CHAPTER 9

AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

9.1.1 New Fuel Storage

9.1.1.1 Design Bases

9.1.1.1.1 Safety Design Bases

9.1.1.1.1.1 Safety Design Bases - Structural

1. The new fuel storage racks containing a full complement of fuel assemblies are designed to withstand all credible static and dynamic loadings, to prevent damage to the structure of the racks, and therefore the contained fuel, and to minimize distortion of the racks arrangement (Table 3.9B-2s).

2. The modules are designed to protect the fuel assemblies and bundles from excessive physical damage which may cause the release of radioactive materials in excess of 10CFR20 and 10CFR50.67 requirements under normal or abnormal conditions caused by impacting from either fuel assemblies, bundles, or other equipment. Amendment 132 revised the design basis accident offsite dose limit requirements from 10CFR100 to 10CFR50.67.

3. The racks are constructed in accordance with the quality assurance requirements of 10CFR50, Appendix B.

4. The new fuel storage racks are categorized as Safety Class 3 and Seismic Category I.

5. The new fuel storage facility is housed within a Seismic Category I structure that is tornado, missile, and flood protected.

6. The new fuel storage facility is designed to conform to the requirements of Regulatory Guide 1.29.

7. The new fuel storage facility is designed in accordance with General Design Criteria 2, 3, 4, 5, 61, 62, and 63.

9.1.1.1.1.2 Safety Design Bases - Nuclear

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The new fuel storage racks are designed and maintained with sufficient spacing between the new fuel assemblies to assure that the array, when racks are fully loaded, is subcritical by at least 5 percent Δk including allowance for calculational biases and uncertainties. In the calculations performed to assure that $k_{eff} \leq 0.95$, the standard lattice methods[2] used at GE are employed. Confirmatory analyses are performed for new fuel designs to demonstrate that the 0.95 acceptance criterion continues to be satisfied. Under conditions where diffusion theory is valid, it is used in calculations. Monte Carlo techniques are employed to bench mark the diffusion theory results to assure accuracy.

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It is assumed that the storage array is infinite in all directions. Since no credit is taken for leakage, the values reported as effective neutron multiplication factors are in reality infinite medium neutron multiplication factors.

The biases between the calculated results and experimental results as well as the uncertainty involved in the calculations are taken into account as part of the calculational procedure to assure that the specified k_{eff} limits are met.

9.1.1.1.2 Storage Design Bases

1. New fuel storage racks are supplied for a fuel load of 30 percent of a full core.

2. New fuel storage racks are designed and arranged so that the fuel assemblies can be handled efficiently during refueling operations.

9.1.1.2 Facilities Description

The location of the new fuel storage facility within the fuel building is shown in Fig. 1.2-20. Each new fuel storage rack (Figs. 9.1-1 and 9.1-1a) holds up to 10 channeled or unchanneled assemblies in a row.

Fuel spacing (7 in center-to-center within a rack, 12.25 in center-to-center between adjacent racks) within the rack and from rack-to-rack limits the effective multiplication factor of the array (k_{eff}) to not more than 0.95. The fuel assemblies are loaded into the rack through the top. Each hole for a fuel assembly has adequate clearance for inserting or withdrawing the assembly channeled or unchanneled. Sufficient guidance is provided to preclude damage to the fuel assemblies. The upper tie plate of the fuel element rests against the rack to provide lateral support. The design of the racks prevents accidental insertion of the fuel assembly in a position not intended for the fuel. This is achieved by abutting the sides of each casting to the adjacently installed casting. In this way, the only spaces in the assembly are those into which it is intended to insert fuel. The weight of the fuel assembly is supported by the lower tie plate which is seated in a chamfered hole in the base casting.

The material specifications for the racks are ASTM B108, alloy SG708-T61, and ASTM B211, alloy 6061-T651.

The floor of the new fuel storage vault is sloped to a drain located at the low point. This drain removes any water that may be accidentally and unknowingly introduced into the vault. The drain is part of the fuel building drain system and ultimately discharges to the liquid radwaste system.

The new fuel storage vault is provided with 12 separate steel covers to prevent moisture and debris from entering the vault. The covers are fabricated solid steel checked plate, with steel grating attached to the underside. The covers are attached to the fuel building floor by hinges. Gasket material is attached to the fuel building floor providing a seal around the perimeter of the new fuel vault between the covers and the floor.

The radiation monitoring equipment for the new fuel storage area is described in Section 7.6.1.4.

9.1.1.3 Safety Evaluation

9.1.1.3.1 Criticality Control

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The calculations of k_{eff} are based upon the geometrical arrangements of the fuel array and subcriticality does not depend upon the presence of neutron absorbing materials. The arrangement of fuel assemblies in the fuel storage racks results in k_{eff} below 0.95 in a dry condition or completely flooded with water which has a density of 1 g/cc. To meet the requirements of General Design Criterion 62, geometrically-safe configurations of fuel stored in the new fuel array are employed to assure that k_{eff} does not exceed 0.95 if fuel is stored in the dry condition or if the abnormal condition of flooding (water with a density of 1 g/cc) occurs. In the dry condition, k_{eff} is maintained $\leq$0.95 due to under-moderation. In the flooded condition, the geometry of the fuel storage array assures the k_{eff} remains $\leq$0.95 due to over-moderation. No limitation is placed on the size of the new fuel storage array from a criticality standpoint since all calculations are performed on an infinite basis. Confirmatory analyses are performed for new fuel designs to demonstrate that the 0.95 acceptance criterion continues to be satisfied.

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placed on the size of the new fuel storage array from a criticality standpoint since all calculations are performed on an infinite basis.

Administrative controls are provided to preclude removal of the new fuel storage vault covers during times other than:

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1. Movement of fuel in or out of the vault

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2. Inspections

3. Special nuclear material accounting

Additionally, administrative controls are provided to preclude sources of optimum moderation in the new fuel storage vault area.

9.1.1.3.2 Structural Design (Refer to Figs. 9.1-1 and 9.1-1a)

1. The new fuel storage vault contains 22 sets of racks, each of which may contain up to 10 fuel assemblies. A maximum of 220 fuel assemblies may be stored.

2. The storage racks provide an individual storage compartment for each fuel assembly and are secured to the vault wall through associated hardware. The fuel assemblies are stored in a vertical position, with the lower tie plate engaging in a captive slot in the lower fuel rack support casting. Additional restraints are provided to restrict lateral movement.

3. The weight of the fuel assembly is held by the lower support casting.

4. The new fuel storage racks are made from aluminum. Materials used for construction are specified in accordance with the applicable ASTM specifications. The material choice is based on a consideration of the susceptibility of various metal combinations to electrochemical reaction. When considering the susceptibility of metals to galvanic corrosion, aluminum and stainless steel are relatively close together insofar as their coupled potential is concerned. The use of stainless steel fasteners in aluminum to avoid detrimental galvanic corrosion is a recommended practice and has been used

successfully for many years by the aluminum industry

5. The center-to-center spacing for the fuel assembly between rows is 12.25 in. The center-to-center spacing within the rows is 7.00 in. Fuel assembly placement between rows is not possible.

6. Lead-in and lead-out guides at the top of the racks provide guidance of the fuel assembly during insertion or withdrawal.

7. The rack is designed to withstand the impact load of 1,980 ft-lb while maintaining the safety design basis. This impact load could be generated by the vertical free fall of a fuel assembly from the height of 3 ft.

8. The storage rack is designed to withstand the pull-up force of 4,000 lb and a horizontal force of 1,000 lb. There are no readily available forces in excess of 1,000 lb. The racks are designed with lead outs to prevent sticking. However, in the event of a stuck fuel assembly, the maximum lifting force of the fuel handling platform grapple (assumes limit switches fail) is 3,000 lb.

9. The storage rack is designed to withstand horizontal combined loads up to 3 g.

   The fuel storage rack analysis was performed in a sequential step-by-step method. Each step was verified prior to proceeding to the next level of analysis. An outline of the analysis is described below:

   a. Casting effective stiffness - The top, middle, and lower casting equivalent stiffnesses are derived from finite element models. Unit loadings are used to define the stiffness. Castings are then simulated as simple beams in the more complex rack analysis.

   b. Rack analysis - There are three levels (top, middle, and lower) in the rack structure. Each level is independently analyzed as a separate structure using only spring connections between elevation levels for structural interaction. Spring values are based on actual structure geometry. A spectral analysis was made using natural frequency modes to 60 Hz. Load cases are combined with static loads to result in a total stress summary.

c. Finite element analysis - A model of the storage racks has been developed for analysis purposes. The finite element model accounts for closely spaced nodes. In general, the model consists of three similar node data sets for the three racks but with different elements, characteristics, and numbering. The dynamic input was applied at each attachment point between the rack system and the surrounding pool. Influences of thermal loading, hydrodynamic mass, and variable loadings have all been accounted for. A fully loaded fuel storage rack, as opposed to other equipment items in the racks, was shown to be the highest loaded design parameter.

d. Casting analysis - Final load distributions from the rack analysis are used to develop the stresses in the castings. A separate analysis using node point accelerations to the element masses is used to obtain an accurate casting load distribution. Axial load and bending moments are distributed to the individual elements of the casting. The resulting stresses are calculated from the individual section geometries.

Node point loads for the rack model contain the influence of beam and cruciform bending moments and shears, as well as the casting loads. Vertical end moments resulting from the prying action of the casting on the hold-down clamp, which cause casting end rotation, are considered in the calculation of casting stresses.

Analysis of gap effects in the fuel racks was performed using a model based on a Rayleigh-Ritz procedure for describing component displacements, and a direct integration technique for solving the equations of motion in the time domain. The behavior of fuel bundles within the fuel racks is formulated by means of an element specifically designed to include the impact due to gaps.This element has two degrees of freedom, one corresponding to the fuel bundle and the other to the fuel rack. Impacts are determined by monitoring the differential displacements of these two degrees of freedom, and at impact the program applies a central impact formulation to determine the separation velocities of the two degrees of freedom.

Multiple loading (static, seismic, OBE/SSE, SRV, and LOCA) combinations were investigated for the limiting conditions. Damping values (2 percent for OBE and 4 percent for SSE) and multiple loading combinations were applied to the racks.

Seismic and other loads applied to the racks were combined by the absolute sum (ABS) and square root of the sum of the squares (SRSS) methods, the minimum requirement being the SRSS method. Dynamic loads, applied to the pool wall, considered fully loaded racks and beams, including hydrodynamic mass.

10. The fuel storage rack is designed to handle non-irradiated, low emission radioactive fuel assemblies. The expected radiation levels are well below the design levels.

11. The fuel storage rack is designed using noncombustible materials.

12. The fuel storage racks are provided protection from adverse environmental effects by proper design of the new fuel storage facility (Section 9.1.1.3.3).

9.1.1.3.3 Protection Features of Fuel Storage Facilities

The new fuel storage vault is provided with a removable cover to ensure a watertight facility. Section 9.1.1.1.1.1 discusses additional protection features for the new fuel storage facility.

9.1.2 Spent Fuel Storage

9.1.2.1 Design Bases

9.1.2.1.1 Safety Design Bases

9.1.2.1.1.1 Safety Design Bases - Structural

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The spent fuel storage racks in the containment fuel pool, which will be used for storage of spent fuel only during refueling operations, contain a storage space sufficient for 200 fuel assemblies (i.e., 30 percent of one full core) and are designed to withstand all credible static and dynamic loadings to prevent damage to the structure of the racks, and therefore the contained fuel, and to minimize distortion of the racks arrangement (See Table 3.9B-2s). This equipment uses industry standards to define design limits such as AISC code. The ASME NC and ND sections have been referenced to be used as a backup when other codes do not apply or where probabilistic allowables are not available. Design limits used in the low density fuel storage racks design are in conformance to the requirements of subsection NF.

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The spent fuel storage racks in the fuel building fuel pool contain a storage space sufficient for 3,172 fuel assemblies (i.e., 508 percent of one full core of fuel assemblies) and 9 defective fuel assemblies with their storage canisters. A maximum of 3,104 fuel assemblies can be loaded into the spent fuel pool. The spent fuel storage racks are designed to withstand all credible static and dynamic loadings to prevent damage to the structure of the racks, and therefore the contained fuel; and to minimize distortion of the racks arrangement. The material, fabrication, welding, and quality control of these spent fuel racks are in conformance with the 1977 ASME Code, Section III, Division I, and Summer 1977 Addenda except for the wrapper used for supporting the neutron absorbing material. Fabrication of the wrapper shall be accomplished by gas tungsten arc spot welding. The spot welding procedure shall be qualified by tension shear test, peel test or sectioning in accordance with AWS Publication C1.1-1966, Recommended Practices for Resistance Welding[3]. This method of welding is justified since the mechanical properties of the wrapper are not considered as part of the structural analysis.

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The modules are designed to protect the fuel assemblies and bundles from excessive physical damage which may cause the release of radioactive materials in excess of 10CFR20 and 10CFR50.67 requirements under normal or abnormal conditions caused by impact from any of the fuel assemblies. Amendment 132 revised the design basis accident offsite dose limit requirements from 10CFR100 to 10CFR50.67.

The racks are constructed in accordance with the quality assurance requirements of 10CFR50, Appendix B.

The spent fuel storage racks are categorized as Safety Class 3 and Seismic Category I.

The spent fuel storage facilities are housed within Seismic Category I structures which are tornado, missile, and flood protected, and are designed to Regulatory Guides 1.13 and 1.29. The spent fuel storage facility is designed in accordance with General Design Criteria 2, 3, 4, 5, 61, 62, and 63.

9.1.2.1.1.2 Safety Design Bases - Nuclear

The fuel array in the fully loaded spent fuel racks is designed to be subcritical, by at least 5 percent k. Geometrically safe configurations of fuel stored in the spent fuel array are employed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal storage conditions. The geometry of the spent fuel storage array is such that k_{eff} will be ≤ 0.95 due to overmoderation.

Standard General Electric lattice methods[2] and Monte Carlo techniques are employed in the calculations performed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal fuel storage conditions (Section 9.1.2.3.1.1) for the containment fuel pool storage racks.

Standard criticality calculations employing KENO IV three-dimensional Monte Carlo method are utilized to assure that k_{eff} does not exceed 0.95 under all normal and abnormal conditions (Section 9.1.2.3.1.2) for the fuel building fuel pool high-density spent fuel storage racks.

It is assumed that the storage array is infinite in all directions. Since no credit is taken for leakage, the values reported as effective neutron multiplication factors are, in reality, infinite medium neutron multiplication factors.

The biases between the calculated results and experimental results, as well as the uncertainty involved in the calculations, are taken into account as part of the calculational procedure to assure that the specified k_{eff} limits are met.

9.1.2.1.2 Storage Design Bases

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Spent fuel storage space is provided in the containment building fuel pool and fuel building fuel pool which accommodate 200 and 3,104 fuel assemblies, respectively.

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The option of offloading a full reactor core is available when the 200 spaces in the containment building and 424 spaces in the fuel building are open. This requires all spaces in the containment to be open and 424 open in the fuel building, no more than 2680 full. The option to maintain the ability for a full reactor core offload is not a regulatory requirement.

The fuel building pool also contains storage space for 9 defective fuel assemblies and their storage cannisters.

Spent fuel storage racks are designed and arranged so that the fuel assemblies can be handled safely and efficiently during refueling operations and interim storage.

9.1.2.2 Facilities Description

Spent fuel storage racks provide a place in the containment fuel pool and the fuel building fuel pool for storing spent fuel received from the reactor vessel. These are top-entry racks designed to maintain the spent fuel in a space geometry that precludes the possibility of criticality under normal and abnormal conditions.

Both fuel pools are lined with ASME SA-240 type 304 solution annealed stainless steel liner plate welded to stainless steel plates embedded in concrete. Leak detection channels are included in the liner design. This stainless steel liner plate (3/16 in thick) is designed as a Seismic Category I structure to withstand all loads and loading combinations defined in Section 3.8.2 and Table 3.8-2. The liner serves as a leakproof membrane that is resistant to damage from abrasion, impact, and concrete floor and wall displacements. The pool concrete walls and slabs are designed as a Seismic Category I structure to withstand all of the loading associated with a safe shutdown earthquake, without regard to the strength provided by the liner plate. Typical spent fuel pool liner details are given in Figures 9.1-33, 9.1-34, and 9.1-35.

9.1.2.2.1 Containment Fuel Storage

The location of the spent fuel storage racks within the reactor building is shown in Fig. 1.2-9 and 1.2-12. The containment pools consist of four separate but interconnected stainless steel-lined concrete pools. The refueling cavity is a large pool located above the reactor pressure vessel. The second pool, the separator storage pool, is located south of the refueling cavity and is separated from it by a partial-height wall. The third pool, the dryer storage pool, is located north of the refueling cavity and is separated from it by a full-height wall broken by a watertight gate. This pool is used to store the steam dryer assembly during refueling, and a portion of this pool is used for storage of new/spent fuel assemblies. During special circumstances, the steam dryer assembly may be temporarily stored in the separator storage pool and the separator stored in the dryer storage pool. The fourth pool, the upper transfer pool, is located east of the dryer storage pool and is separated from it by a full-height wall broken by a watertight gate. The gates are designed as

Seismic Category I structures to withstand all loads and loading combinations, as defined in Section 3.8.

Each spent fuel rack (Figs. 9.1-2 and 9.1-2a) stores 10 fuel assemblies. The upper tie plate of the fuel element rests against the racks to provide lateral support. The racks are pinned to the rack support structure. All racks are built with a common mounting dimension to facilitate rack rearrangement or replacement. The material specifications for the racks are ASTM B108, alloy SG708-T61, ASTM B211, alloy 6061-T651.

The material specifications for fuel storage rack supporting structures are ASTM B221 or B308, alloy 6061-T6, ASTM B211 or B209, alloy 6061-T651, and ASTM A312, type 304.

The rack arrangement is designed to prevent accidental insertion of fuel bundles between adjacent racks. The storage rack structure is designed so that the upper tie plate casting cannot be lowered below the top of the upper rack. This prevents any tendency of the fuel bundle to jam on insertion or removal from the rack. The rack holddown bolt spacing is such as to maintain minimum spacing of adjacent racks for geometric reactivity control. The racks are designed to maintain a nominal fuel storage cell spacing of 7 in (center to center) within a rack and 12.25 in (center to center) from rack to rack.

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The storage of spent fuel in the upper containment fuel storage pool is prohibited during Operational Conditions 1 and 2.

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In addition to fuel, other plant equipment and materials may be stored in the pool as controlled by plant administrative procedures.

9.1.2.2.2 Fuel Building Fuel Storage

The location of the spent fuel storage facility within the fuel building is shown in Fig. 1.2-20 and 1.2-22. The fuel building pools consist of three separate but interconnected stainless steel-lined concrete pools. The spent fuel storage pool is the largest of these pools. Adjacent to the fuel storage pool are the cask pool and the lower transfer pool. Each of these two pools is separated from the fuel storage pool by a full-height wall broken by a watertight gate. The watertight gates are normally open. These gates are closed to seal their respective pools during cask handling and equipment maintenance operations. The gates are designed as Seismic Category I structures to withstand all loads and loading combinations, as defined in Section 3.8.

The fuel storage pool incorporates poison-type, high-density spent fuel racks. Applicable material specifications for the structural components of the racks are ASME SA-240 or SA-479 type 304 solution annealed stainless steel (or equivalent ASTM designation per NCA-1221.1). The storage racks utilize a modular array construction. The arrangement of the racks is shown in Fig. 9.1-3.

The design of the racks precludes accidental insertion of the fuel assemblies between adjacent racks and ensures the required spacing and mechanical support of the neutron-absorbing material for reactivity control.

The fuel building spent fuel racks employ a fixed neutron absorber or poison material for criticality control. Boraflex II, manufactured by Brand Industrial Services, is used. This material has been tested in a fuel pool-like environment to $10^{(11)}$ rad and found to behave acceptably. Alteration in physical properties and off gassing due to irradiation and material chemical or galvanic interaction with the rack structure have been considered in the design of the racks.

The installation of the high density spent fuel storage racks is accomplished in two stages. The first stage includes the installation of 30 adapter plates welded to the floor embedment plates. These plates serve as supports for the racks providing both horizontal and vertical downward restraints. The second stage to be accomplished prior to the first refueling outage includes the installation of all 20 racks. Special tools are used for the initial alignment of adapter plates and leveling of racks. After installation is complete, pool can be flooded in preparation for storage of spent fuel assemblies.

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Spent control rod blades are stored on permanently installed control rod blade storage racks, two to a hanger, on hooks at the 101' elevation of the spent fuel pool. Additional storage locations for control rod blades are also available via removable control rod blade storage racks mounted on the curb of the spent fuel pool. During control blade transit, the minimum required submergence is maintained at no less than 6 feet 9 inches. Once the spent control blade is resting on the hanger, the tops of the highest spent control blades in underwater storage are covered by a minimum of 10 feet of water.

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The 15-ton fuel building bridge crane is used for the rack installation. Subsequent to the installation of the racks, the crane will be utilized for transporting only light loads over stored spent fuel, except for movement of the spent fuel pool gates <u>for repair or seal replacement</u>. Administrative controls exist to prevent the transport of heavy loads other than spent fuel pool gates over stored spent fuel.

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In addition to fuel, other plant equipment and materials may be stored in the pool as controlled by plant administrative procedures.

9.1.2.3 Safety Evaluation

9.1.2.3.1 Criticality Control

9.1.2.3.1.1 Containment Fuel Storage

The design of the spent fuel storage racks provides for a subcritical multiplication factor (k_{eff}) for both normal and abnormal storage conditions. For normal and abnormal conditions, k_{eff} is equal to or less than 0.95. Normal conditions exist when the fuel storage racks are located in the pool and are covered with a normal depth of water (about 25 ft above the stored fuel) for radiation shielding and with the maximum number of fuel assemblies or bundles in

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their design storage position. The spent fuel is covered with water at all times by a minimum depth of 10 ft required to provide sufficient shielding. An abnormal condition may result from accidental dropping of equipment or damage caused by the horizontal movement of fuel handling equipment without first disengaging the fuel from the hoisting equipment. To meet the requirements of General Design Criterion 62, geometrically safe configurations of fuel, stored in the spent fuel array, are employed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal storage conditions. The geometry of the spent fuel storage array is such that k_{eff} is ≤ 0.95 due to overmoderation. Confirmatory analyses are performed for new fuel designs to demonstrate that the 0.95 acceptance criterion continued to be satisfied. To ensure that the design criteria are met, the following normal and abnormal spent fuel storage conditions were analyzed:
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1. Normal positioning in the spent fuel storage array

2. Eccentric positioning in the spent fuel storage array (Fig. 9.1 4)

3. Fuel stored in control rod guide tube racks (Fig. 9.1 5)

4. Pool water temperature increases to 212°F

5. Two bundles placed side by side while separated from the storage rack area by 12 in of water (Fig. 9.1 6)

6. Three bundle linear array separated from the storage rack area by 12 in of water (Fig. 9.1 6)

7. Three bundle tee array separated from the storage rack area by 12 in of water (Fig. 9.1 6)

8. Normal storage array of ruptured fuel

9. Abnormal condition of pool being drained and ruptured fuel containers being flooded

10. Moving fuel bundle between work rack and storage area

11. Moving fuel bundle in aisle between storage racks

12. Grapple drop displacing two fuel bundles (Fig. 9.1 6)

Concerning safety implications related to sharing, no limitation is placed on the size of the spent fuel storage array from a criticality standpoint, since all calculations are performed on an infinite basis.

9.1.2.3.1.2 Fuel Building Fuel Storage

Criticality of fuel assemblies in the spent fuel storage rack is prevented by the design of the rack which limits fuel assembly interaction. This is done by fixing the minimum separation between assemblies and inserting neutron poison between assemblies. The spent fuel rack is designed to be in compliance with General Design Criteria 62.

The design basis for preventing criticality outside the reactor is that, including uncertainties, there is a 95 percent probability at a 95-percent confidence level that the effective multiplication factor (K_{eff}) of the fuel assembly array will be less than 0.95 as recommended in ANSI N210-1976[4] and in Reference 1. This design basis applies for both normal and abnormal fuel storage conditions. Normal conditions exist when the spent fuel storage racks are located in the pool and are covered with a normal depth of water. An abnormal condition may result from accidental dropping of a fuel assembly or equipment, or loss of spent fuel pool cooling.

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The design method which determines the criticality safety of fuel assemblies in the spent fuel storage rack uses the SCALE-4 system of codes[5] for cross section generation and reactivity determination. The Criticality Safety Analysis Sequence Number (CSAS25) Control Sequence is used for this calculation. CSAS25 sequentially executes the functional modules BONAMI-S, NITWAL-S, and KENO-V.a[5]. A set of 21 critical experiments has been analyzed using CSAS25 to demonstrate applicability to criticality analysis and to establish method bias and variability included in reactivity analysis of the rack.

The CASMO[6] two-dimensional integral transport code is used to evaluate the rack and fuel design tolerances, and to perform burnup credit calculations. Burnup credit uncertainty is assessed including CSAS25 to CASMO correlation uncertainty and an allowance for isotopic uncertainty due to depletion.

Fuel assembly and rack geometry mechanical tolerances are either treated as worse case (highest reactivity), or evaluated through a statistical combination of the reactivity associated with each tolerance. The statistically treated tolerances include variability in fuel enrichment, density and Gadolinia loading as well as dimensional uncertainties. Dimensional uncertainties addressed include variations in pellet and clad radii, channel bulge, cell pitch and rack wall thickness. Since these tolerances are independent, they are statistically combined in a Δk adder which is applied to the analytical k value.

The poison material evaluated in the analysis includes allowances for gapping and potential degradation due to water ingress. Gaps are generated in random axial locations in the panels associated

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with a 4x4 array of fueled rack cells. This array of cells is repeated, resulting in an infinite array of cells on the x and y axes. Multiple cases with different randomly generated gap configurations are evaluated. The results of these cases are statistically combined with method bias and uncertainty, tolerances and burnup credit to calculate a final reactivity.

For normal fuel storage, a model is developed based on the following assumptions:

1. The base fuel assembly analyzed is General Electric 10x10 BWR/6 fuel (GE12, GE14, and GNF2). Representative fuel channels are included in the model.

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2. Radial enrichment zoning within the fuel assembly is not credited. All enriched fuel is modeled at 4.80 wt% U-235. The bottom 6″ and top 12″ of fuel is a natural Uranium blanket. Fourteen rods are assumed to contain Gad poison at 4.0 wt%. In addition to the base cases, a 9x9 lattice (GE11) at 4.40 wt% 8 Gad 5, GE11 at 3.20 wt% no Gad rod and an 8x8 lattice (GE8) at 3.60 wt% 6 Gad 3 were evaluated in an identical rack configuration.

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3. Peak reactivity after shutdown at the assemblies most reactive point in life is assumed when evaluating burnup credit.

4. The moderator is pure water at 68°F. Water density is set to the maximum value of 1.0 gm/cc.

5. Much structure (e.g., spacers, Inconel springs, rack base plate) is not modeled.

6. Minimum as-designed Boraflex dimensions are used. In addition, the B-10 content is assumed to be 90% of the minimum design areal loading.

7. The Boraflex panels are assumed to shrink 4.1% in width. Densification due to shrinkage is not credited.

8. Each panel is assumed to have a single 6″ gap. The gaps are assumed to be randomly distributed within the central 50% of the panels length.

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9. No radial neutron leakage is assumed. The calculation of k_{eff} for the above nominal case results in a 95 percent probability / 95 percent confidence level reactivity less than 0.95. Analysis is performed to confirm ATRIUM-10 fuel is less reactive than the reference GE12 fuel design used in the criticality safety analysis of record.

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Interactions along the unpoisoned periphery of the racks was evaluated separately from the base case. The minimum physically permitted inter-rack spacing was assumed. Resultant reactivity for this configuration is bounded by the base configuration.
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The following abnormal fuel storage conditions were analyzed.

1. Drop of a fuel assembly on top of the storage racks.

2. Drop of a fuel assembly next to the unpoisoned periphery of the racks.

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3. A three bundle array stored in and near the fuel transfer tube upender.

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4. Loss of spent fuel pool cooling system.

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5. Drop of a fresh fuel assembly from the maximum fuel assembly lifting height over the spent fuel rack. This postulated lifting height is defined with the lowest point of a fresh fuel assembly 442 inches above the top of rack.

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For all of the above abnormal conditions, the criticality analysis shows that the acceptance criterion for criticality is met.

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9.1.2.3.2 Structural Design

9.1.2.3.2.1 Containment Fuel Storage (Refer to Figs. 9.1-2 and 9.1-2a)

1. The spent fuel pool in the containment building contains 20 sets of racks which may contain up to 10 fuel assemblies. A maximum of 200 fuel assemblies may be stored.

2. The storage racks provide an individual storage compartment for each fuel assembly and are secured to the pool wall through associated hardware. The fuel assemblies are stored in a vertical position, with the lower tie plate engaged on a captive slot in the lower fuel rack support casting. Additional restraints are provided to restrict lateral movement.

3. The weight of the fuel assembly is held by the lower rack support casting.

4. The containment spent fuel storage racks are made from aluminum. Materials used for construction are specified in accordance with the latest issue of applicable ASTM specifications. The material choice is based on a consideration of the susceptibility of various metal combinations to electrochemical reaction. When considering the susceptibility of metals to galvanic corrosion, aluminum and stainless steel are relatively close together insofar as their coupled potential is concerned. The use of stainless steel fasteners in aluminum to avoid detrimental galvanic corrosion is recommended practice and has been used successfully for many years by the aluminum industry.

5. The center-to-center spacing for the fuel assembly between rows is 12.25 in. The center-to-center spacing within the rows is 7.00 in. Fuel assembly placement between rows is not possible.

6. Lead-in and lead-out guides at the top of the racks provide guidance of the fuel assembly during insertion or withdrawal.

7. The rack is designed to withstand a fuel bundle drop of 4 ft.

8. The containment spent fuel storage rack is designed to withstand the pullup force of 4,000 lb and a horizontal force of 1,000 lb. There are no readily available forces in excess of 1,000 lb. The racks are designed with lead outs to prevent sticking. However, in the event of a stuck fuel assembly, the maximum lifting force of the refueling platform grapple (assumes limit switches fail) is 3,000 lb.

9. The storage rack is designed to withstand horizontal combined loads up to 3g's, well in excess of expected loads.

10. The maximum stress in the full-loaded rack in a faulted condition is identified in Table 3.9B-2s.

    The fuel storage rack analysis was performed in a sequential step-by-step method. Each step was verified prior to proceeding to the next level of analysis. An outline of the analysis follows:

    a. Casting effective stiffness - The top, middle, and lower casting equivalent stiffnesses are derived from finite element models. Unit loadings are used to define the stiffness. Castings are then stimulated as simple beams in the more complex rack analysis.

    b. Rack analysis - There are three levels (top, middle, and lower) in the rack structure. Each level is independently analyzed as a separate structure, using only spring connections between elevation levels for structural interaction. Spring values are based on actual structure geometry. A spectral analysis was made using natural frequency modes to 60 Hz. Load cases are combined with static loads resulting in a total stress summary.

    c. Finite element analysis - A model of the storage racks has been developed for analysis purposes. The finite element model accounts for closely spaced nodes. In general, the model consists of three similar node data sets for the three racks, but with different elements, characteristics, and numbering. The dynamic input was applied at each attachment point between the rack system and the surrounding pool. Influences of thermal loading, hydrodynamic mass, and variable loadings have been accounted for. A fully loaded fuel storage rack, as opposed to other equipment items in the racks, was shown to be the highest loaded design parameter.

d. Casting analysis - Final load distributions from the rack analysis are used to develop the stresses in the castings. A separate analysis using node point accelerations to the element masses is used to obtain an accurate casting load distribution. Axial load and bending moments are distributed to the individual elements of the casting. The resulting stress are calculated from the individual section geometries.

Node point loads for the rack model contain the influence of beam and cruciform bending moments and shears, as well as the casting loads. Vertical end moments resulting from the prying action of the casting on the hold down clamp, that cause casting end rotation, are considered in the calculation of casting stresses.

Analysis of gap effects in the fuel racks was performed using a model based on a Rayleigh-Ritz procedure for describing component displacements, and a direct integration technique for solving the equations of motion in the time domain. The behavior of fuel bundles within the fuel racks is formulated by means of an element specifically designed to include the impact due to gaps. This element has two degrees of freedom, one corresponding to the fuel bundle and the other to the fuel rack. Impacts are determined by monitoring the differential displacements of these two degrees of freedom, and at impact the program applies a central impact formulation to determine the separation velocities of the two degrees of freedom.

Multiple loading (static, seismic, OBE/SSE, SRV, and LOCA) combinations were investigated for the limiting conditions. Damping values (2 percent for OBE and 4 percent for SSE) and multiple loading combinations were applied to the racks.

Seismic and other loads applied to the racks were combined by the absolute sum (ABS) and square root of the sum of squares (SRSS) methods, the minimum requirement being the SRSS method. Dynamic loads, applied to the pool wall, considered fully loaded racks and beams, including hydrodynamic mass.

11. The fuel storage racks are designed to handle irradiated fuel assemblies. The expected radiation levels are well below the design levels.

12. The containment spent fuel storage racks have the capability of also storing 9 control rod guide tubes and 9 defective fuel containers. These special castings prevent fuel from exceeding k_{eff} of 0.95 in the event that they are positioned in these positions.

9.1.2.3.2.2 Fuel Building Fuel Storage

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1. The spent fuel pool contains three sizes of racks: 12x13, 13x13, and a modified 12x13 containing nine defective fuel cells. A maximum of 3,104 fuel assemblies may be stored along with the nine defective fuel cells (Figure 9.1-3).

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2. Each rack utilizes individually fabricated cells. All cells are assembled to each other and welded to a grid base to form an integral structure.

3. All structural components of racks are made from type 304 stainless steel. The optimum storage density is provided by the incorporation of neutron-absorbing material between adjacent cells. The material choice is based on a consideration of the susceptibility of various metal combinations to electrochemical reactions.

4. All racks are designed to allow for remote underwater installation and/or removal. Lifting attachments are provided in the lower structure of each rack to facilitate moving and handling.

5. The center-to-center spacing for the fuel assemblies within a rack is 6.28 in and 8.5 in between cell centers

of adjacent racks. Fuel assembly placement between adjacent storage cells or between racks is not possible.

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6. The storage rack structure is designed to withstand the impact resulting from a falling object possessing 3,800 ft-lb of kinetic energy. The structural design is such that under this impact force no lateral displacement of fuel occurs; therefore, subcritical spacing is maintained. To accommodate light load handling (less than or equal to 1200 pounds) by the fuel building bridge crane over the spent fuel pool, the storage racks have been analyzed to withstand a drop of up to 44,200 ft-lb kinetic energy. The resulting storage rack deformation under that abnormal load/accident continues to meet the subcritical spacing requirements and GDC 62 criteria of Keff less than 0.95.

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7. The storage rack structure is designed to withstand the uplift force of 1,100 lb due to fuel handling equipment jamming or maloperation. The racks are designed with lead outs to prevent sticking.

8. The spent fuel racks are seismically analyzed utilizing a combination of linear and nonlinear analysis techniques. The nonlinear model includes the effects of fuel-to-rack impact and submergence.

   The dynamic response used for the design of the fuel building spent fuel rack assembly during a seismic event is for the condition which produces the governing loads and stresses on the structure. The dynamic responses and internal stresses and loads are obtained from a time history analysis on a nonlinear finite element model. The damping values used in the seismic analysis are 2 percent damping for OBE and 4 percent damping for SSE. Responses to the three earthquake directions are combined in accordance with Regulatory Guide 1.92. Seismic, dead weight, accident, and thermal loads are combined, and stress limits are set in accordance with the NRC position paper on review and acceptance of spent fuel storage and handling applications(1).

   The River Bend Station fuel storage racks are constrained horizontally by shear studs and vertically by the rack assembly and fuel assembly weight (less buoyancy). Since these boundary conditions are structurally nonlinear, the seismic analysis is a nonlinear time history analysis.

   The nonlinear model has the structural characteristics of an individual cell within a submerged rack assembly. The fuel and cell assemblies are modeled mathematically by three-dimensional beam elements. The fuel and cell assemblies are connected by linear springs and gap elements, which account for grid and cell impacting, and a general matrix element which represents the hydrodynamic mass effect of the water inside the cell. The cell is connected to the pool wall by a general matrix element which represents the hydrodynamic mass effects of the submerged cell assembly. The floor connection is modeled with linear springs and gap elements which account for the horizontal constraint of the floor shear studs. These elements are shown in Fig. 9.1-3a.

The nonlinearities of the model account for the effects of the gap between the cell and fuel, and the potential lift of a support pad. Westinghouse Electric Corporation's WECAN computer program is used to determine the time history response of the fuel assembly/fuel rack system. The fuel assembly to cell impact loads, and overall rack loading are obtained from the time history response of this model. In determining the maximum response for each item of interest, the response value for each item is searched for maximum values.

9. One modified storage rack has the capability of storing 143 fuel assemblies and 9 defective fuel containers.

10. The fuel storage racks are designed to handle irradiated fuel assemblies. The expected radiation levels are well below the design levels.

11. The neutron poison material is supported along the full length via stainless steel sheets, which additionally form the inside surface of the fuel storage cells. A spacer positioned in the lower portion of the neutron-absorbing material cavity ensures alignment of the absorber material with the active fuel region of the fuel assembly.

The fuel storage facilities are designed to Seismic Category I requirements to prevent earthquake damage to the stored fuel.

From the foregoing analysis, it is concluded that the spent fuel storage arrangement and design meet the safety design bases.

The fuel storage pools have adequate water shielding for the stored spent fuel. Adequate shielding for transporting the fuel is also provided. Liquid level sensors are installed to detect a low pool water level, and adequate makeup water is available to assure that the fuel is not uncovered should a leak occur.

Since the fuel storage racks are made of noncombustible material and are stored under water, there is no potential fire hazard. The large water volume also protects the spent fuel storage racks from potential pipe breaks and associated jet impingement loads.

9.1.2.3.3 Protection Features of Spent Fuel Storage Facilities

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1. The layout of the fuel handling areas around the fuel pool in the fuel building (Fig. 1.2-20 and 1.2-22) is designed such that the traversing of any heavy objects over stored spent fuel is precluded. The only heavy objects that will be moved in the vicinity of stored spent fuel are the fuel pool gates, as required for repair or seal replacement. The load handling of the pool gates will be performed in accordance with the intent of NUREG-0612, NUREG-0554, RIS-2005-25, and RIS-2005-25, Supplement 1, for reducing the potential for an accidental load drop. The load associated with movement of pool gates is approximately 2500 pounds, which accounts for the weight of a gate plus the rigging. Prior to movement of the fuel pool gates, it will be verified that no fuel assembly in the pools has been part of a critical core within the previous 14 days. The spent fuel cask pool and the spent fuel cask trolley are physically outside the boundaries of the fuel pool, with the only interconnection being a fuel transfer slot which is sealed by a watertight gate. Therefore, the spent fuel cask handling crane, which passes over the cask storage area, cannot in any way be traversed over any portion of the fuel pool.

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In addition, the spent fuel cask trolley has a fixed main hoist, i.e., the hoist centerline is fixed between the runway rails with no capability for traversing between the runways. This arrangement precludes an off-center lowering of the spent fuel cask, and a vertical cask drop cannot impinge upon spent fuel racks.

The fixed main hoist arrangement also makes a cask drop at an angle unlikely. The consequences of a cask drop, at an angle or vertically, may result in local yielding and possible rupture of the cask pool liner. The watertight gate which is in the sealing position during cask transfer operations prevents loss of water from the spent fuel pool and no damage to the spent fuel results. No safety-related equipment is located near the spent fuel cask pool or near the spent fuel cask handling area.

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During all cask handling operations, the watertight gate is closed, thus restricting any water loss resulting from the consequences of a cask drop accident and postulated damage to the cask storage area.

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2. Any high levels of radioactivity released in the fuel building are detected in the fuel building ventilation exhaust. Automatic controls are provided to divert this exhaust through the fuel building charcoal filtration system prior to release to the atmosphere. For further details see Section 9.4.2.

3. Administrative procedures require periodic sampling of the leak test system on the spent fuel pool liner. Little or no leakage is expected during normal operating conditions.

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4. Antisiphoning devices are provided on the fuel building and containment spent fuel pool piping to ensure that, in the event of a pipe break, the pool water is not siphoned to a level less than 10 ft above the top of the fuel. This ensures the minimum required water shielding depth above the top of the fuel is maintained.

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Three types of siphon breakers are utilized:

a. A 1/2-in. diameter hole is drilled in the highest portion of the pipe. This type is typically used on those pipes that do not extend to the bottom of the pools.

b. A piece of 1/2-in. pipe extending above the minimum required water level is typically used on pipes that extend to the bottom of the fuel building pools. This piece of pipe is tapped to accept a pipe plug, which is inserted only when it is desired to draw down or empty a pool for maintenance purposes.

c. A piece of 1/2 in. pipe extending above the minimum required water level is typically used on pipes that extend to the bottom of the containment pools. This piece of pipe is tapped to accept an additional section of pipe equipped with a normally open manual ball valve. The open end of the valve discharge piping is also located above the minimum required water level. The valve will be closed only when it is desired to draw down or empty the pool for maintenance purposes.

The above-described siphon breakers are passive devices that admit air to the piping system to stop siphon-induced flow. There is no active failure which would preclude operation of these devices.

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Section 9.1.2.1.1.1 discusses additional protection features for the spent fuel storage facility.

9.1.2.4 Inspection and Testing Requirements

9.1.2.4.1 Containment Fuel Storage

The containment spent fuel storage racks require no periodic special testing or inspection for nuclear safety purposes.

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9.1.2.4.2 Fuel Building Fuel Storage

A poison surveillance program will be conducted throughout the life of the spent fuel storage racks to ensure that the neutron-absorbing material is not deteriorating or altering in any way which would not be expected based on the poison material qualification tests. Poison coupons are situated in the pool in areas that are expected to see the most severe radiation environments. These coupons are designed to simulate the material and support conditions of the poison material in the racks. Periodically, a coupon is removed and evaluated. B_{10} concentration and mechanical properties will be evaluated and compared against acceptable ranges established by the criticality calculation and poison material qualification reports.

9.1.2.5 Holtec HI-STORM Dry Spent Fuel Storage System

The other dry fuel storage system utilized is Holtec International's HI-STORM system. The HI-STORM system is comprised of a metal basket, the Multi-Purpose Canister (MPC) that contains the fuel, an on-site transfer cask (HI-TRAC 125D), and a concrete and steel storage container (HI-STORM 100S). These components are classified as important to safety (ITS) as described in the NRC approved FSAR and Certificate of Compliance (CoC) for the Holtec dry fuel storage cask system licensed under 10 CFR 72.214. These components are treated as safety related (Q) at RBS. Since the dry fuel storage cask system has been independently reviewed and approved for use by the NRC apart from the site reactor licenses, the full description of the system is in other documents. These documents include the Holtec CoC, Holtec Final Safety Analysis Report (FSAR), NRC Safety Evaluation Report (SER) and the Entergy Nuclear South 10CFR72.212 Evaluation Report.

Ancillaries consisting of: 1) a forced helium dehydration (FHD) system (Not Important to Safety) including a chiller and various pumps, valves, pressure indicators and hoses mounted on a skid to facilitate preparing the MPC for storage operations, 2) impact limiters (Important to Safety) in the lower shelf of the cask pool and the cask wash down area, 3) a HI-TRAC Lift Yoke and Lift Yoke Extensions (Important to Safety) for lifting and moving the HI-TRAC, 4) MPC lifting cleats (Important to Safety) for lowering the MPC into the HI-STORM, and 5) a vertical cask transporter (VCT) (Not Important to Safety) used to transport the loaded HI-STORM overpack from the Fuel Building outdoor crane structure to the ISFSI pad.

The RBS ISFSI cask storage pad for the Holtec system, which is classified as not important to safety (non-Q), was seismically designed and qualified to support the worst case casks loading conditions. The free standing casks are to be stored on three dowel connected pads with the casks arranged in a 4 x 11 array providing space for a 44 cask total storing capacity. The ISFSI pad is a reinforced concrete slab 210 feet long by 61 feet wide and approximately 30 inches thick. The RBS ISFSI is located approximately 470 feet southwest of the Reactor Building, and 134 feet southwest of the Auxiliary Control Building.

9.1.3 Fuel Pool Cooling and Cleanup System

The fuel pool cooling and cleanup system consists of two separate subsystems: the fuel pool cooling subsystem and the fuel pool purification subsystem.

The fuel pool cooling subsystem provides heat removal for spent fuel and maintains the spent fuel covered with water during all storage conditions. The purification subsystem maintains required water purity under normal conditions and is not required under accident conditions.

9.1.3.1 Design Bases

9.1.3.1.1 Fuel Pool Cooling Subsystem

The fuel pool cooling subsystem is designed to remove decay heat produced by stored spent fuel assemblies during all anticipated plant operation, refueling, and accident conditions. The design criteria for the fuel pool cooling subsystem are as follows:

1. The fuel pool cooling subsystem and the connecting piping for the backup source of fuel pool makeup are classified as Safety Class 3 and Seismic Category I and are designed in accordance with Regulatory Guides 1.13, 1.26, and 1.29 and General Design Criteria 2, 4, 5, 44, 45, 46, 61, and 63.

2. The spent fuel storage capacity is 3,172 fuel assemblies, approximately 5.08 cores, of which 4.29 cores are designated for routine spent fuel storage in the fuel building. This provides fuel pool cooling capacity for an abnormal offload

up to 424 fuel assemblies stored in the spent fuel pool, not to exceed 3,104 fuel assemblies.

3. The fuel pool cooling subsystem is designed to maintain the temperature of the water in the fuel building fuel storage pool at or below 139.8°F during normal operation, with one cooler and one cooling pump in service.

The heat load for normal operation was calculated based on the following:

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a. Consistent with Section 9.1.3 of the Standard Review Plan (NUREG - 0800), the decay heat load from the latest three refueling offloads are considered. The discharge batch sizes and decay times are shown in Table 9.1-6. Residual decay energy release rates are calculated in accordance with Branch Technical Position ASB 9-2, Revision 1. These assumptions are in agreement with Standard Review Plan 9.1.3 Spent Fuel Pool Cooling and Cleanup System for determining the maximum amount of thermal energy to be removed by the spent fuel cooling system when a full core offload is not done. (See SRP 9.1.3.III.1.h). Spent fuel assemblies in the spent fuel pool do not exceed 4.29 cores.

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b. The rate in which assemblies are offloaded will be regulated to maintain pool temperature below 139.8°F. Spent fuel assemblies in the spent fuel pool do not exceed 3,104 fuel assemblies.

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4. The fuel pool cooling subsystem is designed to remove the decay heat from the spent fuel storage pool at a rate sufficient to maintain the temperature of the water at or below 155.6°F, when 497 percent of an equilibrium core is stored in the pools (Fig. 9.1-8). The calculation of the water temperature for this abnormal load with the storage of 497 percent of an equilibrium core was based on the following:

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   a. An abnormal core removal event (up to 424 fuel assemblies stored in the spent fuel pool, with 200 fuel assemblies stored in the containment fuel pool) is assumed to be required at the time when batches from each of the previous refueling outages (with the most recent outage completed in 14 days, or greater), totaling 4.29 cores, are in the pool.

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b. The rate in which assemblies are offloaded will be regulated to maintain pool temperature at or below 155.6°F.

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5. The fuel pool cooling subsystem is designed to maintain the temperature of the containment fuel storage pool water at or below 128.5°F, when 32 percent of an equilibrium core is stored in the fuel storage area of the containment pool during refueling operations.

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6. The decay heat generated by the spent fuel was calculated in accordance with Branch Technical Position ASB9-2.

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7. In the event of a temporary loss of all fuel pool cooling, the fuel pool cooling subsystem has been analyzed to operate with a maximum spent fuel temperature of 170°F.

8A←•

The fuel pool cooling subsystem is also designed to: 1) provide makeup water to the fuel building pools and containment pools from the condensate storage tank; 2) provide makeup water to the fuel building pools and containment pools from the standby service water system; 3) maintain the fuel storage racks submerged in water under all conditions; and 4) circulate and cool containment fuel storage pool water through the residual heat removal (RHR) system.

All fuel pool cooling subsystem active components and fuel pool coolers are designed to meet the single-failure criterion.

9.1.3.1.2 Fuel Pool Purification Subsystem

The fuel pool purification subsystem is classified as non-safety related and is designed to:

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1. Simultaneously filter spent fuel pool water at a rate of at least two volumes per day, and containment pools' water at a rate of at least one volume per day.

2. Demineralize either spent fuel pool water at a rate of at least one volume per day, or containment

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pools water at a rate of at least one volume every 2 days.

3. Maintain water quality as specified in Table 9.1-5 through filtration and demineralization in order to permit unobstructed underwater observation.

4. Remove suspended and dissolved radionuclides in order to maintain the radiation level above the fuel building pools and at the fuel building operating floor within the radiation zone limits as described in Section 12.3.

5. Drain the reactor refueling cavity to either the condenser hotwell or the condensate storage tank in less than 7 hr.

6. Drain the spent fuel cask pool to either the condenser hotwell or the condensate storage tank in less than 2 hr.

7. Drain the fuel building pools' and containment pools' water, for moderate level adjustments, to either the condenser hotwell, the condensate storage tank, or the radwaste system.

9.1.3.2 System Description

The fuel pool cooling and purification subsystems provide cooling and purification functions for the fuel building pools and the containment pools. The fuel building pools consist of spent fuel storage pool, cask pool, and lower transfer pool. The containment pools consist of refueling cavity, separator storage pool, dryer storage pool, and the upper transfer pool. A portion of the dryer storage pool is used for the storage of new/spent fuel assemblies and is referred to as fuel storage throughout this section. The layout of these pools is described in Section 9.1.2.

9.1.3.2.1 Fuel Pool Cooling Subsystem

The fuel pool cooling subsystem (Fig. 9.1-23a and 23b) consists of two 100-percent capacity horizontal, centrifugal pumps (2,500 gpm at 87.6-ft head), two 100-percent capacity coolers, and associated piping, drains, vents, instrumentation, and valves. The design parameters of the fuel pool cooling subsystem are given in Table 9.1-5. These design parameters are based on a maximum reactor plant component cooling water (RPCCW) temperature of 105°F.

Reactor plant component cooling water (Section 9.2.2) is provided as the cooling medium on the shell side of the coolers during normal operation. One pump and one cooler are normally in operation for cooling the fuel building fuel storage pool. The other pump and cooler are in standby or used for containment fuel storage pool cooling. Pump and cooler operation is alternated periodically to ensure operability of redundant equipment.

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Provisions are made to circulate and cool containment fuel storage pool water through the RHR system (Section 5.4.7). This circulation is only initiated, if necessary, during refueling. During normal operations, the RHR connections are isolated by manually operated, locked-closed globe valves.

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Normal pool makeup water is taken from the condensate storage tank. A backup source of makeup water is available from the standby service water system via the reactor plant component cooling water system (Section 9.2.2). The fuel pool cooling pumps take suction from one end of the fuel building fuel storage pool and discharge at the opposite end of the pool through diffusers to minimize water turbulence. Antisiphoning devices are provided at the suction pipe inlet and the discharge pipe outlet, located to ensure that, in case of a pipe break, the pool water is not siphoned below a point approximately 10 ft above the top of the fuel.

The fuel pool cooling subsystem provides the necessary piping and valves for shell-side cooling of coolers by the standby service water (SSW) system. Standby service water is used for cooling of the heat exchangers if the RPCCW system is out of service. In this mode the heat removal capability of the subsystem is greater since the maximum design temperature of the standby service water is 95°F. Fig. 9.2-2 shows the cooler shell-side piping and the makeup lines to the fuel pool cooling subsystem from the RPCCW system.

Containment fuel storage pool water is circulated through the cooling subsystem standby pump and cooler during unit refueling operations, when spent fuel assemblies are temporarily stored in the fuel storage area of the containment pool awaiting transfer to the fuel pool located in fuel building.

Isolation valves and cross-connecting piping are provided to cool spent fuel stored in the containment pool via the RHR system, should the standby fuel pool cooling equipment be required to operate to cool the fuel building fuel storage pool.

Following refueling operations, after the reactor vessel head and the drywell head have been reinstalled, the standby fuel pool cooling pump is used to fill the refueling cavity with water from the condensate storage tank.

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A radiation monitor is provided to detect radioactive leakage to the RPCCW system.

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Electric power is supplied from the standby buses to the pump motors, and from the standby uninterruptible power supply system to the instrumentation. The pump motors receive power from the standby diesel generators if normal power is lost. The pumps are manually started on a loss of offsite power, if needed.

9.1.3.2.2 Fuel Pool Purification Subsystem

The fuel pool purification subsystem (Fig. 9.1-23a and 9.1-23b) consists of two 50-percent capacity horizontal, centrifugal pumps; two inline 50-percent flow etched disc type filters; one offstream 25-percent flow nonregenerable mixed-bed demineralizer; one post-demineralizer strainer; and associated piping, drains, vents, flushing lines, instruments, and valves. Design parameters of the fuel pool purification subsystem are given in Table 9.1-5.

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Full capacity is based on simultaneously recirculating the spent fuel pool water volume a minimum of two times a day, and the containment pools' water volume a minimum of once a day.

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The fuel pool purification pumps take suction from the containment pools and fuel building pools through suction pipes located on the sides of the pools.

The fuel pool purification pump discharge is returned to the pools through downward flowing vertical pipes. Discharge pipes to the condenser hotwell, condensate storage tank, and radwaste system are also provided for discharge of fuel building pool and containment pool water.

Prior to refueling operations, one purification pump and one filter are used to transfer water in the refueling cavity of the containment pool to the radwaste system, condensate storage tank, or condenser hotwell.

During unit refueling operations, one purification pump and one filter are used to filter the entire water volume of the containment pool, at a rate of at least once per day.

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During unit normal power operation, one pump, one filter, the demineralizer, and the post demineralizer strainer purify the fuel building pools at a filtration rate of approximately two volumes per day and a demineralization rate of approximately one volume per day. The water in the containment pools can be filtered at a rate of at least one volume per day and can be demineralized at a rate of at least one volume every 2 days, if the demineralization is required.

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Moderate adjustment of the water level in the containment pools or fuel building pools is accomplished by adding water from the condensate storage tank through the cooling subsystem or by discharging excess water to either the hotwell, condensate storage tank, or radwaste system via the purification subsystem. Through the use of cross-connecting piping and manual valves, it is possible to switch the demineralizer from the fuel building pools' cleanup loop to the containment pools' cleanup loop, as required to maintain water clarity and quality.

The spent fuel cask pool is provided with a drain connection piped to the purification pumps suction header to permit partial drainage of the cask pool into the condensate storage tank, condenser hotwell, or radwaste system. Complete drainage is achieved with portable equipment.

Antisiphoning devices are provided at the suction pipe inlet and discharge pipe outlet to ensure that, in case of pipe break, the pool water is not siphoned below a point approximately 10 ft above the top of the fuel.

Also, common headers are sized to permit simultaneous use of both purification pumps to perform any one of the operations described in the previous paragraphs.

The following grab samples are obtained from the fuel pool cooling and cleanup system (Table 9.3-1):

(a) Purification pump 2A and 2B discharge

(b) Filter 1A and 1B effluent

(c) Fuel pool demineralizer effluent

Samples are analyzed for conductivity, pH, chloride and silica content, and gamma activity on a weekly basis. Daily

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flow rate indications, filter differential pressure recordings, and demineralizer/purification pump conductivity recordings are combined with weekly analyses in appropriate procedures to determine the need for filter backwash or resin replacement based on the water quality parameters and trends of parameters identified in Table 9.1-5. These limits are consistent with GE recommendations to ensure maintenance of proper water quality in the fuel pools. Radiochemical parameters are monitored to maintain acceptable area radiation levels. Fuel building area radiation monitors in the vicinity of the spent fuel pool (Table 12.3-1) help ensure that radiation exposures to plant personnel from the fuel pool cooling and cleanup system are minimal. Section 12.3 addresses additional radiation protection concepts factored into the system design such as minimization of crud traps. Based on anticipated influent water quality characteristics, the Vacco etched disc filters are expected to process about 1.3 million gallons before being backwashed and returned to service. Depending on operating conditions, the filter differential pressure limit is set between 75 and 100 psid. The nonregenerable demineralizer is estimated to normally process about 4.0 million gallons per cubic foot of resin prior to complete ionic capacity exhaustion.
16←•
The fuel pool purification subsystem piping, valves, and equipment are designed to meet the code requirements indicated in Section 3.2.

Electric power is supplied from the normal buses to the motors, and from the normal ac instrument buses to the instrumentation.

9.1.3.3 Safety Evaluation

The fuel pool cooling subsystem is a highly reliable system, designed with 100-percent redundancy during normal and accident conditions. Its design includes the necessary piping and valves to permit cooling of the containment fuel storage pool or fuel building fuel storage pool during a loss of offsite power or during a seismic event. In addition, cooling for the fuel building fuel storage pool is designed to remain functional under all accident conditions including LOCA. The cooling subsystem piping and equipment are located within the fuel building, a Seismic Category I structure, and protected from internally and externally generated missiles, tornadoes, hurricanes, and floods, as defined in Section 3. It also includes Safety Class 3 Seismic Category I supply lines from the RPCCW system to provide a standby source of makeup water to the fuel building and containment pools, in addition to the normal makeup water from the condensate storage tank through non-nuclear safety piping. RPCCW can be used for pool makeup through either of two lines, one from each of the redundant RPCCW supply lines serving the coolers. Each of these RPCCW supply lines is provided with a direct connection from SSW to ensure availability of makeup water in all emergency or accident conditions, including earthquakes.

The fuel pool coolers are cooled by the RPCCW system (Table 9.2-2). The cooling piping is connected to that portion of the RPCCW system which is designed to Seismic Category I, and ASME III Code, Class 3 requirements. In the event that the RPCCW system is out of service, standby service water is also supplied to the heat exchangers for cooling (Section 9.2.7).

Normal pool makeup water from the condensate storage tank is sized for normal evaporation and equipment leakage losses, as well as leakage rates associated with potential damage to the fuel storage pool (Section 9.1.4.2.2.1).

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The fuel pool cooling subsystem is designed with complete redundancy during both normal, abnormal, and accident plant conditions. Either one of the two cooling loops can maintain fuel building fuel storage pool temperature at or below 139.8°F, with the design decay heat load (criteria discussed in Section 9.1.3.1) at the time of plant startup after the refueling is completed. Fig. 9.1-8 is a graphical representation of an analysis of fuel building fuel pool temperature versus heat load. If an abnormal operating condition requires up to full core removal (criteria discussed in Section 9.1.3.1), the fuel building fuel storage pool temperature may rise up to 155.6°F. The spent fuel pool and cooling system have been analyzed for a temperature excursion up to 170°F. Therefore, this temperature is within the design limits of the pool concrete structure, liner, storage racks, and fuel pool cooling subsystem.

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During a refueling outage, spent fuel may be stored in the containment fuel storage racks. A fuel pool cooling pump and heat exchanger are then aligned to cool the containment fuel pool. The other fuel pool cooling pump and heat exchanger are aligned to cool the fuel building storage pool. In the event of failure of either train during this situation, the operating train is used to cool the fuel building pool and the RHR train in standby is aligned and initiated as necessary to cool the containment fuel pool.

Figures 5.4 12 (RHR) and 9.1 23a and b (fuel pool cooling) show this capability.

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The spent fuel cask pool is normally open to the fuel storage pool with a watertight gate, which closes the opening through which spent fuel passes as it is being transported to the cask area. The bottom of this opening is above the top of the spent fuel storage racks so that if water in the spent fuel cask pool is lost while the gate is open, the fuel storage racks are not uncovered.

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The consequence of fuel pool cooling subsystem component failures are presented in the Failure Modes and Effects Analysis (FMEA) report submitted under separate cover.

A radiological evaluation of the fuel pool purification subsystem is presented in Chapter 12.

9.1.3.4 Inspection and Testing Requirements

The cooling and purification subsystems and the pool instrumentation and alarms are tested and calibrated on a periodic basis. No special equipment tests are required, since system components are normally in operation when spent fuel is stored in the fuel building fuel storage pool or containment fuel storage pool. Operating and standby components are alternated periodically to verify operability of all equipment. Visual inspection of system components and instrumentation is conducted periodically. Chemical and radiochemical analyses are performed for both the fuel building fuel storage pool and containment fuel storage pool water.

Inservice inspection is considered in the design of the cooling subsystem. This consideration assures adequate working space and access for the inspection of the selected component. The inservice testing of cooling pumps and valves is conducted in accordance with the requirements of ASME OM Code, Subsections ISTB and ISTC.

9.1.3.5 Instrumentation Requirements

Control of the fuel pool cooling and cleanup system is shown on Figure 7.6 7. The fuel pool cooling pumps (P1A, B) are manually controlled by switches in the main control room. Automatic startup of the cooling pumps for either accident conditions or loss of an operating pump is not required. However, when a pump that is running trips automatically, an alarm is activated in the main control room. An indication of fuel pool outlet temperature is provided in the main control room. High and high high temperature alarms are provided in the main control room and also on a local panel in the fuel building. A low fuel pool cooling pump discharge pressure condition activates an alarm in the main control room.

Control switches are provided in the main control room for manual operation of the fuel pool cooling and cleanup system isolation valves. A LOCA signal or manual containment isolation signal closes the respective isolation valves.

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The containment pool and fuel pool water levels are monitored, and high and low level alarms are provided in the main control room. High and low level alarms are also provided on a local panel in the fuel building for fuel pool water level.

Containment pool and fuel pool inlet water flows are monitored by the plant computer.

Pushbutton controls are provided in the auxiliary control room for manual operation of the fuel pool purification pumps (P2A, B). An alarm is activated in the auxiliary control room when a pump that is running trips automatically. A low fuel pool purification pump discharge pressure condition activates an alarm in the auxiliary control room. Fuel pool purification system return water flow is monitored in the auxiliary control room.

Fuel pool demineralizer flow is monitored in the auxiliary control room and maintained at its set point by modulating the fuel pool demineralizer bypass flow control valve. A high demineralizer inlet flow alarm is provided in the auxiliary control room.

The fuel pool purification filter backwash tank transfer pumps (P3A, B) are manually controlled by switches in the auxiliary control room. A low backwash pump discharge pressure condition activates an alarm in the auxiliary control room.

Backwash tank level is monitored, and an extreme high level condition activates an alarm in the auxiliary control room.

An extreme low level condition trips the running backwash tank transfer pump. Control switches are provided in the auxiliary control room for manual operation of the backwash tank flushing water valve (SOV 101). Control logic is provided to open the valve when the backwash tank level is low and to close the valve when the level is high. A high or low backwash tank level condition activates an alarm in the auxiliary control room. Backwash air accumulator pressure is monitored in the auxiliary control room. Control logic is provided to open the backwash air accumulator air supply valve (SOV 165) when the air accumulator air pressure is low and to close the valve when the pressure returns to normal.

Level indicators and high and low level alarms are also provided in the main control room for the following:

1. Upper transfer pool
2. Lower transfer pool
3. Refueling cavity
4. Cask pool.

The fuel pool purification filter backwash sequence is manually initiated. High differential pressure across the fuel pool purification filter is alarmed on the local panel in the fuel building.

Fuel pool cooling system inoperative alarms are provided in the main control room.

High-differential pressure alarms are provided in the auxiliary control room for the fuel pool demineralizer and fuel pool demineralizer outlet strainer.

9.1.4 Fuel Handling System

9.1.4.1 Design Bases

9.1.4.1.1 Fuel Handling Equipment

The fuel handling system is designed to provide a safe, effective means for transporting and handling fuel from the time it reaches the plant until it leaves the plant after post-irradiation cooling. Safe handling of fuel includes design considerations for maintaining occupational radiation exposures as low as reasonably achievable during transportation and handling.

Design criteria for major fuel handling system equipment is provided in Tables 9.1-2 through 9.1-4 which list the safety class and seismic category. Where applicable, the appropriate ASME, ANSI, Industrial and Electrical Codes are identified. Additional design criteria are shown below and expanded further in Section 9.1.4.2.

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The transfer of new fuel assemblies between the uncrating area and the new fuel inspection stand and/or the new fuel storage vault is accomplished using the 15-ton fuel building crane equipped with a suitable grapple.

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The 1,000 lb mono-rail hoist on the fuel handling platform may be used with a suitable grapple to transfer new fuel from the new fuel vault to the new fuel inspection stand or the fuel storage pool. From this point on, the fuel is either handled by the telescoping grapples on the fuel handling platform or on the refueling platform, and is transported between the reactor and fuel buildings by the fuel transfer system.

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These platforms are Safety Class 2 and Seismic Category 1 from a structural standpoint. Allowable stress due to safe shutdown earthquake (SSE) loading is 120 percent of yield or 70 percent of ultimate, whichever is less. A dynamic analysis is performed on the structures using the response spectrum method with load contributions resulting from each of three earthquakes being combined by the root mean square procedure. Working loads of the platform structures are in accordance with the AISC Manual of Steel Construction. All parts of the hoist systems are designed to have a safety factor of 5 based on the ultimate strength of the material. A redundant load path is incorporated in the fuel hoists so that no single component failure could result in a fuel bundle drop. Maximum deflection limitations are imposed on the main structures to maintain relative stiffness of the platform. Welding of the platforms is in accordance with AWS D14-1 or ASME Boiler and Pressure Vessel Code Section 9. Gears and bearings meet AGMA Gear Classification Manual and ANSI B3.5. Materials used in construction of load bearing members are to ASTM specifications. For personnel safety, OSHA Part 1910-179 is applied. Electrical equipment and controls meet ANSI CI, National Electric Code, and NEMA Publication No. IC1, MG1.

The auxiliary fuel grapple and the main telescoping fuel grapples have redundant lifting features and an indicator which confirms positive grapple engagement.

The fuel grapple is used for lifting and transporting fuel bundles. It is designed as a telescoping grapple that can extend to the proper work level and in its fully retracted state still maintains adequate water shielding over fuel.

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Redundant electrical interlocks (LSI and LS2) and Administrative procedures are in place to preclude the possibility of raising radioactive materials out of the water. In addition to the maximum-up Limit Stop (LS3), the cables on the auxiliary hoists incorporate an adjustable, removable stop that jams the hoist cable against part of the platform structure to prevent equipment damage.

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The provision of a separate cask loading pool, capable of being isolated from the spent fuel storage pool, eliminates the potential accident of dropping the cask and rupturing the spent fuel storage pool. Furthermore, physical limitation of the travel of the crane handling the cask precludes transporting the cask over any portion of spent fuel storage pool. Refer to Chapter 15 for accident considerations.

9.1.4.1.2 Overhead Bridge Cranes

9.1.4.1.2.1 Spent Fuel Cask Trolley

For dry fuel storage cask operations, the Spent Fuel Cask Trolley (SFCT) is referred to as the Fuel Building Cask Handling Crane (FBCHC).

The spent fuel cask trolley is designed in accordance with the following criteria:

1. The SFCT is rated for a 125 ton load.

2. The SFCT is designed as a Seismic Category I crane.

3. The SFCT is designed to the requirements of AWS D1.1, NEC Article 610, NEMA MG1-18.501 through MG1-18.518, and CMAA Specification No. 70 as a Service Class A1 Crane.

4. The requirements of 29CFR17 Part 1910.179 (including amendment dated July 1, 1973) and of ANSI B30.2.0 are safety-related requirements and are also incorporated into the trolley system's design.

9.1.4.1.2.2 Fuel Building Bridge Crane

The fuel building bridge crane (FBBC) is designed in accordance with the following criteria:

1. The FBBC includes the design requirements of AWS D1.1, NEC Article 610, NEMA MG1-18.501 through

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MG1-18.518, and CMAA Specification No. 70 as a Service Class B Crane.

2. The requirements of 29CFR17 Part 1910.179 (including amendment dated July 1, 1973), and ANSI B30.2.0 are safety-related requirements and are also incorporated into the crane design.

3. The FBBC is designed as Category II - Seismic.

2←•

9.1.4.1.2.3 Reactor Building Polar Crane

The reactor building polar crane (RBPC) is designed in accordance with the following criteria:

1. The RBPC is designed to Seismic Category I requirements.

2. The RBPC design includes the applicable design requirements of AWS D1.1, NEC Article 610, NEMA MG1-18.501 through MG1-18.518, and CMAA Specification No. 70 as a Service Class A1 crane.

3. The requirements of 29CFR17 Part 1910.179 (including amendment dated July 1, 1973) and of ANSI B30.2.0 are also incorporated into the crane design.

9.1.4.2 System Description

Table 9.1-1 is a listing of typical tools and servicing equipment supplied with the nuclear system. The following sections describe the use of some of the major tools and servicing equipment and address safety aspects of the design where applicable.

9.1.4.2.1 Spent Fuel Casks

9.1.4.2.1.1 Spent Fuel Shipping Casks

The design of the spent fuel shipping cask storage and handling facilities is based upon a cask with the approximate dimensions of 12 ft in diameter and 18 ft in length, with a maximum loaded weight of approximately 125 tons.

These large casks are shipped to and from the site on a specially designed rail car. Smaller casks are shipped on a flatbed truck equipped with suitable cask hold-down devices and heat exchangers as required. Design of the casks and transport vehicles conform to the rules and regulations for packaging and transportation of radioactive materials (10CFR71 and 49CFR171-178).

9.1.4.2.1.2 Spent Fuel Storage Casks

Holtec transfer casks (HI-TRAC) are utilized for transporting spent fuel from the cask pool to the HI-STORM storage container. The dimensions and loaded weight of the HI-TRAC are encompassed by those of the shipping casks. The spent fuel is transferred from the HI-TRAC to the HI-STORM for storage at the ISFSI pad.

9.1.4.2.2 Overhead Bridge Cranes

9.1.4.2.2.1 Spent Fuel Cask Trolley

The arrangement of the spent fuel cask handling system is shown in Fig. 9.1 9.

The SFCT (also called the FBCHC), located at the eastern end of the fuel building, is an overhead electric trolley with an auxiliary bridge. The trolley (Fig. 9.1 10) travels in a north south direction on a straight runway and houses the 125 ton main hoist whose hook position is fixed laterally at the midpoint of the trolley span. The auxiliary bridge consists of two wide flange double beam girders and is permanently fixed to the main trolley. The auxiliary bridge is not provided with a separate drive, but is driven by means of the main trolley drive. The auxiliary trolley rails are mounted on the centerlines of the auxiliary bridge girders and span their entire length. The auxiliary trolley houses the 15 ton auxiliary hoist and moves in a plane of travel perpendicular to the main runway.

Primary functions of this crane are 1) to upend and transfer the spent fuel shipping cask and 2) to transfer a transfer cask (HI TRAC) with loaded spent fuel from the cask pool to the cask pit and then to the HI STORM for transfer of the spent fuel to the HI STORM for storage. The crane will also be used in reverse order for unloading casks. For the performance of these functions, the crane has been designed for service in the outside environment. It is used to service the transporting vehicle and the fuel transferring mechanism in the fuel transfer canal. The SFCT rails do not extend over any portion of the spent fuel pool; thus, the casks cannot be transported over the spent fuel.

The SFCT is operated from an operator's cab located beneath the main trolley and the auxiliary bridge or by a radio controller. Controls for the main hoist and trolley, and auxiliary hoist and trolley are fully magnetic, reversible, with five steps of variable speed. The load control for the main hoist is provided by an eddy current control brake for hoisting and lowering motions. In addition to this electric brake, the main hoist has two independent shoe type holding brakes which are automatically applied to the hoist motor shaft when the motor is de energized. The main trolley movement is controlled by a self adjusting brake, hydraulically operated and actuated by a foot lever in the cab. Interlocks are in place to assure only singular motion during loaded cask movement. Additionally, the main trolley is provided with an electric brake which is applied automatically when the trolley controls are returned to the off position (cab or radio controller), upon a loss of power, or when the main contractor is opened.

Due to the precise handling requirements for cask movements, both the main hoist and main trolley are provided with an inching device. These devices provide a continuous maximum speed not greater than 0.5 fpm regardless of load for both the main hoist and main trolley. Each hoist is provided with limit switches to stop the hoist in its highest and lowest safe position. In addition, the main hoist is equipped with a slack cable limit switch to prevent hoisting and lowering against a slack cable and with a centrifugal limit switch to apply the holding brakes in the event of an overspeed. Each hoist is also provided with a load-limiting device that senses an overload on the hoist and stops the hoisting motion. This cutoff switch interrupts the hoisting motion, but does not affect the lowering circuit. Upon lowering and removing the load, the load-limiting device automatically resets and permits hoisting operations to continue.

9.1.4.2.2.2 Fuel Building Bridge Crane

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The fuel building bridge crane is a welded box girder, overhead crane that travels in an east-west direction in the fuel building. The trolley houses the 15-ton hoisting assembly and travels laterally on its rails which are mounted on the centerlines of the girders (see Fig. 1.2-21). The crane is controlled by a pendant control box suspended from the bridge and independent of the trolley location. The primary function of the bridge crane is the handling of new fuel between the receiving area and the new fuel inspection stand and/or the new fuel storage vault and/or the high density fuel racks. During construction the crane is used for placement of the high density fuel racks (HDFR).

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Controls for the bridge, hoist, and trolley motors are fully magnetic reversible with five steps of variable speed. The hoist is equipped with an eddy current control brake for hoisting and lowering motions. Accompanying the control brake are two independent holding brakes which are automatically applied to the hoist motor shaft when the motor is de-energized. One holding brake is the dc-rectified type; the other a motor-mounted disc brake. The bridge motor is equipped with an electric shoe brake that automatically and immediately is applied to the bridge motor shaft in the event of loss of power. The trolley traverse motor has an ac disc brake that responds to a loss of power in the same manner as the bridge brake.

9.1.4.2.2.3 Reactor Building Polar Crane

The RBPC consists of two girders and a trolley. The crane, shown in Fig. 1.2-12, is of welded box girder construction with the girders connected by end ties at the left and right ends of the girders. This bridge assembly rests on circular runway rails (el 214 ft 3 in) which provide for 360-deg rotation of the crane girders. The runway rails are mounted on a circular support structure welded to the containment vessel. The trolley travels laterally on its rails mounted on the crane girders and serves as the platform for the main (100-ton) and auxiliary (5-ton) hoisting mechanisms. The crane can be operated from either the bridge-mounted cab or from a pendant control suspended from the bridge or operated by a radio controller.

The RBPC is used to move the portable refueling shield, drywell head, reactor vessel head, steam dryer, steam separator, and reactor vessel head insulation and support frame. During the construction phase, the crane is used for the lifting and placement of major machinery and equipment. The RBPC is not used for handling of fuel.

Controls for the bridge, auxiliary hoist, and trolley motors are fully magnetic reversible with five steps of variable speed. Controls for the main hoist are of the variable, stepless direct current static type. The main hoist is provided with phase loss and phase reversal protection to prevent hoist brakes from being released until the motor field is energized and armature current is flowing. The load control for the auxiliary hoist is provided by eddy-current braking for hoisting and lowering motions. The main hoist has dynamic control with an emergency feature which automatically lowers the load at a safe rate in the event of simultaneous loss of ac power and holding brakes. Both main and auxiliary hoist have an independent shoe-type brake which is automatically applied to the motor shaft when the motor is de-energized. Bridge movement is equipped with two independent braking systems, one electric and one hydraulic.

The trolley traverse motor is equipped with an electric brake which is applied automatically to the motor shaft upon loss of power, the opening of the main line contactor, or the return of the trolley controllers to the off position. Both the bridge and trolley are equipped with inching drives for precision positioning. The inching motor circuits are interlocked so that the inching motors cannot be operated unless both the bridge and trolley are essentially at rest.

9.1.4.2.3 Fuel Servicing Equipment

The fuel servicing equipment described below has been designed in accordance with the criteria listed in Table 9.1-2.

9.1.4.2.3.1 Fuel Preparation Machine

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The two fuel preparation machines (Fig. 9.1-11) are mounted on the west wall of the fuel building spent fuel storage pool. Each fuel preparation machine consists of a work platform, frame and a movable carriage. The movable carriage is located below the spent fuel pool water level, thus providing a water shield when irradiated fuel bundles are being handled. Mechanical stops on each fuel preparation machine prevent the carriage from lifting irradiated fuel above the safe water shield level. Each fuel preparation machine is operated by a foot pedal controlled air hoist for vertical positioning of the carriage. The fuel preparation machines are fitted with a fuel inspection fixture when required to provide the station with an underwater fuel inspection capability.

The mechanical stops on the fuel preparation machine are administratively removed for receipt of new fuel into the spent fuel pool.

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9.1.4.2.3.2 New Fuel Inspection Stand

The new fuel inspection stand (Fig. 9.1-12) serves as a support for the new fuel bundles undergoing receiving inspection and provides a working platform for technicians engaged in performing the inspection.

The new fuel inspection stand consists of a vertical guide column, a lift unit to position the work platform at any desired level, bearing seats, and upper clamps to hold the fuel bundles in position.

9.1.4.2.3.3 Channel Bolt Wrench

The channel bolt wrench (Fig. 9.1-13) is a manually operated device approximately 12 ft (3.6 m) in overall length. The wrench is used for removing and installing the channel fastener assembly while the fuel assembly is held in the fuel preparation machine.

The channel bolt wrench has a socket which mates and captures the channel fastener capscrew.

9.1.4.2.3.4 Channel Handling Tool

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The channel handling tool (Fig. 9.1-14) is used in conjunction with the fuel preparation machine to remove, install, and transport fuel channels.

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The tool is composed of a handling bail, a lock/release knob, extension shaft, angle guides, and clamp arms which engage the fuel channel. The clamps are actuated (extended or retracted) by manually rotating lock/release knob.

The channel handling tool is suspended by its bail from a spring balancer on the channel handling boom located on the fuel pool periphery or the monorail auxiliary hoist structure on the fuel platform.

9.1.4.2.3.5 Fuel Pool Sipper

The fuel pool sipper (Fig. 9.1-15) provides a means of isolating a fuel assembly in demineralized water in order to concentrate fission products in relation to a controlled background.

The fuel pool sipper consists of a control panel assembly and a sipping container cover.

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9.1.4.2.3.5.a Fuel Sipper

The Fuel Sipper provides a means to sip for failed fuel. There are several different manufacturers currently providing fuel sippers to the nuclear industry. Each of these manufacturers employ essentially the same methodology for sipping fuel, all manufacturers sample and analyze the water near a potentially defective fuel bundle for an increase in gaseous soluble fission products. The following provides a general description of the configuration and how an ABB Telescope Fuel Sipper operates however, other approved fuel sippers are acceptable provided they are compatible with the refueling platform and mast arrangement.

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The Telescope Fuel Sipper consists of a set of four stainless steel sampling tubes placed at each corner of the grapple, approximately 3" above the bottom of the grapple. The four stainless steel sampling tubes run to a common header block above the top of the grapple. From this point, samples are carried to the measuring equipment station by means of a suction sampling hose. The sampling station consists of a pump, a vacuum chamber to draw the dissolved gases out of solution and a high sensitivity Beta detector.

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9.1.4.2.3.6 Channel Gauging Fixture

The channel gauging fixture (Fig. 9.1 16) is a go/no go gauge used to evaluate the condition of a fuel channel, prior to rechanneling or when one is difficult to install.

The channel gauging fixture consists basically of a frame, gauging plate, and gauging block. The gauging plate is shimmed to correspond to the outside dimension of a usable fuel channel. The gauging block conforms to the inside dimension of lower end of a usable fuel channel.

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The channel gauging fixture is installed in the vertical position between the two fuel preparation machines and hangs from the spent fuel storage pool curb.

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9.1.4.2.3.7 General Purpose Grapple

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The general purpose grapple (Fig. 9.1 17) is a handling tool used generally with the fuel. The grapple can be attached to the jib crane to handle fuel during channeling.

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9.1.4.2.3.8 Jib Crane

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The jib crane (Fig. 9.1 18) consists of motor driven swing boom monorail and a motor driven trolley with an electric hoist. The jib crane is mounted along the edge of the containment dryer storage pool to be used during refueling operations. Use of the jib crane leaves the refueling platform free to perform general fuel shuffling operations and still permit uninterrupted fuel preparation in the work area. The hoist has two full capacity brakes and in series adjustable uptravel limit switches. On hoisting, the first two independently adjustable limit switches automatically stop the hoist cable terminal approximately 8 ft below the jib crane base. Continued hoisting is possible by depressing a momentary contact, uptravel override push button on the pendant together with the normal hoisting push button. Two additional independent switches automatically cut hoist power at the maximum safe uptravel limit. When the jib crane is used in the handling of hazardous radioactive materials that must be kept below a specific water level, a fixed tool length stop is installed on the hoist cable to prevent further hoisting when that level is reached.

9.1.4.2.3.9 Fuel Handling Platform

Refer to Section 9.1.4.2.7.3 for fuel handling platform.

9.1.4.2.3.10 Channel Handling Boom

A channel handling boom (Fig. 9.1 19) with a spring loaded balance reel is used to assist the operator in supporting a portion of the weight of the channel after it is removed from the fuel assembly. The boom is set between the fuel preparation machines. With the channel handling tool attached to the reel, the channel may be conveniently moved between fuel preparation machines. The monorail auxiliary hoist structure on the fuel platform may also be used to remove and move a fuel channel.

9.1.4.2.3.11 Fuel Transfer System

The inclined fuel transfer system (Fig. 9.1 20) is used to transfer fuel, control rods, defective fuel storage containers, and other small items between the containment and the fuel building pools by means of a carriage traveling in a transfer tube (a 23 in I.D. stainless steel pipe). At the containment upper pool, the transfer tube connects to pool penetration and to a sheave box. Connected to the sheave box is a 24 in flap valve, a vent pipe, cable enclosures, and a fill valve. In the fuel building pool, the transfer tube connects to a 24-in gate valve. A bellows connects the building penetration to the valve and transfer tube to prevent water entrapment between the tube and penetration. A 4-in Weldolet located on the transfer tube approximately 2 ft above the fuel building pool water level and a motor-operated valve are provided for connections to a drain pipe for water level control in the transfer tube.

A containment isolation assembly containing a blind flange and a bellows which connects from the containment penetration to the assembly are provided to make containment isolation. A hand operated 24-in gate valve is provided to isolate the reactor building pool water from the transfer tube so the blind flange can be installed. A hydraulically actuated upender is provided in each pool for rotating part of the carriage, the tilt tube, to the vertical position for loading and unloading and to the inclined position for transfer. The carriage consists of the tilt tube and a follower connected with a pivot pin which allows upending of the tilt tube while maintaining the follower in the inclined position. The carriage has rollers and wheels which ride on tracks within the transfer tube and upenders to assure low friction, correct carriage orientation, and smooth transition across valves and between other components. The tilt tube is designed to accept two different inserts - a fuel bundle insert with a two-bundle capacity and a control rod insert for control rods, defective fuel storage containers, and other small items.

A winch, located on the containment refueling floor, uses two cables attached to the lower end of the follower for pulling the carriage from the fuel building to the containment and for controlling the carriage descent velocity. A slow winch speed is provided for starting and stopping the carriage to limit the acceleration on the fuel assemblies. Cable underload and overload protection is provided by a load cell. Carriage position readout is provided. Cable enclosures, attached to the sheave box and projecting above the containment upper pool water level, provide the means for cable exit from the transfer tube while isolating the pool water from the tube.

A vent pipe with a fluid stop connected to the containment ventilation system isolates the displaced air in the tube during filling from the reactor building atmosphere and confines the water surge to the pool water.

A hydraulic power unit is provided in each building to actuate the cylinders attached to the upenders, the fill valve, the flap valve, and the fuel building gate valve.

In both buildings, the pool area in which the transfer system components are located is physically separated from the fuel storage area by a concrete wall which serves as a positive barrier to prevent fuel in the storage area from being uncovered in the event of loss of pool water through the transfer system. In addition, these walls are provided with gates to allow drainage of the transfer pool areas for maintenance and/or removal of the transfer tube and components.

Control panels are provided in close proximity to each transfer pool area and are connected for voice and interlock communication. Each panel has control buttons for actuating the upender, a button for initiating the transfer sequence to the other building and a stop button. The transfer operation functions on an automatic basis with provision made for manual override. Automatic sequencing is accomplished by use of an electronic controller located in the fuel building which utilizes sensors for confirming the successful completion of each step before initiating the next step. The completion of a transfer sequence is signaled at the control panels.

The inclined fuel transfer control system is operated on a semiautomatic basis. Safety interlocks prevent opening the transfer tube bottom valve when the flap valve is open, and vice versa, to prevent drainage of the reactor building transfer pool.

The interlock control system has dual channel logic, which provides a backup sensor for each required sensor and provides the redundancy necessary for the system to function safely. The failure of a channel to perform its intended function causes an alarm which identifies the failed channel.

Emergency cooling is available in the unlikely event of the tilt tube becoming lodged in the transfer tube. The worst-case scenario would be if the tilt tube, with the maximum heat source (two freshly discharged fuel assemblies), was lodged above the water exit valve with all valves closed and a loss of power and transfer tube leak occurred. Thirty min is available before the water in the tilt tube boils down to active fuel level. The addition of cooling water by manually opening the water inlet valve or by running a hose through the vent pipes would be started within 30 min. This additional cooling can maintain the fuel at a safe temperature indefinitely.

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Interlocks assure the correct sequencing of the transfer system components and fuel handling equipment during automatic or manual override operation. Interlocks prevent the refueling platform from moving into the reactor building transfer area unless the upender (7) is in the vertical position and prevent upender movement if the platform is in the transfer area. Interlocks prevent the fuel handling platform from moving into the fuel building transfer area unless the upender (31) is in the vertical position and prevent movement of the upender if the platform is in the transfer area. Interlocks for entry into the fuel transfer areas may be bypassed when the Refueling and/or Fuel Handling Platforms are de-energized to allow operation of the IFTS, provided that the main mast of the respective platform is outside of the fuel transfer area while de-energized.

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The operational sequence for the fuel transfer system (Fig. 9.1-20) is described as follows. As a starting point, assume the carriage (24) is in the containment transfer pool with the tilt tube (24A) supported by the upender (7) in the inclined position. In this position, the sheave box cover (11) and manual gate valve (17) are open with the fill valve (13), gate valve (25) and drain valve (27) closed. The operational sequence is as follows:

1. The hydraulic cylinder (9) is actuated to push the upender and tilt tube (7 and 24A) to the vertical position.

2. Load and unload fuel, control rods or other items into and from the tilt tube.

3. The hydraulic cylinder (9) is actuated to pull the tilt tube into the inclined position for transfer.

4. The automatic operation is started by depressing the transfer button on the containment control panel.This starts the winch (1) unwinding the cables to lower the carriage (24).

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5. The carriage is stopped approximately 1 ft above the gate valve (25).

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6. The sheave box cover (11) is closed.

7. The drain valve (27) is opened and water is drained to the level of drain pipe attachment to the transfer pipe (20).

8. The gate valve (25) is opened.

9. The winch lowers the carriage until it is stopped and supported by the pivot arm framing (32).

10. The hydraulic cylinder (9) is actuated to push the upender (31) and tilt tube (24A) to the vertical position.

11. Unload and load cargo.

12. The hydraulic cylinder (9) is actuated to lower the tilt tube (24A) and upender (31) to the inclined position.

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13. The winch is actuated by depressing the fuel building control panel's transfer button and pulls the carriage (24) to a position approximately 1 ft above the gate valve (25) where it is automatically stopped.

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14. The gate valve (25) and drain valve (27) are closed.

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15. The fill valve (13) is opened.

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16. The sheave box cover (11) is opened when sensors indicate that the transfer tube (20), sheave box (14), vent pipe (4), and cable enclosures (5) are filled with water.

17. The carriage is pulled to the containment transfer pool (starting point).

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Testing requirements for the fuel transfer system (Fig. 9.1 20) in Modes 1, 2, or 3 are described as follows. Prior to testing, assume the carriage is stored in the containment building transfer pool on the upender (7) with the primary containment blind flange installed. In this position, the manual gate valve (17), fill valve (13), gate valve (25) and drain valve (27) are all closed. The testing requirements are as follows:

Testing preparation.

1. The second drain valve (downstream of 27) is closed.
2. The primary containment blind flange is removed in accordance with plant procedures.

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3. The amount of time that the containment blind flange is removed in Modes 1, 2, or 3 is tracked.

Testing performance.

1. A dedicated operator is stationed in a low dose area in the vicinity of the fuel transfer system drain line isolation valve. This operator is responsible for manually closing the drain valve (27) if it fails to close properly or upon a loss of offsite power.
2. Fuel Transfer System testing is performed in accordance with plant procedures.
3. The drain line dedicated operator is notified prior to each operation of the drain valve. (27).

Containment blind flange removed with testing suspended.

1. The manual gate valve (17), drain valve (27), and second drain valve (downstream of 27) are all closed.
2. The drain line dedicated operator is not required.

After transfer operations or testing are completed, the carriage is stored in the containment building transfer pool on the upender (7). Containment isolation is then made as follows:

15←•

1. Close the manual gate valve (17).

2. Remove bolts from the containment isolation assembly (18) as required to allow insertion of the blind flange. (Not all bolts have to be removed). Loosen remaining bolts to allow approximately 1.25 in movement of the transfer tube flange.

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3. Lower transfer tube with the hydraulic cylinders (16).

4. Insert the blind flange and install bolts.

5. Pull the transfer tube up with the cylinders (16).

6. Tighten the bolts and relieve pressure on the cylinders.

Containment is made by the containment isolation assembly and blind flange, containment bellows (19) and the steel containment penetration. Special gaskets and double-ply bellows are provided for leak checking to assure containment isolation.

Refer to Table 9.1-3 for component identification essential classifications, safety classifications, and seismic categories.

9.1.4.2.4 Servicing Aids

General area underwater lights are provided with suitable reflectors for illumination. Light support brackets are furnished to support the lights in the reactor vessel to allow the light to be positioned over the area being serviced independent of the platform. Local area underwater lights are small diameter lights for additional illumination. Drop lights are used for illumination where needed.

A radiation-hardened, portable underwater closed-circuit television camera is provided. The camera may be lowered into the reactor vessel and/or fuel storage pool to assist in the inspection and/or maintenance of these areas. The camera lens is capable of pitching 90 deg which allows infinite scanning of 360 deg, solid angle.

A general purpose, plastic viewing aid is provided to float on the water surface to provide better visibility. The sides of the viewing aid are brightly colored to allow the operator to observe it in the event of its filling with water and sinking. A portable, submersible-type underwater vacuum cleaner is provided to assist in removing crud and miscellaneous particulate matter from the pool floors or the reactor vessel. The pump and filter unit are completely submersible for extended periods. The filter package is capable of being remotely changed and the filters fit into a standard shipping container for offsite burial. Fuel pool tool accessories are also provided to meet servicing requirements. A fuel sampler is provided to detect defective fuel assemblies during open vessel periods while the fuel is in the core. The fuel sampler head isolates individual fuel assemblies by sealing the top of the fuel channel and pumping water from the bottom of the fuel assembly, through the fuel channel, to a sampling station, and returning it to the primary coolant system. After a soaking period, a water sample is obtained and radiochemically analyzed.

9.1.4.2.5 Reactor Vessel Servicing Equipment

The essential and safety classifications, and the seismic category for this equipment are listed in Table 9.1-4. Following is a description of the equipment designs in reference to that table.

9.1.4.2.5.1 Reactor Vessel Service Tools

These tools are used when the reactor is shut down and the reactor vessel head is being removed or reinstalled. Tools in this group are:

1. Stud handling tool
2. Stud wrench
3. Nut runner
4. Stud thread protector
5. Thread protector mandrel
6. Bushing wrench
7. Seal surface protector
8. Stud elongation measuring rod
9. Dial indicator elongation measuring device
10. Head guide cap.

These tools are designed for a 40-yr life in the specified environment. Lifting tools are designed for a safety factor of 5 or better with respect to the ultimate strength of the material used. When carbon steel is used, it is either hard chrome plated, parkerized, or coated with an approved paint in accordance with Regulatory Guide 1.54.

9.1.4.2.5.2 Steam Line Plug

•→16

The steam line plugs are used during reactor refueling or servicing; they are inserted in the steam outlet nozzles from inside the reactor vessel to prevent a flow of water from the reactor well into the main steam line during servicing of safety relief valves, main steam isolation valves, or other components of the main steam lines, while the reactor water level is at the refueling level. The steam line plug design provides two seals of different types. Each one is independently capable of holding full head pressure. The equipment is constructed of noncorrosive materials. All calculated safety factors are 5 or better. The plug body is designed in accordance with the Aluminum Construction Manual by the Aluminum Association. Other approved Main Steam Line Plug designs may be used provided they meet the minimum functionality requirements stated above.

16←•

9.1.4.2.5.3 Shroud Head Bolt Wrench

•→7

This is a hand operated tool supported by RBPC auxiliary hoist for operation of the shroud head bolts. Designed for a 40-yr life, it is made of stainless steel to be easy to handle and to resist corrosion. Testing has been performed to confirm the design. Additional approved tools for the shroud head bolt operation may be used as long as the weight values of Table 9.1-9 are not exceeded.

7←•

9.1.4.2.5.4 Head Holding Pedestal

Three pedestals are provided for mounting on the refueling floor for supporting the reactor vessel head and strongback/carousel during periods of reactor service. The pedestals have studs which engage three evenly-spaced stud holes in the head flange. The flange surface rests on replaceable wear pads made of aluminum. When resting on the pedestals, the head flange is approximately 3 ft above the floor to allow access to the seal surface for inspection and O-ring replacement.

The pedestal structure is a carbon steel weldment coated with an approved paint. It has a base with bolt holes for mounting it to the concrete floor.

A seismic analysis was made to determine the seismic forces imposed onto the floor anchors of the pedestals, using the floor response spectrum method. The structure is designed to withstand these calculated forces and meet the requirements of AISC.

9.1.4.2.5.5 Head Stud Rack

The head stud rack is used for transporting and storage of eight reactor pressure vessel studs. It is suspended from the reactor building polar crane auxiliary hoist when lifting studs from the reactor well to the operating floor.

The rack is made of aluminum to resist corrosion, and it is designed for a safety factor of 5 with respect to the ultimate strength of the material.

The structure is designed in accordance with the Aluminum Construction Manual by the Aluminum Association.

9.1.4.2.5.6 Dryer and Separator Strongback

The dryer and separator strongback is a lifting device used for transporting the steam dryer or the shroud head with the steam separators between the reactor vessel and the storage pools. The strongback is a cruciform shaped I-beam structure which has a hook box with two hook pins in the center for engagement with the reactor service crane sister hook and it has a socket with a pneumatically operated pin on the end of each arm for engaging it to the four lift eyes on the steam dryer or shroud head.

The strongback has been designed in such a way that one hook pin and one main beam of the cruciform are capable of carrying the total load and so that no single component failure can cause the load to drop or swing uncontrollably out of an essentially level attitude. The safety factor of all lifting members is 5 or better in reference to the ultimate breaking strength of the material.

•→4

The structure is designed in accordance with the AISC Manual of Steel Construction. The completed assembly is proof tested at 125 percent of rated load and all structural welds are magnetic particle inspected after load test. The assembly is inspected on a 5 refueling outage interval based on the very limited and dedicated use of this device. Additionally visual inspections of the lifting rigs are performed once per refueling outage to provide additional assurance against degradation between lifts.

4←•

9.1.4.2.5.7 Head Strongback/Carousel

The reactor pressure vessel (RPV) head strongback/carousel is an integrated piece of equipment consisting of a cruciform shaped strongback, a circular monorail, and a circular storage tray.

The strongback is a box beam structure which has a hook box with two hook pins in the center for engagement with the reactor service crane sister hook. Each arm has a lift rod for engagement to the four lift lugs on the RPV head. The monorail is mounted on extensions of the strongback arms and four additional arms equally spaced between the strongback arms. The monorail circle matches the stud circle of the reactor vessel and it serves to suspend stud tensioners and

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nut handling devices. The storage tray is suspended from the ends of the same eight arms and surrounds the RPV flange. A manifold is mounted underneath the hook box for distributing hydraulic and pneumatic pressures to equipment traveling on the monorail. The head strongback/carousel serves the following functions:

1. Lifting of Vessel Head - The strongback, when suspended from the reactor building polar crane main hook, transports the RPV head plus the carousel with all its attachments between the reactor vessel and storage on the pedestals.

2. Tensioning of Vessel Head Closure - The carousel, when supported on the RPV head on the vessel can carry up to eight tensioners, its own weight, the strongback, storage of nuts, washers, thread protectors, and associated tools and equipment. The eight tensioners are suspended equally spaced from a monorail above the vessel stud circle. Each tensioner has an air-operated hoist with individual controls.

3. Storage with RPV Head - The carousel, when stored with the RPV head on the head holding pedestals, carries the same load as for 2 above. When in storage position, it accommodates nut cleaning and inspection.

4. Storage without RPV Head - During reactor operation, the carousel is stored on the refueling floor, straddling the three pedestals. Support cradles with a flat base are provided for supporting the four carousel legs on the floor.

The strongback with its lifting components is designed to meet the Crane Manufacturers Association of America, Specification No. 70. The design provides a 15 percent impact allowance and a safety factor of 5 in reference to the ultimate strength of the material used. After completion of welding and before painting, the lifting assembly is proof load tested and all load affected welds and lift pins are magnetic particle inspected.

The steel structure is designed in accordance with The Manual of Steel Construction by AISC. Aluminum structures are designed in accordance with the Aluminum Construction Manual by the Aluminum Association.

•→4
The strongback is designed in accordance with ASME, American National Standard for overhead hoists ANSI B30.16 - 1973, Paragraph 16-1.2.2.2, in such a way that one hook pin and one main beam of the structure is capable of carrying the total load, and so that no single component failure can cause the load to drop or swing uncontrollably out of an essentially level attitude. The assembly is inspected on a 5 refueling outage interval based on the very limited and dedicated use of this device. Additionally visual inspections of the lifting rigs are performed once per refueling outage to provide additional assurance against degradation between lifts.
4←•

9.1.4.2.6 In-Vessel Servicing Equipment

Each incore instrumentation guide tube is sealed by an O-ring on the flange and in the event that the seal needs replacing, an incore guide tube sealing tool is provided. The tool is inserted into an empty guide tube and sits on the beveled guide tube entry in the vessel. When the drain on the water seal cap is opened, hydrostatic pressure seats the tool. The flange can then be removed for seal replacement.
•→16
The frame mounted and monorail hoists on the refueling platform are used with appropriate grapples to handle control rods, flux monitor dry tubes, sources, and other internals of the reactor. Interlocks on both hoists and auxiliary hoist are provided for safety purposes.
16←•

9.1.4.2.7 Refueling Equipment

Fuel movement and reactor servicing operations are performed from platforms which span the refueling, servicing, and storage cavities. The containment building is supplied with a refueling platform for fuel movement and servicing, an auxiliary platform for servicing operations from the refueling floor level, and a vessel platform for reactor servicing from the vessel flange level. The fuel building is supplied with a fuel handling platform for fuel movement and servicing.

9.1.4.2.7.1 Refueling Platform

The refueling platform is a gantry crane which is used to transport fuel and reactor components to and from containment pool storage and the reactor vessel. The platform spans the fuel storage and vessel pools on bedded

•→7
tracks in the refueling floor. A telescoping mast and grapple suspended from a trolley system is used to lift and orient fuel bundles for core, storage rack, or upender placement. Two verification methods are required for fuel movement. These methods can include visual serial number verification, digital readout from the position indicating system, or counting of cells/racks. A grapple mounted camera provides a close-up picture of the bail for visual serial number verification. Control of the platform is from an operator station on the main trolley. A position indicating system and travel limit computer is provided to locate the grapple
7←•

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•→8 •→4
over the vessel core and prevent collisions with pool obstacles. Two 1,000 lb capacity auxiliary hoists, one main trolley mounted and one auxiliary monorail trolley mounted, are provided for incore servicing such as detector module replacement, fuel support replacement, jet pump servicing, and control rod blade replacement. These auxiliary hoists can also serve as a means of handling other equipment within the pool. The load weighing system for each auxiliary hoist limits the hoisting capacity to 500 lb. during normal use for the above mentioned activities. This load limit is provided to prevent the possibility of hoisting any item as heavy as an irradiated fuel bundle. The fuel grapple in its fully retracted position provides a safe water shield over the active fuel during transit. The fuel grapple hoist has a redundant load path so that no single component failure results in a fuel bundle drop. Interlocks on the platform limit operation over the vessel during control rod movements, prevent collision with the auxiliary platform, limit operation in the transfer tube upender zone, limit travel of the fuel grapple, and interlock grapple hook engagement with hoist load and hoist up power.
4←• 8←•

9.1.4.2.7.2 Auxiliary and Vessel Platforms

An auxiliary platform is provided to allow versatility of operations. This platform operates over the reactor building pool and provides an additional work area for reactor servicing. A 500 lb capacity hoist is provided for reactor servicing tasks. Part of the auxiliary platform is used as the vessel flange level service platform.

The reactor level servicing platform provides a reactor flange level working surface for invessel inspection and reactor internals servicing, and permits servicing access for the full vessel diameter. Typical operations to be performed are inservice inspection and jet pump servicing. No hoisting equipment is provided with this platform as this function can be obtained from the refueling platform or auxiliary platform. The platform operates on tracks at the reactor vessel flange level and is lowered into position by the reactor building polar crane using the dryer/separator strongback. The platform weighs approximately 4,000 lb and features 5 ft wide work areas and motorized travel. The platform power is supplied by a cable from the refueling floor elevation.

9.1.4.2.7.3 Fuel Handling Platform

The fuel handling platform is a gantry crane which is used to transport fuel within the fuel building storage pool. The platform spans the fuel storage and transfer tube upender pools on tracks embedded in the fuel building floor. A telescoping mast and grapple is used to lift and orient fuel bundles for storage rack or upender placement. Control of the platform is from an operator station on the main trolley. A vertical position indicating system is provided

•→8 •→4
for the grapple. Limit switches are located on the rail stops to interlock the platform and minimize the possibility of running into pool obstacles. A 1,000 lb capacity auxiliary hoist is mounted on the auxiliary monorail trolley and may be used for moving new fuel from the new fuel vault to the storage pool; control rod blade transport, and fuel channel movement. Both the main fuel hoist and monorail auxiliary hoists have redundant features so that no common single component failure could result in a fuel bundle drop. During transfer of fuel, the grapple in its normal up position provides a safe water shield over the active fuel.
4←• 8←•

9.1.4.2.7.4 Portable Radiation Shield

•→16
The portable radiation shield is a temporary shielding device that is installed prior to transfer of spent fuel bundles from the reactor to the containment fuel storage pool. The fuel bundles are passed through the shield which reduces radiation levels in the upper drywell area. The shield is handled by the RBPC. In the installed position, one end of the shield is supported by the reactor vessel flange and the other end is supported by the floor at el 162 ft 3 in. Following its use, the shield is stored in the separator pool.
16←•

9.1.4.2.8 Storage Equipment

Specially designed equipment storage racks are provided. Additional storage equipment is listed in Table 9.1-1. For description of new and spent fuel storage racks, see Sections 9.1.1 and 9.1.2.

•→8
Defective fuel assemblies may be placed in defective fuel storage containers, which are stored in the defective fuel storage rack, both of which are designed for the defective fuel. These may be used to isolate leaking or defective fuel while in the fuel pool. Channels can also be removed from the fuel bundle while in a defective fuel storage container.

Various fuel sipping machines may be used for out-of-core wet sipping at any time. These are used to detect a defective fuel bundle while circulating water through the fuel bundle.
8←•

9.1.4.2.9 Refueling Seal

The refueling seal forms a watertight barrier between the reactor vessel and the drywell to permit flooding of the refueling cavity above the vessel. The refueling seal assembly (Fig. 3.8-3) consists of a stainless steel bellows, backing plate, spring seal, and a removable guard ring. The backing plate surrounds the outer circumference of the bellows, providing mechanical protection and support, and is equipped with a pressure tap for leak testing and monitoring of the bellows. The spring seal, located in the area between the bellows and the backing plate, is self-energizing. The spring seal is designed to limit water loss through the refueling seal assembly due to a postulated bellows rupture. Should this occur, the spring seal is forced into a tight fit to the backing plate when subjected to the full hydrostatic pressure. The guard ring is attached to the seal assembly within the inner circumference of the bellows and serves as a protective barrier against small dropped objects, such as hand tools. Visual inspection of the bellows is possible by removal of the guard ring from above. The refueling seal assembly is supported from the reactor vessel by a support skirt welded to the vessel flange, and from the drywell by means of a bulkhead which spans the distance between the top of the bellows and the drywell wall. Located around the bulkhead are hinged watertight covers which are bolted in place during normal refueling operations. During normal station operations, the covers are opened, allowing removable air supply and air return ducts to circulate ventilation air in the region above the refueling seal. In addition, the reactor head spray line, head vent line, and nuclear boiler instrumentation lines penetrate the refueling seal support during normal operation and refueling.

The refueling seal assembly is designed to withstand the hydrostatic head of the refueling water above the reactor vessel, in conjunction with the temperature effects due to reactor residual heat. The effects of equipment and structural response to pipe rupture and earthquake loadings are considered in the design of the refueling seal assembly.

All water retaining surfaces of the refueling seal assembly are of all steel, welded construction. All welds are continuous and examined for integrity and water tightness throughout fabrication and installation.

The location, orientation, and general method of attachment of the refueling seal assembly within the plant are indicated on Fig. 3.8-3. Attachment joints between the assembly and the bulkhead on the drywell structure and the seal support skirt on the reactor vessel are continuously welded at installation of the assembly. This provides for the structural continuity of the joints. Subsequent to installation of the assembly, the attachment welds are nondestructively tested (MT or PT, as applicable) to verify their integrity, and the entire assembly inspected for water leakage during the hydrostatic test of the upper containment pool.

Fig. 3.8-3 depicts the geometry of a typical refueling seal assembly, and identifies its components and their general relationship to each other. All weld joints exposed to water are continuous and leak tested prior to operation to ensure their watertight integrity. The bellows element is of stainless steel construction and is designed to be compatible with the reactor operating conditions. As shown on Fig. 3.8-3, the bellows element of the refueling seal assembly, while exposed to the upper containment pool water, is mechanically protected from dropped objects. his protection is afforded by the assembly attachment rings and the removable guard ring, which is only removed to permit visual inspection of the bellows element.

During refueling operations, the heavy traffic path between the reactor and the fuel transfer area is considered to be the most probable area for a postulated equipment drop accident to occur. The items transferred over this area are limited to reactor core components such as fuel assemblies, control blades, etc, and refueling/servicing equipment. The impact energies generated by dropping of these items is considered in the design of the assembly. In addition, the fuel transfer path over the assembly from the reactor core to the drywell structure is protected by a specially designed removable structure. This removable structure serves as an impact barrier against dropped loads, and as a radiation shield for the drywell area below the seal assembly. This allows personnel access in the drywell for servicing operations during fuel transfer in and out of the reactor, and also in the event of a dropped fuel assembly.

During normal plant operation, the refueling seal assembly is in a dry environment, and protected within the confines of the drywell head.

As indicated on Fig. 3.8-3, leakage through the refueling seal assembly is detected via leakage monitoring connections routed to sampling stations.

9.1.4.2.10 Under Reactor Vessel Servicing Equipment

The primary functions of the under reactor vessel servicing equipment are to 1) remove and install control rod drives, 2) service thermal sleeves, and 3) install and remove the neutron detectors. Table 9.1-1 lists the equipment and tools required for servicing. Of the equipment listed, the equipment handling platform and the control rod drive (CRD) handling equipment are powered pneumatically.

The CRD handling equipment is designed for the removal and installation of the CRDs from their housings. This equipment is used in conjunction with the equipment handling platform. It is designed in accordance with OSHA - 1910.179, American Institute of Steel Construction (AISC).

The equipment handling platform provides a working surface for equipment and personnel performing work in the under vessel area. It is polar platform capable of rotating 360 deg. This equipment is designed in accordance with the applicable requirements of OSHA (Vol. 37, No. 202, Part 1910N), AISC, and ANSI-C-1 (National Electric Code).

The seal cap is designed to prevent leakage of primary coolant from incore detector housings during detector replacement. It is designed to industrial codes and manufactured from noncorrosive material.

The thermal sleeve installation tool locks, unlocks, and lowers the thermal sleeve from the CRD guide tube.

The incore flange seal test plug is used to determine the pressure integrity of the incore flange o-ring seal. It is constructed of noncorrosive material.

The key bender is designed to facilitate installation and removal of the antirotation key that is used on the thermal sleeve.

9.1.4.2.11 Description of Fuel Transfer

The fuel handling system provides a safe and effective means for transporting and handling fuel from the time it reaches the plant until it leaves the plant after post-irradiation cooling. The following sections describe the design bases of the fuel handling system. The requirements of Regulatory Guide 1.13 are satisfied.

9.1.4.2.11.1 Arrival of Fuel Onsite

New fuel for initial loading and subsequent refueling arrives onsite by truck shipment. Two fuel bundles are supported and protected within an inner metal container which, in turn, is shipped within an outer metal container.

•→8
The inner containers are removed from the outer container and transferred to the work area around the new fuel inspection stand. The metal container must be upended to the vertical position before the fuel bundle is removed. Section 9.1.4.2.11.2.1 further discusses the new fuel preparation.
8←•

9.1.4.2.11.2 Refueling Procedure

•→16
A typical plant refueling and servicing sequence diagram is shown on Fig. 9.1 21. Fuel handling procedures are shown on Fig. 9.1 22 and Fig. 9.1 24 through 9.1 30 and described below. Typical fuel building and containment layouts are shown on Fig. 9.1 31 and 9.1 32, and component drawings of the principal fuel handling equipment are shown on Fig. 9.1 11 through 9.1 20.
•→15 •→14 •→12 •→8 •→4
With the reactor shut down, the containment isolation between the fuel and reactor buildings can be opened by removing the blind flange and opening the shutoff valve on the fuel transfer tube. (The containment isolation blind flange may be removed for short periods of time during power operation, as allowed by the Technical Specifications.) At this time, channeled new bundles may be transferred to the containment pool where the refueling platform places them into containment pool storage racks. Prior to commencing refueling operations, the gate separating the refueling cavity from the storage rack section of the upper containment pool is closed (Fig. 9.1 32) and the reactor refueling cavity is drained. After the reactor refueling cavity has been drained, the reactor shutdown and sufficiently cooled, the drywell head, vessel head, and insulation frame are removed by the polar crane and placed in their respective storage areas (Fig. 9.1 32). The polar crane and carousel are used to handle the 84 ton load of RPV head and attachments. The carousel is designed so that no single component failure can cause the load to drop or swing uncontrollably out of an essentially horizontal attitude.
4←• 12←• 15←• 16←•
The carousel attaches to the crane hook by means of an integral hook box and two hook pins. Each pin is capable
8←• 14←•

•→14
of carrying the rated load. Each main beam of the carousel is capable of carrying the rated load.
14←•
On both ends of each leg are adjustable lifting rods, suspended vertically to attach the lifting legs to the RPV head. These are for adjustment for even four-point load distribution and allow for some flexibility in diametrical location of the lifting lugs on the head.

The maximum potential drop height is at the point where the head is lifted vertically from the vessel and before it is moved horizontally to the head storage pedestals. The elevation difference from vessel flange to storage elevation is approximately 30 ft.

The shroud head and steam separater load of 45 tons and the steam dryer load of 32 tons are both lifted with the dryer/separator strongback. This strongback is a cruciform shape with box-shaped sockets at the four ends.Each socket box has two compartments to accommodate the two different lug spacings on the dryer and on the shroud head. Pneumatically operated lifting pins penetrate the sockets to engage the lifting lugs.

Each of the above strongbacks is load-tested at 125 percent rated load. At this test, measurements are taken before test load, under test load, and after releasing load, to verify that deflections are within acceptable limits. A magnetic particle test of structural welds is performed after the load test to assure structural integrity.
•→14
A seal exists around the vessel opening to seal the drywell from the upper containment pool. In the meantime, water is pumped into the reactor refueling cavity. Once the refueling cavity is filled, the separator is removed and transferred to its storage area using the dryer/separator strongback. The tools used in these and subsequent reactor servicing operations are listed in Table 9.1-1. Once access to the core is possible, the refueling platform can relocate assemblies to and from the containment pool storage racks and the inclined fuel transfer system. Simultaneously the CRD hydraulic system and the neutron monitoring system (NMS) may be serviced from beneath the vessel.
14←• •→8 •→4
During refueling, the refueling platform transfers spent fuel to the containment pool storage racks or directly to the containment inclined fuel transfer pool upender. The spent fuel assemblies are transferred to the fuel building transfer pool via the fuel transfer tube. The spent fuel
4←• 8←•

•→8 •→4
assemblies are placed in the fuel building fuel storage racks by the fuel handling platform. The operation of the fuel handling platform is coordinated with the operations of the refueling platform and transfer system to assure a safe, continuous fuel handling process
4←• 8←• •→14
When refueling and servicing are completed, the steam separator assembly is replaced in the vessel, the steam line plugs are removed, and the steam dryer is returned to the vessel. At this point, the gate is closed isolating the reactor refueling cavity from the upper pools. The reactor refueling cavity is then drained. With the reactor refueling cavity empty, the vessel head, insulation, and drywell head are replaced. The reactor refueling cavity is then filled. When all transfer from the upper containment pool to the fuel building has been completed, the containment is isolated by installing the blind flange in the transfer tube and startup operations can begin.
14←• •→12
The storage of spent fuel in the upper containment fuel storage pool is prohibited during Operational Conditions 1 and 2.
12←•
9.1.4.2.11.2.1 New Fuel Preparation

9.1.4.2.11.2.1.1 Receipt and Inspection of New Fuel
•→8A •→8 •→4
The fuel transport crates are unloaded from the transport vehicle. Each crate contains two fuel bundles supported by an inner metal Radioactive Assemblies (RA) container. After removal of the inner metal RA container from the outer container, the inner metal container is transferred to the upending stand where the fuel is rotated into a vertical position. One bundle at a time is moved to the fuel inspection stand where it is thoroughly inspected and then channeled. Both inner and outer containers are reusable. Handling of new fuel within the fuel building is accomplished by use of the fuel building 15-ton overhead bridge crane. The container is supported in a vertical position while the fuel bundles are unstrapped and transported to the new fuel inspection stand.
8A←•
During inspection of new fuel, the individual fuel bundles are inserted in the new fuel inspection stand for visual and/or dimensional inspection. The new fuel inspection stand accommodates two fuel assemblies at one time.
4←• 8←•

9.1.4.2.11.2.1.2 Channeling New Fuel

•→8 •→4

During new fuel receipt activities, each new fuel bundle is placed in the new fuel inspection stand for visual and/or dimensional inspection. A new fuel channel is installed and the new fuel assembly is then stored in the new fuel vault or moved into the spent fuel pool for storage or transfer to the primary containment.

4←• 8←•

9.1.4.2.11.2.1.3 Equipment Preparation

Equipment and new fuel are prepared for refueling readiness. Tools, grapples, slings, strongbacks, stud tensioners, etc, are given a thorough inspection and operational check and any defective (or well worn) parts are replaced. Air hoses on grapples are checked. Crane cables are routinely inspected. Necessary maintenance is performed.

9.1.4.2.11.2.2 Reactor Shutdown

•→12

The reactor is shut down according to a prescribed procedure. During cooldown, the RPV is vented and filled to above flange level to promote cooling and preparations made for drywell head and vessel head removal.

9.1.4.2.11.2.2.1 Drywell Head Removal

Immediately after cooldown, the work to remove the drywell head can begin. The drywell head is a quick-disconnect head provided with double o-ring seals. The closure joint is the Hahn and Clay patented finger-pin closure which consists of a meridional tongue-and-groove arrangement and radial locking pins. To remove the drywell head the radial locking pins are disengaged. After the removal of the locking pins the head is lifted by the reactor building polar crane and placed at its designated space on the refueling floor.

12←•

9.1.4.2.11.2.2.2 Reactor Refueling Cavity Servicing

•→14

When the drywell head has been removed, several pipe lines are exposed. These lines penetrate the reactor refueling cavity. The piping must be removed and the openings sealed. There are also vent openings which must be made watertight. Water level in the vessel is now lowered to flange level in preparation for head removal. The insulation frame is removed at this time.

9.1.4.2.11.2.3 Reactor Vessel Opening

9.1.4.2.11.2.3.1 Vessel Head Removal

•→10

The combination head strongback and carousel stud tensioner is transported by the reactor building polar crane and positioned on the reactor vessel head. Each stud is tensioned and its nut loosened in a series of passes. Finally, when the nuts are loose, they are backed off until only a few threads engage. The nut is rotated free from the stud and the nuts and washers may be placed in the racks provided for them on the carousel. When all the nuts and washers are removed, the vessel stud protectors and vessel head guide caps are installed.

10←•

Next, the head and carousel are transported by the reactor building crane to the head holding pedestals on the refueling floor. The head holding pedestals keep the vessel head elevated to facilitate inspection and O-ring replacement.

14←• •→8

The studs in line with the fuel transfer canal are removed from the vessel and placed in the rack provided for them. The loaded rack is transported to the refueling floor for storage. Removal of these studs provides a path for fuel movement.

8←•

9.1.4.2.11.2.3.2 Steam Dryer Removal

The dryer-separator strongback is lowered by the reactor building polar crane and attached to the dryer lifting lugs. The dryer is lifted from the reactor vessel and transported to its storage location in the dryer storage pool adjacent to the reactor refueling cavity.

9.1.4.2.11.2.3.3 Steam Separator Removal

•→7

Prior to removal of the steam separator, the steam line plugs are installed in the four main steam nozzles from inside the vessel. In preparation for the separator removal, the separator is unbolted and unlatched from the shroud using the shroud head bolt wrenches furnished for this purpose. These wrenches may be used from the vessel flange area, auxiliary platform, or refueling platform. When the unbolting is accomplished, the dryer-separator strongback is lowered into the vessel and attached to the separator lifting lugs. The water in the reactor refueling cavity and the separator storage pool is raised to containment pool water level and the separator is transferred to its allotted storage place in the pool.

7←•

9.1.4.2.11.2.3.4 Fuel Bundle Sampling

•→14 •→6

During reactor operation, the core off gas radiation level is monitored. If a rise in off gas activity has been noted, a process can be started to determine the location, the approximate size, and the approximate number of fuel cladding failures. By comparing changes to local power densities in the core from normal or planned power maneuvers, offgas samples and pre-treatment radiation monitor readings can be used to help identify the potential location of the cladding failure in the core. During the next refueling outage, fuel sipping equipment can be placed on the refueling platform and is used to determine the exact assembly or assemblies with the cladding failure(s). Fuel sipping is a process by which a fuel assembly is sampled for the fission products which would escape from a cladding failure.

6←• •→7

A method used for this inspection is the Telescope Sipping method. The Telescope Fuel Sipping System is used to identify leaking fuel assemblies, based on the detection of gaseous soluble fission products. These fission products are released from a leaking fuel

7←• 14←•

•→7
assembly due to inner gas expansion resulting from the change in the pressure head of water when the assembly is elevated to a higher level. The measurements are based on measuring a count rate for nuclides such as Xe-133 and Kr-85 in the gas phase.
7←•

9.1.4.2.11.2.4 Refueling and Reactor Servicing

•→14
The gate isolating the containment pool from the reactor refueling cavity is opened, thereby interconnecting the containment pool, the reactor refueling cavity, and the fuel transfer area. The refueling of the reactor can now begin.

During a normal refueling outage, fuel is removed from the reactor, the remaining fuel is shuffled, and new fuel is inserted. The actual fuel handling is done with the refueling platform. It is used as the principal means of transporting fuel assemblies between the reactor core and the containment pool; it also serves as a hoist and transport device. It provides an operator with work surface for almost all the other servicing operations. The platform travels on track extending along each side of the reactor refueling cavity and pool and supports the refueling grapple and auxiliary hoists. The platform design permits travel
14←•

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over safety railings placed around the pools. The grapple is suspended from a trolley that can transverse the width of the platform. Platform movement is controlled from an operator station on the trolley. Railing is provided to keep all unauthorized personnel from entering the platform area or the inside of the refueling platform track area.

The refueling platform has two 1000 lb. capacity auxiliary hoists. One auxiliary hoist is mounted on the reactor side of the refueling platform and projects approximately 2 ft from the frame. The second auxiliary hoist is mounted on the platform trolley. These hoists are normally used with appropriate grapples to handle control rods, guide tubes, fuel support pieces, sources, and other internals of the core. These auxiliary hoists can also serve as a means of handling other equipment within the pool. The load weighing system for each auxiliary hoist limits the hoisting capacity to 500 lb. during normal use for the above mentioned incore activities. This load limit is provided to prevent the possibility of hoisting any item as heavy as an irradiated fuel bundle.

•→16 •→14

A single operator can control all the motions of the platform required to handle the fuel assemblies during refueling. Interlocks on the main hoist prevent hoisting of a fuel assembly over the core with a control rod withdrawn; interlocks also prevent withdrawal of a blade with a fuel assembly over the core attached to the fuel grapple. (Note: The auxiliary hoists are not used for irradiated fuel moment.) Interlocks block travel over the reactor in the startup mode.

14←• 16←• •→8 •→4

The refueling platform contains a system that indicates position of the fuel grapple over the core. The readout in the operator's cab matches the core arrangement cell identification numbers. A digital readout is displayed to the operator, showing the coordinates of the grapple over the core.

4←• 8←• •→14 •→7

To move fuel, the fuel grapple is aligned over the fuel assembly, lowered, and attached to the fuel bundle bail. Two verification methods are required for fuel movement. These methods can include visual serial number verification, digital readout from the position indicating system, or counting of cells/racks. A grapple mounted camera provides a close-up picture of the bail for visual serial number verification. The fuel bundle is raised out of the core, moved through the refueling slot to the containment pool, positioned over the storage rack, and lowered into the rack. Fuel may also be moved directly to the inclined fuel transfer system. Fuel is shuffled and new fuel is moved from the containment pool to the reactor vessel in the same manner.

7←• 14←•

9.1.4.2.11.2.5 Vessel Closure

The following steps return the reactor to an operating condition. The procedures are the reverse of those described in the preceding sections (many steps are performed in parallel and not as listed).

1. Core verification. The core position of each fuel assembly must be verified to assure the desired core configuration has been attained.

2. CRD tests; the CRD timing, friction and scram tests are performed as required.

3. Replace separator.

4. Bolt separator, and remove the four steam line plugs.

•→14

5. Close pool gate and drain reactor refueling cavity.

6. Replace steam dryer.

7. Open drywell vents.

14←•

8. Replace vessel studs.

9. Install reactor vessel head.

10. Install vessel head piping and insulation.

11. Hydrotest vessel, if required.

12. Install drywell head; leak check.

13. Flood reactor refueling cavity.

•→14

14. Open pool gate.

14←•

15. Startup tests; the reactor is returned to full power operation. Power is increased gradually in a series of steps until the reactor is operating at rated power. At specific steps during the approach to power, the incore flux monitors are calibrated.

9.1.4.2.11.3 Departure of Spent Fuel from Site

•→6

After spent fuel assemblies have been stored in the spent fuel pool for a sufficient time to allow their decay heat to decrease to levels suitable for their transport, they are shipped offsite to an approved facility licensed to receive irradiated fuel from River Bend Station.

6←•

For shipment of spent fuel from RBS, the empty spent fuel shipping cask (Section 9.1.4.2.1) arrives at the fuel building via a specially designed transport vehicle or truck. The cask handling yoke, which arrives with the cask shipping rig, is attached to the spent fuel cask trolley (SFCT). The SFCT is located over the fuel cask and the handling yoke is attached to the lifting trunnions on the fuel cask. As the cask is transported in a horizontal position, it is upended to the vertical by hoisting with the SFCT while pivoting about a special handling fixture which is integral to the cask transport vehicle. Once the fuel cask is vertical and free of the transport vehicle, it is traversed to the spent fuel cask washdown area where any road dirt or other foreign matter is washed from the external surfaces of the cask. The cask handling crane then raises the cask to the fuel handling area and lowers it into the cask pool. The reverse procedure applies when the loaded fuel shipping cask is being replaced on its transport vehicle for shipment offsite.

Physical barriers are provided to prevent the crane from transporting the cask over the fuel transfer canal while fuel is being handled in the transfer canal. The physical barriers are removed only to utilize the SFCT for maintenance of the lower fuel transfer mechanism. The barriers are reinstalled following maintenance or whenever spent fuel cask handling is required.

The fuel handling platform can be brought under the SFCT over the separate cask pool. However, the SFCT cannot be brought to that area of the spent fuel pool over which the fuel handling crane operates. The crane structures themselves do not interfere with each other due to the building design and runway rail arrangement. Potential interference between the two cranes may result in the unlikely event that the fuel handling platform encroaches the path of the cask handling crane with the hook in a lowered position. Operating procedures are provided to prevent this occurrence.

The cask pool area has a stepped-level floor to ensure that no postulated accident allows the cask to drop through a height greater than 30 ft, as the shipping cask is designed to withstand a 30-ft drop onto an unyielding surface without failure. Additional analyses have been performed for movements of transfer casks in the fuel building as described in section 9.1.4.3.2. With the fuel cask located in the cask pool, the cask head is removed to temporary storage and the cask handling crane parked in a location away from the open cask. The cask pool water level is increased to the level of the fuel pool and its watertight gate is opened, enabling the fuel handling platform to load the cask with spent fuel bundles from the fuel storage racks. With the cask full, the watertight gate is closed, the cask head is secured, the lifting yoke is attached to the cask trunnions, and the fuel cask is transferred to the cask pit (decontamination area). Partial draining of the cask pool during these operations is not necessary since the SFCT's hoisting ropes and load block have been designed for immersion in water.

After decontamination of the cask external surfaces, it is mounted on its transport vehicle with its attendant cask cooling systems, if necessary. The loaded spent fuel shipping cask is then ready for shipment offsite.

9.1.4.2.11.4 Storage of Fuel at the Independent Spent Fuel Storage Installation

Spent fuel is stored in a dry configuration in ventilated storage casks at the ISFSI. However, certain activities in support of dry spent fuel storage take place in the RBS Fuel Building and are governed by 10CFR50. Periodically, dry storage cask loading campaigns are conducted to move a pre-determined number of RBS spent fuel assemblies from the spent fuel pool to the ISFSI. Those spent fuel assemblies remain in temporary storage at the ISFSI until such time as the fuel can be shipped to a federal repository for permanent disposal.

The Holtec International HI-STORM 100 System is used for dry cask storage of nuclear fuel at the RBS ISFSI. The HI-STORM 100 System consists of a multi-purpose canister (MPC), which is capable of holding up to 68 BWR fuel assemblies, a transfer cask (HI-TRAC), which contains the MPC during loading, unloading, and transfer operations, and a storage cask (HI-STORM overpack), which provides shielding, heat removal capability, and structural protection for the MPC during storage. The FBCHC is required to lift and handle the HI-TRAC transfer cask and MPC both empty and loaded with spent nuclear fuel in support of dry storage cask loading. The combined maximum lifted weight, including rigging and lift yoke will not exceed 125 tons, which is the design rated load of the FBCHC.

During each cask loading campaign, spent fuel assemblies are moved, one at a time, from the RBS spent fuel pool wet storage racks into the MPC, which is resting inside the HI-TRAC transfer cask in the cask pool on the lower shelf (Position 5 Figure 9.1-9). The cask pool will have been previously flooded with water to approximately the same elevation as the spent fuel pool and the gate separating the cask pool and spent fuel pool opened. Once the desired number of fuel assemblies has been loaded into the MPC, the MPC lid is installed under water and the transfer cask is lifted by the FBCHC and placed on the cask pool upper shelf to allow changes in rigging equipment (Position 4 on Figure 9.1-9). Then, the transfer cask is lifted out of the cask pool and moved northward to the dry cask washdown area (Position 3 on Figure 9.1-9, hereafter referred to as the "cask pit").

In the cask pit, the MPC lid is seal welded and the canister is drained, dried and backfilled with helium in accordance with the Part 72 cask CoC and FSAR. The transfer cask containing the sealed MPC is decontaminated, lifted out of the cask pit, and moved by the FBCHC through the Fuel Building outer doors into the cask crane structure where it is placed on top of the empty storage overpack, which has previously been prepared to receive the transfer cask with a mating device (Position 2 on Figure 9.1-9)[1]. The FBCHC is disengaged from the transfer cask lifting trunnions and rigged to lift the MPC by its lift cleats. The MPC is lifted slightly to remove the weight from the transfer cask bottom pool lid. The pool lid is detached and lowered into the mating device, the mating device drawer is opened to provide a pathway through to the overpack, and the MPC is lowered into the overpack. After MPC transfer, the overpack lid is installed and the overpack is transported to the ISFSI using a vertical cask transporter (crawler).

9.1.4.3 Safety Evaluation, Fuel Handling System

Safety aspects (evaluation) of the fuel servicing equipment are discussed in Section 9.1.4.2.3 and safety aspects of the refueling equipment are discussed throughout Section 9.1.4.2.7. A description of fuel transfer, including appropriate safety features, is provided in Section 9.1.4.2.11. In addition, the following summary safety evaluation of the fuel handling system is provided.

The SFCT is designed so that during a seismic event, no part of the trolley system, including main trolley, auxiliary trolley, and auxiliary bridge, leaves its rails or becomes detached. The SFCT is not designed to be operable during or after a seismic event. The spent fuel shipping and transfer cask drop analyses were performed to verify that a cask drop does not result in unacceptable damages to the spent fuel storage facility, safety-related equipment or cask contents.

[1] Note that Figure 9.1-9 depicts a shipping cask being loaded onto a transport vehicle at this position. This configuration is not applicable for dry storage cask operations. A cask crawler is used to move the dry storage cask from this point to the ISFSI.

9.1.4.3.1 Shipping Cask Drop Analysis

These considerations form the basis for the structural response due to postulated load drops. For specific transfer cask drop analysis see 9.1.4.3.2. The following considerations are applied in performing the shipping cask drop analysis:

1. The cask is assumed to be a maximum-loaded cask with a weight of 125 tons and handled by the main hook.

2. Each postulated cask drop assumes impact in a manner that inflicts the most severe damage.

3. No credit is taken for the spent fuel cask trolley's multiple independent braking systems, limit switches, or other safety features.

4. Drop analyses are based on an elastic-plastic curve that represents a true stress-strain relationship.

5. The 125 ton load is assumed to be dropped from a maximum height of 6 in above elevation 113 ft-0 in (Fig. 9.1-9). A lifted weight versus drop height curve is developed based on conserving the maximum energy.

6. All energy of each postulated drop is assumed to be absorbed by the structure.

7. Drops are postulated along the travel path of the cask (Fig. 9.1-9) not restricted by mechanical stops.

8. The cask is assumed to be rigid and not to experience any deformation during impact.

9. The cask pool is assumed to be flooded during the cask-handling process. The water level is lowered slightly to avoid spillover while the cask is being handled in the pool. However, this small loss of water does not significantly diminish the drag forces of the cask pool volume.

•→14

Note: The requirement for a flooded cask pool assumes the maximum capacity of the SFCT of 125 tons. However, the pool may be lowered as required for SFCT lift loads less than 125 tons if the resultant effects are bounded by the 125 tons with the cask pool flooded.

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10. The cask washdown area (cask pit) is assumed to be not flooded.

9.1.4.3.2 Storage Cask Component Drop Analyses

Several heavy load lifts are required to support dry spent fuel storage cask operations in the Fuel Building. Because the FBCHC is not a single-failure proof design, certain hypothetical drops have been eliminated by design features and others have been evaluated. In most cases, when the cask is being moved strictly in the horizontal direction, redundant rigging is installed on the crane to provide temporary single-failure proof protection and eliminate the need to postulate drops during these times. However, during vertical movements, the redundant rigging cannot be installed and certain drops have been postulated and analyzed. Based on the guidance in NUREG-0612, seven drops of cask components were evaluated. They are discussed below.

9.1.4.3.2.1 Empty MPC Drop onto Cask Pit North Wall

This drop is postulated to occur when the empty canister is being brought into the Fuel Building from the cask crane structure for installation into the transfer cask before fuel loading operations begin. The MPC is assumed to be dropped onto the north wall of the cask washdown area.

9.1.4.3.2.2 Loaded Transfer Cask Drop onto Cask Pool Upper Shelf Corner with Cask Top-To-Side Wall Impact

This drop is postulated to occur when the transfer cask, loaded with spent fuel, is being moved from the cask pool lower shelf to the cask pool upper shelf and is partially over the upper shelf floor, suspended 4 inches above the shelf. The cask is assumed to drop onto the corner of the upper shelf, pivot about that point, and impact the cask pool wall.

9.1.4.3.2.3 Loaded Transfer Cask Vertical Drop onto Cask Pool Upper Shelf

This drop is postulated to occur when the transfer cask, loaded with spent fuel, has been moved from the cask pool lower shelf to a point where it is suspended 4 inches above the cask pool upper shelf just prior to being lowered onto the shelf. The cask is assumed to drop vertically onto the upper cask shelf.

9.1.4.3.2.4 Loaded Transfer Cask Vertical Drop onto Cask Pool Lower Shelf

This drop is postulated to occur when the transfer cask, loaded with spent fuel, is lifted out of the cask pool to an elevation 42'-6" above an impact limiter that is installed on the floor of the lower shelf. The cask is assumed to drop vertically into the cask pool lower shelf after being lifted to the height necessary for horizontal movement to the cask washdown area but prior to engagement of the redundant crane links.

9.1.4.3.2.5 Loaded Transfer Cask Vertical Drop Into Cask Washdown Area Pit

This drop is postulated to occur when the transfer cask, loaded with spent fuel, is suspended 17'-6" over the cask washdown area pit after having been moved from the cask pool. The cask is assumed to drop vertically onto an impact limiter previously installed in the cask washdown area pit.

9.1.4.3.2.6 Loaded Transfer Cask Vertical Drop onto HI-STORM Mating Device

This drop is postulated to occur when the transfer cask, loaded with spent fuel, has been moved outdoors through the Fuel Building doors and is suspended above the HI-STORM overpack with the mating device installed. The transfer cask is assumed to drop vertically onto the mating device after disengagement of the redundant crane links.

9.1.4.3.2.7 Loaded MPC Vertical Drop Into The Overpack During MPC Transfer Operations

This drop is postulated to occur in the outside cask crane structure after the transfer cask has been secured to the mating device and the MPC is being transferred vertically into the overpack. The MPC is assumed to drop vertically into the empty overpack.

The shipping and transfer cask drop analyses shows that there are no unacceptable effects caused by the free fall of the cask at any point along the path of the main hoist's travel. The evaluation criteria of NUREG-0612, Section 5.1, are satisfied. None of the postulated cask drops result in the release of radioactivity. There is no damage to fuel or fuel storage racks since the SFCT main hook position is fixed at the midpoint between the trolley rails and thereby prevents the cask from being handled over the fuel storage pool or its walls. As shown in Fig. 9.1-9, rail stops prevent travel of the main hoist over the lower fuel transfer pool or its walls. None of the postulated drops cause damage that result in water leakage from the fuel storage pool. No damage to safe shutdown equipment or degradation in safe shutdown capability is experienced due to any of the postulated drops. As shown in Fig. 9.1-9, the cask does travel over a pipe tunnel (Position 3) which contains safety-related electric cable and one safety-related pipe. However, analysis of the postulated drop shows that the reinforced concrete member does not collapse or experience generalized failure. Localized spalling of the concrete may occur, but it will be contained by metal decking and therefore is not considered capable of disabling the safety-related pipe or electric cable. The postulated cask drops at Positions 4 and 5 (Fig. 9.1-9) do not result in unacceptable damage to the reinforced concrete member or slab. A cask drop at either of these positions can be expected to cause localized chafing of the concrete at the impact point; however, analysis shows that structural integrity is maintained and no collapse, structural failure, or breach of the adjacent walls is caused.

A cask drop in the outside cask crane structure area does not result in any unacceptable damage since the cask's fall is either onto a cask transporter for off-site shipping or the HI-STORM mating device for on-site storage at the ISFSI pad and does not impact any fuel building structural members.

The fuel handling accident involving a fully loaded spent fuel cask is addressed in Section 15.7.5.

•→2

The fuel building bridge crane is seismically qualified and is provided with seismic restraints to prevent the trolley and bridge from leaving the rails during a seismic event.

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The RBPC is designed and fabricated so that no component becomes detached during a seismic event. The crane bridge and trolley are designed and fabricated so that they do not leave their rails during a seismic event. The RBPC is not designed to be operable during or after a seismic event. An analysis was performed to determine the structural consequence of dropping the RPV head during maintenance operations. It was postulated that the vessel head would be dropped from a height of approximately 40 ft above the vessel-head flange, and that at impact, the head would be rotated 90 deg from the in-place orientation causing a point impact on the vessel.

The vessel loads due to the postulated impact were determined by dynamic, elastic perfectly-plastic finite element analysis.

The most serious consequence resulting from an accidental drop of vessel head would be severe plastic deformations of the vessel top flange. This accident does not produce any vessel leaks or result in the release of radioactive material.

A polar crane load drop analysis was performed on the remainder of containment to verify that consequences of a load drop do not jeopardize the ability to safely shut down the plant or result in the release of significant amounts of radioactivity. The polar crane load drop analysis evaluated the effects of postulated load drops on both the concrete and the steel framing areas of the refueling floor at el 186 ft-3 in. The following considerations were applied in performing this analysis:

•→2

1. The plant is assumed to be in a stable cold shutdown condition, with the exception of the placement and removal of the RWCU filter demineralizer shield plugs, which may be performed during plant operation. Administrative procedures govern the lifting of the shield plugs to a maximum of 12 in. above the concrete floor and a limited area of travel directly adjacent to and over the RWCU filters. (Note: In addition to the RWCU filter demineralizer shield plugs, load drop analyses were performed/reviewed for the lifting of restrictive loads during Operational Modes 1, 2, and 3. (ie. RPV Head stud tensioners, Refueling Platform mast, and/or loads not exceeding 3 tons excluding the weight of the load block, but including the weight of the rigging.) The results of these analyses/reviews indicated that the conditions were bounded by previous governing scenarios. Administrative procedures govern the lifting of all loads permitted during Modes 1, 2, and 3, and are performed within limited lift areas, along safe load paths, and employ redundant administrative controls.)

2←•

2. No credit was taken for the polar crane's dynamic lowering feature, main hoist speed sensing control, or multiple independent braking systems.

3. Drop analyses were based on elastic-plastic curves that represent a true stress-strain relationship.

4. All energy of each postulated drop was assumed to be absorbed by the impacted structure.

5. All loads were assumed to be completely rigid and to experience no deformation during impact.

6. All postulated load drops assumed impact in a manner that would inflict the most damage.

7. Administrative procedures prohibit the travel of any heavy load over fuel stored in the containment fuel pool.

8. Impact loads of the postulated drops included the weight of the load, any lifting apparatus, and the crane load block.

The load drop was divided into two parts. The first part evaluated the effects of postulated drops onto the concrete areas of the refueling floor. The concrete areas consist of the upper containment pools, the RPV head storage position, and a portion of the drywell head storage position. The second part evaluated effects of postulated drops onto the drywell head and RPV head insulation support storage areas which are supported by structural steel members. The results of these analyses are discussed below.

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The concrete structures were analyzed for postulated drops of the RPV head, drywell head, steam separator, and steam dryer. Each structure was analyzed to determine its energy-absorbing capacity and structural response within limiting deformation ranges. The postulated load drops were assumed to occur at various points along the load's travel path, and the structures were analyzed in order to verify that the resulting ductility ratios were less than 10. This ensures that the structure has sufficient energy-absorbing capacity to withstand the postulated drop without having unacceptable damage. Administrative controls ensure that each load-handling evolution involves only a vertical lift from its origin to its transport height, a horizontal movement of the trolley to the load's destination, and a vertical lowering of the load. The analysis concluded that the evaluation criteria of Section 5.1, of NUREG-0612 were satisfied, as follows:

1. The drywell head storage floor is structurally adequate to withstand a drop of the drywell head from a maximum height of 2 ft above its concrete slab at el 186 ft-3 in.

2. The RPV head storage floor is structurally adequate to withstand a drop of the RPV head from a maximum height of 6 ft above its concrete slab at el 186 ft-3 in.

3. The impact of the RPV head on the concrete plugs on the east side of the refueling floor could cause these plugs to fail and generate secondary missiles immediately below into the reactor water cleanup (RWCU) filter cubicle. However, this will not degrade the capability to maintain safe shutdown because the RWCU system can be isolated and is not required to operate to maintain safe shutdown.

4. A drop of the RPV head from its maximum lift height of 6 ft above the refueling floor into the refueling cavity causes structural damage to the cantilever overhang of the drywell roof. This cantilever is located at the interface of the refueling cavity floor at el 162 ft-3 in with the refueling seal. However, the RPV head may ultimately strike the top flange of the RPV. Neither the impact on the RPV top flange nor the structural failure of the drywell roof cantilever degrades the capability to maintain safe shutdown.

5. The drop of the RPV head from its maximum height into the drained refueling cavity envelops any postulated drops of the steam dryer or steam separator. This is due to two factors:

   a. The RPV head with its attached carousel (total weight = 84 tons) is the heaviest load handled by the polar crane.

   b. The RPV head drop into the drained refueling cavity is not diminished by the drag effects of water as in the case of the steam dryer and steam separator.

•→10

6. None of the postulated drops degraded the plant's ability to maintain safe shutdown or resulted in a release of radioactivity to the environment. A drop into the refueling cavity of any of the loads considered in this analysis may damage the RHR piping and spargers located there, but shutdown cooling could be accomplished using the RHR connection to the feedwater system or the alternate shutdown cooling method (refer to Section 5.4.7.1.5).

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7. None of the postulated drops result in damage that would cause the vessel core to become uncovered.

8. By inspection, the impact of the limiting load on the pool boundary walls may degrade leaktightness of the upper pool walls. However, leaktightness of the boundaries is not a requirement to maintain the reactor in a safe shutdown condition.

9. A postulated drop of the drywell head from a height of 2 ft above the fuel pool valve room roof at el 186 ft-3 in could result in spalling of concrete from the underside of the roof. However, this spalling would not result in damage to any components which are required to maintain safe shutdown.

Calculations were performed to evaluate the ability of the structural steel to withstand drops of the drywell head and the RPV insulation support frame. The calculations demonstrated that the postulated drops could overstress the impacted steel members and collapse the supporting framework. Although a progressive failure of structural steel in the path of the postulated drops is not considered likely, this possibility was evaluated for its effect on the plant's ability to maintain a safe shutdown condition. The evaluation considered a postulated drop resulting in the drywell head or the RPV insulation support frame falling through the refueling floor structural steel and impacting in the suppression pool. The evaluation concluded that the criteria of Section 5.1, NUREG-0612 were satisfied, as follows:

1. Both RHR loops A and B would remain functional to conduct shutdown cooling operations by taking suction from the recirculation system piping and returning the coolant to the reactor via the feedwater piping. Neither the common suction line from the recirculation loop nor the separate RHR connections to the feedwater piping are located beneath the travel path of the drywell head or the RPV insulation support frame.

2. RHR loops B and C would remain functional for alternate shutdown cooling operations. RHR loop A could sustain sufficient damage to its suction piping in the suppression pool to preclude its operation in this mode.

3. Due to damage to supply piping that serves the refueling cavity spargers, RHR loops A and B would lose the capability to return shutdown cooling water to the RPV via the spargers in the refueling cavity. However, this loss would not degrade the plant's ability to maintain safe shutdown because the shutdown cooling paths described in 1 and 2 above are still available.

4. None of the postulated drops result in releases of radioactivity to the environment that exceed the NUREG-0612 recommended dose of less than one quarter of the 10CFR100 reference values. Amendment 132 revised the design basis accident (DBA) source term to the alternate source term (AST). As a result the DBA dose limit requirements were revised from 10CFR100 to 10CFR50.67 and the design basis accidents were reevaluated using the methodology in Regulatory Guide 1.183 which supercedes Regulatory Guides 1.3, 1.5, and 1.25. Regulatory Guide 1.183 does not require the reevaluation of the heavy load analysis, therefore, the acceptability criteria of less than one quarter of 10CFR100 dose limits is unchanged by Amendment 132.

5. None of the postulated drops would result in damage that would cause the vessel core to become uncovered.

In summary, all of the postulated drops could cause damage to the reactor building structures and systems (piping, cable trays, instruments, etc). However, this analysis indicates that none of the drops will degrade the capability to maintain the reactor in a safe shutdown condition.

Safe load paths will be defined in accordance with the guidelines of Section 5.1.1(1) of NUREG-0612.

•→8 •→4
The fuel prep machines can be used to remove and install channels with all parts remaining under water. Mechanical stops prevent the carriage from lifting irradiated fuel above the safe water shield level.
4←• 8←•
There are no nuclear safety problems associated with the handling of new fuel bundles, singly or in pairs. Equipment and procedures prevent an accumulation of more than two bundles in any location.
•→8 •→4
The refueling platform is designed to prevent it from toppling into the pools during an SSE. Redundant safety interlocks and position encoders are provided to prevent accidentally running the grapple into the pool walls. The grapple utilized for fuel movement is on the end of a telescoping mast. At the normal up position of the mast, the fuel is below the safe water shield, so there is no chance of raising a fuel assembly to the point where it is inadequately shielded by water. The grapple is hoisted by redundant cables inside the mast and is lowered by gravity. A digital readout is displayed to the operator, showing him the coordinates of the grapple over the core.
4←• 8←•
The mast is suspended and gimbaled from the trolley, near its top, so that the mast can be swung about the axis of platform travel in order to remove the grapple from the water for servicing and for storage.
•→16
The grapple has two independent hooks, each operated by an air cylinder. Engagement is indicated to the operator. A "slack cable" signal from the lifting cables indicates that the fuel assembly is seated to allow the grapple to be disengaged.

In addition to the main hoist on the trolley, there is an auxiliary hoist on the trolley, and another hoist on its own monorail. These three hoists are precluded from operating simultaneously because control power is available to only one of them at a time. The two auxiliary hoists have load cells with a 500 lb. interlock which prevent the hoists from moving anything as heavy as a fuel bundle during normal use.
•→8 •→4
The two auxiliary hoists have electrical interlocks which prevent the lifting of their loads above the safe water shield level. Redundant electrical interlocks (LS1 and LS2) and Administrative procedures are in place to preclude the possibility of raising radioactive materials out of the water. In addition to the maximum-up Limit Stop (LS3), the cables on the auxiliary hoists incorporate an adjustable, removable stop that jams the hoist cable against part of the platform structure to prevent equipment damage.
4←• 8←• 16←•

Administrative procedures and training are provided to control the handling of objects over the spent fuels in both the containment and spent fuel buildings. An evaluation was performed to determine the maximum kinetic energy that could be attained by objects accidentally dropped over spent fuel either in the fuel building spent fuel pool, the upper containment pool, or the reactor core when the reactor vessel head is off. This evaluation included various refueling equipment and tools, subassemblies and components of fuel assemblies, and other objects, as tabulated in Tables 9.1-7, 9.1-8, and 9.1-9. The evaluation shows the following:

•→2

1. In the fuel building (Table 9.1-7), the kinetic energy of any dropped object does not exceed that of a channeled fuel assembly as described in Section 15.7.4, with the exception of new fuel when being transported by the fuel building bridge crane. The consequences of dropping a new fuel assembly from this crane has been evaluated using the same assumptions as the design basis analysis presented in section 15.7.4. From a radiological release standpoint, the section 15.7.4 design basis analysis is limiting since more irradiated fuel rods would be damaged 123 compared with 99 irradiated rods damaged as a result of dropping a new fuel assembly.

2←•

2. In the containment (Tables 9.1-8 and 9.1-9), certain objects can attain higher kinetic energies than a dropped channeled fuel assembly. However, the drop of a channeled fuel assembly produces the largest number of failed spent fuel rods. An analysis of the radiological consequences of the most severe fuel handling accident is provided in Section 15.7.4.

In summary, the fuel handling system complies with General Design Criteria 2, 3, 4, 5, 61, 62, and 63, applicable portions of 10CFR50, and Regulatory Guide 1.13. In addition, procedures and training, inspection and maintenance programs will be developed in accordance with Section 5.1 and NUREG-0612.

A system-level, qualitative-type failure mode and effects analysis relative to this system is discussed in Section 15A.6.5.

The safety evaluation of the new and spent fuel storage is presented in Sections 9.1.1.3 and 9.1.2.3.

9.1.4.4 Inspection and Testing Requirements

9.1.4.4.1 Inspection

Refueling and servicing equipment is subject to the controls of QA required for their safety class. Components defined as essential to safety, such as the fuel storage racks, refueling platform, and fuel transfer tube have an additional set of engineering specified, quality requirements that identify safety-related features which require specific QA verification of compliance to drawing requirements.

For components classified as ASME Section III, the shop operation must secure and maintain an ASME "N" stamp, which requires the submittal of an acceptable ASME quality plan and a corresponding procedural manual.

Additionally, the shop operation must submit to frequent ASME audits and component inspections by resident state code inspectors.

Prior to shipment, every component inspection item is reviewed by QA supervisory personnel and combined into a summary product quality checklist (PQL). By issuance of the PQL, verification is made that all quality requirements have been confirmed and are on record in the product's historical file.

9.1.4.4.2 Testing

Qualification testing is performed on refueling and servicing equipment prior to production. Test specifications are defined by the responsible design engineer and may include sequence of operations, load capacity, and life cycles tests. These test activities are performed by an independent test engineering group and, in many cases, a full design review of the product is conducted before and after the qualification testing cycle. Any design changes affecting function, that are made after the completion of qualification testing, are requalified by test or calculation.

Functional tests are performed in the shop prior to the shipment of production units and generally include electrical tests, leak tests, and sequence of operations tests.

When the unit is received at the site, it is inspected to insure no damage has occurred during transit or storage. Prior to use and at periodic intervals, each piece of equipment is again tested to ensure that the electrical and/or mechanical functions are operational.

Passive units, such as the fuel storage racks, are visually inspected prior to use.

Fuel handling and vessel servicing equipment preoperational tests are described in Section 14.2.12.1.12.

9.1.4.5 Instrumentation Requirements

The majority of the refueling and servicing equipment is manually operated and controlled by the operator's visual observations. This type of operation does not necessitate the need for a dynamic instrumentation system. However, there are several components, that are essential to prudent operation, that do have instrumentation and control systems.

9.1.4.5.1 Refueling Platform

•→8

The refueling platform has a nonsafety-related X-Y-Z position indicator system that informs the operator which core fuel cell the grapple is accessing. A zone computer receives X-Y-Z position information and provides indication to the operator if platform position has reached a safe zone boundary.

Interlocks and a main control room monitor are provided to prevent the fuel grapple from operating in a fuel cell where the control rod is not in the proper orientation for refueling. Refer to Section 7.7.1.5 for discussion of refueling interlocks.

•→4

Additionally, there is an electronic load cell and mechanically activated switches and relays that provide monitor indications on the operator's console for grapple limits, hoist and cable load conditions, and confirmation that the grapple's hook is either engaged or released.

A separate load cell is installed to provide automatic shutdown whenever threshold limits are exceeded on the fuel grapple or auxiliary hoist units.

4←• 8←•

9.1.4.5.2 Fuel Support Grapple

Although the fuel support grapple is not essential to safety, it has an instrumentation system consisting of mechanical switches and indicator lights. This system provides the operator with a positive indication that the grapple is properly aligned and oriented and that the grappling mechanism is either extended or retracted.

9.1.4.5.3 Inclined Fuel Transfer Tube

The instrumentation sensors for this system provide the inputs to a programmable controller that automatically sequences the opening and closing of valves, the inclination and vertical upending of the fuel carriage, water levels, and the carriage traversing speeds.

The microprocesser control and proximity type sensors also provide monitor and status conditions of the fuel transfer operation on each of the two operator consoles, one located in the fuel building and the other on the RPV refueling floor. Monitor indicators are provided in the control rooms and interlocks are provided to indicate whenever personnel have accessed radiation hazardous areas along the transfer tube's route.

9.1.4.5.4 Other

Refer to Table 9.1-1 for additional refueling and servicing equipment not requiring instrumentation.

9.1.4.5.5 Radiation Monitoring

The radiation monitoring equipment for the refueling and servicing equipment is identified in Sections 11.5 and 12.3.4.

References 9.1

1. NRC letter from Mr. Brian K. Grimes, Assistant Director for Engineering and Projects, Division of Operating Reactors addressed to all Power Reactor Licensees, dated April 14, 1978.

2. TGBLA06A, General Electric Lattice Physics Method, GE Report, October 1994.

3. American Welding Society Publication C1.1 1966, Recommended Practices for Resistance Welding.

4. American Nuclear Society, American National Standard, Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations, ANS 57.2, ANSI N210 1976, April 12, 1976.

•→9

5. "SCALE 4 A Modular Code System for Performing Standardized Computer Analysis for Licensing Evaluation," CCC 545, NUREG/CR 0200 Rev 4 (ORNL/NUREG/CSD 2/R4) Vols. I, II and III, Oak Ridge National Laboratory, February 1990.

6. "CASMO: A Fuel Assembly Burnup Program," Studsvik.

9←•

9.2 WATER SYSTEMS

9.2.1 Normal Service Water System

•→6

The normal service water system provides cooling water to remove heat from turbine and reactor plant auxiliary systems and components during all modes of plant operation. It is cooled by the service water cooling system as described in Section 9.2.12. The normal service water system operates during normal plant operation, as described in this section. In emergency situations, the safety-related standby service water system operates as described in Section 9.2.7.

The service water system is shown on Fig. 9.2-1a through 9.2-1h. Table 9.2-1 lists the flow requirements for the normal service water system.

6←•

9.2.1.1 Design Bases

The normal service water system is designed in accordance with the following criteria:

•→6

1. A normal service water system is designed to provide cooling water to the secondary side of the reactor plant component cooling water (RPCCW) and turbine plant component cooling water (TPCCW) heat exchangers and plant chilled water systems during normal plant operation and planned unit outages.

6←•

2. It is also designed to supply cooling water to the residual heat removal (RHR) heat exchangers to dissipate reactor decay heat when the standby service water system is not in use.

3. The normal service water system components are designed in accordance with the safety classification listed in Table 3.2-1.

4. The normal service water system is designed to remove the heat load listed in Table 9.2-1.

•→6

5. The normal service water system cooling water is cooled in the service water system heat exchangers, which are cooled by the service water cooling system described in Section 9.2.12.

6←•

•→15

6. The normal service water system will provide the source of cooling water for all plant systems and components required for safe shutdown of the reactor in the event of a fire in Fire Area PT-1 (E, F & G-Tunnels).

15←•

9.2.1.2 System Description

•→6

The normal service water system utilizes three 50-percent capacity, motor-driven, horizontal pumps. These pumps each have a capacity of approximately 31,500 gpm. Normal service water is pumped from the service water system heat exchangers. Each normal service water system pump takes suction from the service water system heat exchanger common discharge header/pump suction header and discharges into the normal service water system pump discharge header/common system supply header.

A surge/expansion tank (1SWP-TK3) is provided on the suction side of the normal service water pumps. This tank allow for thermal expansion in service water. A pressurized N^2 blanket is provided to minimize oxygen ingression into the water and to minimize the amount of service water piping subjected to a vacuum and the degree of vacuum when no NSW pumps are running. Level in the tank is controlled by MWS-A0V53 located on the 95' el in the Turbine building. This valve auto opens on low level in the tank to inject demineralized water from the demineralized makeup water system (MWS) into the NSW return piping upstream of the CCS heat exchangers. The valve closes on high level in the tank. Manual control of the A0V is available in the main control room.

6←• •→12

The normal service water supply header is routed to a point outside the turbine building where the main header branches into two supply headers. One supply header branch is routed to the turbine building, while the other supply header branch is routed to the radwaste building and auxiliary building, control building, standby diesel generator building, and reactor building.

•→6

The turbine building branch supply header supplies the three TPCCW heat exchangers, three air-conditioning water chillers, four generator hydrogen coolers, one alternator cooler, two EHC coolers, and two turbine lube oil coolers. The return from each of these components is routed to a return header which returns the service water to the service water system heat exchanger inlet header.

•→10

The second branch supply header, supplies three radwaste/fuel building chiller condensers, three RPCCW heat exchangers, suppression pool cleanup, cooling, and alternate decay heat removal heat exchanger, auxiliary building unit coolers, four main control room air-conditioning water chillers, two RHR heat exchangers, three standby diesel generator jacket water coolers, and six drywell unit coolers. The return from each of the radwaste building, auxiliary building, drywell, and control building components is routed to a header which returns the service water to the service water system heat exchanger inlet header.

10←• 12←•

Major component design data is listed in Table 9.2-1.

During normal operation and unit cooldown, two of the three normal service water pumps are required to dissipate the auxiliary heat loads. The third is a spare to accommodate maintenance or failure of either of the two operating pumps.

•→16 •→12 •→8 •→3

The water quality of the service water system is controlled in order to minimize scaling, corrosion and biological fouling. This is accomplished by injecting multifunctional chemicals as required.

3←• 8←• 12←• 16←• •→9 •→6 •→2

During normal plant operation, the treated normal service water flows at a nominal rate of approximately 50 GPM from the normal service water supply and return headers located in the piping tunnels up to within close proximity of the standby cooling tower and then back into the normal service water system return headers to inhibit corrosion and organic fouling within the standby service water headers which are normally on standby. The flow path of treated normal service water is accomplished by using small bore piping cross-ties between the Divisions 1 and 2 standby service water supply and return headers. The normal service water supply and return header differential pressures and orifices in the cross-ties are used to establish the flow rate of treated normal service water through the standby service water supply and return headers.

Some of the treatment chemicals may be activated when the treated water passes through the drywell unit coolers. The drywell unit coolers are exposed to neutron leakage and scatter from the core during normal operation. These neutrons interact with the chemical constituents sodium and molybdenum which are then activated to their radioactive forms. For example, natural sodium (Na) is composed of the Na-23 which can be activated by neutron capture to Na-24. The radiological impact of service water leakage on normal plant effluents is negligible.

2←• 6←• 9←•

•→6 •→2
Piping wall thicknesses are increased over standard design requirements by corrosion allowance of 0.125, to ensure against degradation of system performance due to the effects of long-term corrosion, is provided for all piping but the 48-in header between the normal service water pumps and the turbine building. For this piping, a program of corrosion monitoring is provided to detect corrosion problems before the minimum pipe wall thickness is compromised (see Section 9.2.1.4). Additionally, the water in the normal cooling water system is chemically treated and protective coatings are applied to the internals of certain components to control corrosion.
2←• 6←•

9.2.1.3 Safety Evaluation

The normal service water system is a non-nuclear safety system. Upon complete loss of normal service water, the plant is shut down. Cooling water for safe shutdown and maintenance of the safe shutdown condition is provided by the standby service water system (Section 9.2.7).
•→12
The normal service water headers in the turbine building and radwaste building can be isolated from the safety-related lines in the auxiliary, diesel generator, control, and containment buildings by automatic block valves and check valves in the normal service water supply header, and automatic block valves in the normal service water return header. These valves are Safety Class 3, except the containment isolation valves which are Safety Class 2. Piping within the auxiliary building, diesel generator room, control building, and reactor containment is common to the normal service water and standby service water systems. This piping is Safety Class 3, Seismic Category I.
12←•
Automatic isolation of the normal service water supply and return headers serving the auxiliary, control, and diesel generator buildings allows standby service water to cool essential components within these buildings under all accident conditions.

Analysis of postulated cracks in moderate-energy piping systems is covered in Section 3.6.

•→15
A fire in Area PT-1 (E, F & G-Tunnels) could potentially render the standby service water system inoperable. Normal service water and its required support systems (including the necessary portions of the Off-Site Power Distribution System) has been analyzed to remain free from fire damage during a fire in Fire Area PT-1. In this area only, normal service water is credited for cooling the required safe shutdown systems and components.
15←•

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9.2.1.4 Testing and Inspection Requirements

•→11 •→8A •→8 •→4

The normal service water pumps are proven operable during continuous plant operation. Selection of the two operating and one spare pump is rotated periodically to equalize wear. A SWP corrosion rack including materials used throughout the SWP System is installed in the plant in the piping tunnel to monitor and trend corrosion rates of various SWP materials. The coupon rack is designed to simulate various piping and components in the system including various flow rates and temperatures. Also, an instrument rack is connected to the coupon rack. The instrument rack provides connections for in-line instrumentation to further monitor Normal Service Water chemistry.

4←• 8←• 8A←• 11←•

9.2.1.5 Instrumentation Requirements

•→6

Normal service water system pump discharge header pressure and temperature are monitored in the main control room, and controls are provided for automatic startup of a third pump on low service water header pressure or automatic trip of either one of the two running pumps. Low and extreme low header pressure alarms are provided in the main control room. Pump suction pressure switches are provided to inhibit pump start or trip operating an operating pump on low suction pressure. Interlocks are provided to prevent the startup of a service water pump unless its discharge valve is partially open. Control switches are provided in the main control room as well as locally on the switchgear for manual operation of the normal service water pumps.

6←•

Automatic transfer from the normal service water system to the standby service water system is described in Section 9.2.7.5.

Control valves are provided at the outlets of the following coolers for controlling the process-side temperatures:

1. Main turbine lube oil coolers
2. Main alternator casing cooler
3. EHC coolers.

The temperature of the service water leaving the TPCCW heat exchangers is monitored.

Control valves are provided in the service water system for controlling the temperature of the control building, radwaste/fuel building, and turbine building chilled water chiller condensers. Local controls are provided for manual operation of the turbine building chiller condenser service water recirculation pumps and inlet valves. Manual control switches are provided in the auxiliary control room for operation of the radwaste/fuel building chiller condenser service water recirculation pumps and inlet valves. Control switches are provided in the main control room for automatic and manual operation of the control building chiller condenser service water recirculation pumps.

•→12 •→6

Service water system flow (Normal or Standby) to each RHR heat exchanger and the temperature of the service water leaving each RHR heat exchanger unit are monitored in the main control room. The radiation level of the service water leaving the RHR heat exchangers is monitored, and high radiation level alarms are provided in the main control room. Manual control switches are provided in the main control room for opening and closing a valve in the service water line at the outlet of each RHR heat exchanger.

6←• 12←•

Manual control switches are provided in the main control room for opening and closing isolation valves located in the service water supply and return lines of the HPCS diesel generator coolers.

Manual control switches are provided in the main control room for opening and closing containment isolation valves located in the service water supply and return lines of the drywell unit coolers. The supply valves automatically close on a LOCA signal. The drywell coolers are provided with temperature control valves in the cooler outlet water line for controlling the process temperature.

The temperature of the service water leaving the standby diesel generator coolers is monitored. A high temperature alarm is provided in the main control room. Service water flow to the HPCS diesel generator cooler is monitored, and a low flow alarm is provided in the main control room.

Manual control switches are provided in the main control room for opening and closing isolation valves located in the service water supply and return lines of the RPCCW heat exchangers.

9.2.2 Reactor Plant Component Cooling Water System

The reactor plant component cooling water (RPCCW) system provides cooling water to reactor auxiliary system equipment and accessories during normal plant operation and is shown in Fig. 9.2-2a and 9.2-2b.

9.2.2.1 Design Bases

The RPCCW system is designed in accordance with the following design bases:

1. The safety-related components of the RPCCW system include piping and associated equipment supplying cooling water to the residual heat removal (RHR) pumps and fuel pool coolers. This safety-related portion of the RPCCW system is designed to Seismic Category I and Safety Class 3 requirements and has sufficient redundancy and protection to meet the single-failure criterion.

2. The remainder of the RPCCW system, including pumps, heat exchangers, and surge tank, is nonnuclear safety (NNS). The component cooling water portions of the reactor recirculation pumps are not required to be Seismic Category I since the pumps do not perform a safety function. However, the piping is seismically supported. Interruption of coolant to the recirculation pumps does not result in unacceptable consequences.

3. Remotely actuated valves are provided in the component cooling water system to isolate the piping which is not safety related from that which is safety related.

4. The RPCCW system is designed to provide a closed cooling water loop between potentially radioactive systems and the service water system used for cooling.

5. The RPCCW system is designed as a single unit system and does not share functions, piping, or equipment with other units.

6. System containment penetrations and isolation valves are designed to meet Seismic Category I and ASME Section III, Class 2 requirements. The process piping to and from the fuel pool coolers and RHR pump seal coolers, including the component isolation valves, is designed to meet Seismic Category I and ASME Section III, Class 3 requirements. The remainder of the system is designed to ANSI B31.1, TEMA, NEMA, and ASME Section VIII Codes and Standards as applicable. The RPCCW system also meets the requirements of 10CFR50, Appendix A, GDC 44, 45, 46, 54, and 57; and is designed according to the River Bend Station positions on Regulatory Guides 1.26, 1.29, 1.46, and 1.53 as applicable.

7. The safety-related components of the RPCCW system are located within plant structures which are designed to protect against the effects of adverse external environmental conditions as discussed in Sections 3.3, 3.4, 3.5, and 3.7. Protection is provided from the effects of internally generated missiles as described in Section 3.5. In addition, Section 3.6 and Appendix 3C address, respectively, the ability of the safety-related portions of the system to withstand the effects of both high energy pipe breaks and moderate energy pipe cracks and the resultant internal flooding. Section 3.11 addresses the qualification of safety-related components to specified internal environmental conditions such as pressure, temperature, humidity, and radiation.

9.2.2.2 System Description

The system is a closed-loop design and consists of three 50 percent flow cooling water pumps, three 50 percent capacity heat exchangers, one system surge tank, redundant headers in that portion of the system which is shared with the standby service water (SSW) system, piping, valves, and instrumentation. The component cooling water is circulated through the shell side of the RPCCW heat exchangers and system heat is transferred to the service water flowing through the tubes. The system capacity is based on the maximum heat load which could occur during normal plant operations. Tables 9.2-2 and 9.2-3 provide RPCCW system component description and the heat loads and equipment parameters for normal plant operation and for post-accident conditions. These numbers are based on 105°F RPCCW heat exchanger outlet temperature for normal operation and 95°F standby service water supply temperature following an accident.

Cooling water to the RHR pump seal coolers and fuel pool coolers, in addition to being supplied by the RPCCW system, is also supplied by the SSW system whose operation is initiated by the operator upon low pressure detected in either of the two redundant headers that service safety-related equipment.

During normal operation and accident conditions, two pumps and two heat exchangers provide the required cooling capacity for the heat load of the system with the remaining pump and heat exchanger in standby. During low heat load periods, i.e., extended shutdown, one pump and one heat exchanger in operation are sufficient.

Equipment which may be operated during a loss of offsite power condition is supplied cooling water through lines branching off a single header. This header is connected to two redundant supply headers through normally open motor-operated isolation valves which are closed automatically upon receipt of low water pressure signals in the safety-related portions of the system. The components supplied under plant normal and upset conditions are:

1. Control rod drive (CRD) pump lube oil cooler

2. Reactor coolant recirculation pump coolers for upper motor bearing, lower motor bearing, motor windings, and pump seal

3. RWCU pump seal, motor bearing, pedestal, and cover coolers

4. RWCU nonregenerative heat exchangers

5. Reactor building sample coolers

6. Drywell equipment drain sump cooler

7. RHR pump seal coolers

8. Fuel pool coolers

•→12

9. Reactor plant sampling panel.

12←•

The RPCCW system pumps, heat exchangers, and surge tank are located in the auxiliary building. The CRD pumps and fuel pool coolers are located in the fuel building. RHR pumps and RWCU pumps are located in the auxiliary building and the remainder of the equipment listed is located within the containment.

During loss-of-coolant accident (LOCA), with adequate RPCCW pressure, the RPCCW system supplies cooling water to the following equipment:

1. Fuel pool coolers

2. RHR pump seal coolers

3. RWCU pump coolers

4. Control rod drive pump lube oil coolers.

The remaining equipment serviced by the RPCCW system is isolated.

When low water pressure is sensed at either of the RPCCW redundant supply headers, the standby service water pumps are automatically started and the operator is required to manually open the standby service water supply and return valves to the RPCCW system. The RPCCW system is then supplied with standby service water through redundant supply headers. This mode of operation supplies only the following equipment:

1. Fuel pool coolers

2. RHR pump seal coolers.

The remaining equipment normally serviced by the RPCCW system is automatically isolated in this situation with the exception of the RWCU pumps.

Equipment required to operate during accident conditions is supplied with cooling water by means of parallel take-offs from redundant headers. The redundant supply and return headers are connected to the SSW system through normally closed motor-operated isolation valves. The redundant safety-related supply headers are isolated from the nonsafety portion of the RPCCW system by means of check valves (one in each header) in series with normally open motor-operated isolation valves located in the RPCCW heat exchanger discharge headers. The redundant safety-related return headers are isolated from the nonsafety-related portion of RPCCW system by two normally open motor-operated isolation valves.

Single inlet and outlet connections are provided for each RHR pump seal cooler and fuel pool cooler. Since the cooling lines are designed to Seismic Category I requirements, Safety Class 3, failure of one RHR cooling line or one of the two redundant headers would constitute a single failure. This failure would be survived by the redundant cooling header and the associated safety-related components; hence, these essential components would continue to perform their required functions.

Temperature control of the cooling water is established by bypassing part of the component cooling water flow around the RPCCW heat exchangers. A full flow bypass line with a temperature control valve is provided to regulate flow through the heat exchangers to maintain the desired system temperature. The bypass temperature control valve is designed to fail closed. A normally closed, manually operated globe valve is provided to bypass the temperature control valve during control valve malfunction.

The standby RPCCW system pump starts automatically upon electrical trip of one running pump or low pressure in the pump discharge header. The RPCCW system pumps and heat exchangers do not have a safety function; therefore they are not required to be in operation to ensure the safe shutdown of the reactor.

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The RPCCW surge tank is pressurized with nitrogen in order to inhibit the introduction of oxygen into the system and thereby reduce piping corrosion caused by active oxygen attack. Chemical additives may be used to inhibit corrosion.

6←•

Makeup water for the RPCCW system is supplied from the makeup demineralized water storage tank to the RPCCW system surge tank by a connection from the makeup demineralized water transfer pump. The RPCCW system surge tank is readily accessible during normal unit operation for level adjustment. The surge tank accommodates system volume changes resulting from coolant expansion and contraction. The surge tank is physically located above the RPCCW pumps and pressurized with nitrogen to provide the pumps sufficient net positive suction head (NPSH).

Containment isolation valves are discussed in Section 6.2.4.

Thermal relief valves are provided on all equipment which might be overpressurized by a combination of closed component cooling water inlet and outlet valves and heat input from the isolated equipment.

9.2.2.3 Safety Evaluation

A single failure of a safety-related component of the RPCCW does not cause loss of a safety function of either RHR pumps or fuel pool coolers. There are two redundant SSW headers supplying two safety-related redundant portions of the RPCCW system. Complete loss of either header does not affect the circulation of water through the other header. All the containment isolation valves connect to onsite standby ac power systems (Section 8.3). The RPCCW pumps are not required to be in operation to shut down the reactor.

During normal operation, two component cooling pumps and two component cooling heat exchangers can accommodate the heat removal load. The third pump and heat exchanger provide redundancy so that in the event of a pump or heat exchanger failure, a replacement component is available.

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A radiation monitor is provided in the RPCCW System to detect leakage into this system from a radioactive system. Excessive leakage from the system, indicative of a large break, is detected by pressure instrumentation in the system supply headers downstream of the RPCCW heat exchangers. Smaller leaks are detected by observing an abnormally high number of makeup cycles to the RPCCW surge tank.

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Portions of the RPCCW system that penetrate the containment and drywell are provided with isolation valves that can be remotely actuated by the operator in the main control room and that close automatically on a LOCA signal.

Components with a single barrier between the RPCCW system and the reactor primary coolant system are:

1. Sample coolers for the reactor recirculation system and the RWCU system

2. Fuel pool cooling subsystem coolers

3. RWCU system nonregenerative heat exchangers.

Operating pressure and temperatures for these components during normal and shutdown modes are as follows.

Equipment	Normal Operation: Operating Temperature (°F)	Normal Operation: Operating Pressure (psig)	Shutdown Mode: Operating Temperature (°F)	Shutdown Mode: Operating Pressure (psig)
•→15 Reactor recirculation system sample coolers	538	1325.6	100	45
RWCU system sample coolers	120	1210	70	180
Fuel pool coolers	125	86	155	86
RWCU nonregenerative heat exchangers	237	1220	70	190

15←•

Gross leakage of the sample coolers does not result in leakage of component cooling water into the reactor coolant system during normal operation. The reactor coolant system is at a much higher pressure, thus precluding backflow of low pressure reactor plant component cooling water. Any reactor coolant system leakage into the cooling water system is detected by the RPCCW radiation monitors. The radiation monitors provide a high radiation alarm in the main control room alerting the operator to isolate the cooling system. During shutdown conditions, gross leakage of the sample coolers would result in leakage of component cooling water to the sample cooler discharge leading to the equipment drain system.

Gross leakage of the fuel pool cooling subsystem coolers does not result in leakage of component cooling water into the fuel pool cooling subsystem during normal, shutdown, and refueling modes. Gross leakage of the fuel pool cooling subsystem coolers could result in leakage of component cooling water to the fuel pool cooling subsystem during emergency operation. However, the fuel pool water quality is monitored so that this potential source of inleakage can be isolated.

Gross leakage of the RWCU system nonregenerative heat exchangers during normal operation does not result in leakage of component cooling water to the reactor coolant system because the reactor coolant system is at a much higher pressure. During shutdown conditions, component cooling water pressure (shell side) is lower than the RWCU system pressure (tube side) and, hence, does not result in leakage of component cooling water to the reactor coolant system. In the event of leakage of component cooling water to the RWCU system, possible inleakage would be treated by RWCU filter-demineralizer units located downstream of the potential inleakage

The consequences of RPCCW system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) Report submitted under separate cover.

9.2.2.4 Testing and Inspection Requirements

Pumps in the RPCCW system are proven operable by their use during normal plant operations. Pump and heat exchanger usage are rotated on a scheduled basis to ensure availability. Motor-operated isolation valves and instruments are tested and calibrated on a periodic basis. The system piping and components are hydrostatically tested prior to initial startup.

9.2.2.5 Instrumentation Requirements

Control switches are provided in the main control room for manual operation of the RPCCW pumps. Control logic is provided so that a low pump discharge header pressure or auto-trip of a running pump automatically starts the standby pump.

The RPCCW header pressure is monitored, and a low header pressure alarm is provided in the main control room.

The outlet temperature of the RPCCW heat exchanger is maintained at its set point by modulating the air-operated RPCCW heat exchanger outlet and bypass temperature control valves (TVY128 and TVX128).

The level in the RPCCW surge tank is monitored and maintained within design limits by operating an air-operated valve in the makeup water line to the surge tank. A low level of water in the surge tank opens the valve and provides a makeup supply rate of 125 gpm. When the water reaches its normal level, the valve closes. Extreme high and low level alarms are provided in the main control room.

Control switches are provided in the main control room for remote manual operation of the supply and return valves on lines serving safety-related equipment. Control logic is provided so that lines serving safety-related equipment are isolated from the RPCCW system upon extreme low water pressure in the safety-related section of the system. This results in the automatic supply of cooling water to safety-related section of the system. This results in the automatic supply of cooling water to safety-related equipment by the SSW system. The supply and return valves to safety-related equipment can be reopened when the low pressure failure switch is reset.

Manual control switches are provided in the main control room for operation of the containment isolation valves. A LOCA signal or a manual containment isolation signal automatically closes the isolation valves.

•→12
The radiation level in the RPCCW system is monitored and a high radiation level alarm is provided in the main control room.
←•12
RPCCW system inoperative alarms are provided in the main control room.

Abnormal temperature and flow conditions in the RPCCW system are monitored by the plant computer.
•→14 •→8
←•8 ←•14
9.2.3 Makeup Water Treatment System

The makeup water treatment system is shown in Fig. 9.2-3, 9.2-4, and 9.2-5.

9.2.3.1 Design Bases

The station makeup water treatment system is designed:

1. To provide makeup water of reactor coolant quality.

2. To provide an adequate supply of treated water for all station operating requirements.

The makeup water treatment system is not safety related and does not convey radioactive fluids.
•→7

Note: In addition to the makeup water treatment system as described in this section, piping connections are provided to utilize a contractor supplied trailer mounted water treatment skid. The trailer unit is normally utilized in lieu of the makeup water demineralizers, to purify the well water prior to transferring to the makeup water storage tanks. The effluent water quality from the trailer unit meets or exceeds the limits specified below.

7←•
At the design makeup flow of 150 gpm per demineralizer train, the makeup demineralizers are expected to produce effluent of at least the following quality:

Constituents	Maximum Limit of Concentration (ppm)
Hardness (as $CaCO_3$)	2.0
Silica (SiO_2)	0.02
Total Iron (Fe)	0.01
Chloride	0.05
Oxygen (O_2)	0.50
pH at 77°F (25°C)	6.5 to 7.5
Conductivity, S/cm (at 25°C)	0.1

The design pressure of each makeup water demineralizer train is 150 psig.

9.2.3.2 System Description

The makeup water treatment equipment is located in the auxiliary boiler and water treatment building at floor elevation 95 ft-0 in.

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The makeup water treatment system consists of two trains each having one cation exchange unit, one vacuum deaerator, two demineralizer forwarding pumps (one for standby operation), one anion exchange unit, and one mixed bed exchange unit. Each train, sized for 150 gpm, provides the normal makeup water requirement for River Bend Station. The system is designed for one train in service or regeneration, and one in standby.

4←• 7←•

Raw water is pumped from two deep wells at 150 gpm each to maintain level in the 100,000-gallon well water storage tank and to maintain level in the standby cooling tower water storage basins (Section 9.2.5). The system is designed to operate with both deep wells operating at their rated capacity to meet peak demands. The 100,000-gallon wellwater storage tank provides sufficient reserve capacity to allow operation of the makeup water treatment system due to the loss of a deep well pump.

Well water is directed to the makeup demineralizer system by three well water transfer pumps (one for standby operation), arranged in parallel, which take suction from the well water storage tank. Discharge from the makeup demineralizers flows to two 350,000-gallon demineralized water storage tanks located outside and adjacent to the Unit 1 turbine building. Makeup water from the demineralized water storage tanks is pumped by three demineralized water transfer pumps (one for standby operation) with a design capacity of 330 gpm each arranged in parallel and distributed to various services, including makeup to the condensate storage tank. Other demineralized water services are as follows:

Fuel pool cooling and cleanup system (purge water to SFC-P2A and SFC-P2B)

Turbine plant component cooling water system

Turbine generator stator cooling unit

Reactor plant component cooling water system

Control building chilled water system

Ventilation chilled water system

Auxiliary boiler makeup

Laboratories, decontamination areas, and sample sinks.

Standby diesel generators

Condenser air removal pumps discharge separators

Condensate makeup and drawoff system (to condenser hotwell)

•→6

Makeup to the normal service water system to accommodate normal minor leakages from seals, packing, etc. (Section 9.2.1).

6←•

When the exchange capacity of either the cation exchange unit, the anion exchange unit, or the mixed bed exchange unit in a train becomes exhausted, the train is removed from service. The exhausted units are regenerated with solutions of dilute acid or dilute caustic or both as required. The cation and anion exchange unit pair is normally regenerated in the same sequence, even if only one is exhausted.

Dilute acid and dilute caustic are prepared by the in-line dilution of concentrated sulfuric acid and concentrated liquid caustic, which are pumped from their respective measuring tanks, with demineralized water.

A caustic dilution water heater maintains the caustic dilution water at a temperature sufficient to produce a caustic solution temperature of approximately 120°F. This ensures regeneration efficiency for the anion resin by enhancing silica elution. The measuring tanks are filled periodically from the acid and caustic bulk storage tanks.

When required, acid and caustic solution in standard commercial concentrations are brought by transport for makeup to the storage tanks. Using pressurized air, the concentrated acid and caustic are transferred through fill connections and fixed piping located outside the building which houses the water treating equipment, and into the respective storage tank. Heat tracing is provided for any piping which can contain concentrated caustic in a static condition and be subjected to temperatures below that at which crystallization would commence.

Crystallization of a caustic solution containing 50 percent NaOH can be expected to commence at 11.8°C (53.2°F).

The bulk acid and caustic storage tanks are common to this system and to the condensate demineralizer system for Unit 1. The system is designed with gravity feedlines to all measuring tanks, with an atmospheric pressure break to prevent backflow. There are no return lines to the storage tanks. Since all flow is in the direction of the condensate demineralizer system, radioactive contamination of the storage tanks cannot occur.

After regenerating the ion exchanger resins, the dirty acid and caustic solutions are discharged to the acid and caustic waste sump and treated in the following manner.

Chemical waste associated with the makeup water demineralization system consists of regenerant tank spillage and spent acid and caustic solution from the ion exchange resin regeneration cycles.

All components in contact with the regenerants are constructed of materials suitable for the intended service, i.e., special alloy steels or chemical-resistant lining and seals. The acid and caustic storage and measuring tanks are located within diked areas, so that any spills or leaks are contained and do not adversely impact other equipment. The acid and caustic waste sump is sized to contain a spill from the rupture of the largest storage tank.

The waste neutralization tank is equipped with eductors which aid in the neutralization of the acidic and basic wastes that are received by the waste neutralization system. The liquid waste is recirculated through the eductors to ensure thorough mixing of the waste. During the recirculation procedure, either concentrated caustic soda or sulfuric acid is added to the liquid waste as determined by pH monitoring. When the pH is adjusted to a value acceptable for discharge, the neutralized waste is pumped into the cooling tower blowdown line for ultimate discharge to the Mississippi River.

9.2.3.3 Safety Evaluation

The two 350,000-gallon demineralized water storage tanks provide sufficient capacity to ensure a supply of demineralized water to meet station requirements.

The makeup water system is not required for safe shutdown of the plant or to support the operation of engineered safety feature systems.

Demineralized makeup water is not required for operation of the control building chilled water system, reactor plant component cooling water system, or the standby or HPCS diesel generators during accident conditions. Abnormal and accident conditions for these systems are discussed in Sections 9.2.10, 9.2.2, and 9.5.5, respectively.

Conductivity is continuously monitored at the effluent of each demineralizer exchange unit. High conductivity alarms are provided on the makeup demineralizer control panel in the auxiliary control room to alert the station operators to an abnormal condition. Silica analyzers are provided for each train of demineralizers to alert the operator of silica breakthrough. Operator action is then taken to correct the situation and to minimize the amount of contaminated fluid being distributed throughout the station, including the control building chilled water system. The makeup water requirement of the chilled water system is low (estimated at 5 gpd) when compared to the total volume in the system (1,100 gallons). Consequently, small amounts of fluid exceeding makeup water conductivity limits are not detrimental to the operation of the chilled water system. The entry of radioactive water into the makeup water system is not likely to occur because, with the exception of the condensate makeup and drawoff system, all other interconnecting systems do not normally contain radioactivity and the makeup water system is normally at a higher pressure.

The makeup water system is protected against the intrusion of low level radioactive water from the condensate makeup and drawoff system by the following:

1. The makeup water connection to the condensate storage tank is located one foot above the tank overflow and therefore radioactive contamination is not possible. This connection is an open nozzle, with no piping on the inside of the tank.

2. The makeup water connection to the condensate makeup and drawoff system is used for filling the condenser hotwell during maintenance. This connection is normally closed with a locked closed gate valve and check valve.

The makeup water system is protected against the intrusion of radioactive water from fuel pool cooling and cleanup system by the following:

1. A Check valve installed in the common supply line for makeup / purge water to fuel pool cleanup water pumps SFC-P2A and P2B. This will prevent back flow of motor cooling water into the Makeup Water System during both pump shutdown and operation.

2. The fuel pool cooling and cleanup system process fluid leakage via the restrictive bushing located in the pump’s stuffing box is prevented by Makeup Water System pressure exceeding process fluid pressure with the pump in either operating or standby condition.

9.2.3.4 Testing and Inspection Requirements

The demineralized water makeup system is an operational system which is expected to be in daily use and as such does not require periodic testing to ensure operability. During periods of low makeup requirements, standby equipment can be placed in a recycle mode and monitored to ensure acceptable quality and availability.

During startup, various inspections and performance tests are made to ensure that the system meets specification requirements.

Grab samples are periodically tested in the laboratory to verify demineralizer performance and to ascertain stored water quality.

9.2.3.5 Instrumentation Requirements

Control panels located in the auxiliary control room accommodate instruments and controls for operation of the makeup water system, makeup water treatment system, and waste water treatment system.

Well water and demineralized water header pressures are monitored, and controls are provided for automatic startup of the respective backup transfer pumps on low header pressure. Local controls are provided for operation of the makeup water deep well water pumps. Controls for operation of the makeup water shallow well water pump are provided in the auxiliary control room. Pump trouble alarms are provided in the auxiliary control room.

Controls are provided for the automatic startup of the caustic feed pump and caustic feed tank mixer on makeup water shallow well pump running. Local controls are provided also for the running of the caustic feed pump and caustic feed tank mixer. The level in the caustic feed tank is monitored through a level switch which gives a low-level alarm in the auxiliary control room.

The level in the well water storage tank is continuously monitored, and low level alarms are provided in the auxiliary control room and in the fire pump house.

The level in the demineralized water storage tanks is continuously monitored and maintained within limits by controlling the amount of makeup water from the makeup water treatment system. High and low alarms are provided in the auxiliary control room.

The makeup water treatment system includes pressure, flow, and conductivity instruments for each exchange unit to indicate when the unit becomes exhausted. The regeneration cycle is automatically controlled by a programmer. The deaerator level is maintained within limits by controlling the amount of makeup water from the well water storage tank. Controls are provided for maintaining a constant caustic dilution water temperature. Conductivity, silica, and flow recorders are provided for the exchange units. Level and temperature indicators are provided for the deaerators and dilution water tanks. Abnormal conditions are alarmed in the auxiliary control room. Controls are provided for automatic operation of the waste water treatment system neutralization process.

The pH of the neutralized waste is continuously monitored, and controls are provided for automatic operation of the neutralized waste discharge to cooling tower blowdown valve. High and low alarms are provided in the auxiliary control room. Neutralized waste discharge flow to the cooling tower blowdown is recorded in the auxiliary control room. Manual controls are provided in the auxiliary control room for operation of the neutralized waste discharge pump recirculation valve. The level in the waste water treatment system neutralization tanks is continuously monitored, and level controls are provided for operation of the neutralized waste discharge pumps. Extreme high level alarms are provided in the auxiliary control room.

The level in the acid and caustic waste sump is continuously monitored and maintained within limits by controlling the acid and caustic waste sump pumps. A high level alarm is provided in the auxiliary control room.

9.2.4 Domestic Water and Sanitary Drains and Disposal Systems

The domestic water system and sanitary drains and disposal system are schematically shown in Fig. 9.2 6 and 9.2 10, respectively.

9.2.4.1 Design Bases

Domestic Water System

The system is designed to provide sufficient treated potable (drinking) water from the Consolidated Water District No. 13 Water Supply System to satisfy the quantity and pressure requirements of all installed plumbing fixtures. The quality of the treated water is in accordance with Chapter VIII of the Sanitary Code, State of Louisiana.

Sanitary Drains and Disposal System

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The system is designed to treat and dispose of the waste from all plumbing fixtures, except lavatories, sinks, and drains containing waste that is contaminated or potentially contaminated with chemicals or radioactivity. Such contaminated or potentially contaminated waste is physically separate from the sanitary drains and disposal system and is piped directly to the radioactive liquid waste system (Section 11.2). The quality of treated effluent from the sanitary Wastewater Treatment Plant (WWTP) facility meets the discharge limitations stated in NPDES Permit No. LA0042731.

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9.2.4.2 System Description

Domestic Water System

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The supply of domestic water originates from the Consolidated Water District No. 13 Water Supply System.

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Distribution lines are extended underground to the buildings that require domestic water. Domestic hot water is generated by a separate electric hot water heater in each facility containing sanitary facilities.

Sanitary Drains and Disposal System

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Sanitary waste is conveyed, either by gravity flow or by air pressure from a pneumatic ejector, to underground lift station equipped with two sewage pumps. These pumps are controlled for alternate operation to pump sewage to a Wastewater Treatment Plant (WWTP) facility remotely located south west of the Clarifiers. The WWTP is a 65,000 gpd sanitary treatment facility that is comprised of aerated lagoons, sedimentation ponds, rock filter basins, gravity sand filter and a ultraviolet disinfection unit. The WWTP has a capacity to accommodate 20 years of sludge accumulation in two separate sedimentation ponds. The design employs two parallel treatment systems, with one side of the system (Train 1) dedicated to the radiologically active portion of the plant inside the Protected Area. The other (larger) side of the system (Train 2) serves the bulk of sewage media from outlying site area support structures. Train 2 is designed for 50,000 gpd and will produce a volume of approximately 572,000 gallons of undried sludge, which can be disposed of in an approved landfill. Train 1 is designed for 15,000 gpd and will produce a volume of approximately 191,000 gallons of undried sludge, which may need to be dried, compressed and stored as low level dry active waste.

14←•

Sanitary discharge from inside the Protected Area is collected and routed to lift station PBS SLS1. The discharge of the vertical non clog pumps in lift station SLS1, is routed to the wastewater treatment system Train No. 1. Sanitary discharge from the remainder of the River Bend facility is rerouted to lift station PBS TK3. The discharge from TK3 is routed to the wastewater treatment system Train No. 2.

Raw sewage is routed through two parallel coarse screening structures immediately prior to entering the aerated lagoons. At no time is wastewater from the two different sources mixed until tertiary treatment. Both aerated lagoons are considered complete mix reactors without recycle, with turbulence created by the floating aerators maintaining the contents of the lagoons in suspension. Effluent from each aerated lagoon is collected via a 60' scum baffle and weir on the opposite end from the influent of each lagoon. Effluent flows by gravity to the sedimentation ponds. Each pond is designed to contain a 20 year accumulation of sludge deposits, while maintaining a 3' minimum liquid layer at the surface. Effluent from the sedimentation

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●→8
ponds are collected via a 60' and 76' scum baffle and weir on opposite end from the influent to pond Train No. 1 and Train No. 2 respectively. Effluent flows by gravity to the rock filter basins to remove undesirable microbial activity. The design life for the rock filter basins are 25 years. Wastewater will travel upward through the rock, leaving algae growth trapped in voids and attached to rock. Effluent flows by gravity to two separate lift station, effluent lift station No. 1 and No. 2, which pump wastewater to a common tertiary treatment system. Treated effluent drains by gravity through a sand filter and through an ultraviolet disinfection unit immediately prior to the NPDES sample point. Solids removed by the sand filter are backwashed to a lift station that pumps effluent back to aerated lagoon Train No. 1. Effluent is then pumped to the Circulating Water System Blowdown line. There, it is combined with the Cooling Tower Blowdown and other previously monitored Outfalls for discharge to the Mississippi River.
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9.2.4.3 Safety Evaluation

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The domestic water and sanitary drains and disposal systems are not safety related. They are in no way connected to any process system which may be radioactive. The domestic water system is completely independent and does not normally act as a backup supply for any of the other water systems throughout the station. In the event of an emergency if the filling of fire water storage tanks via the deep well pumps is required the spool piece shown on figure 9.2 3a located between valves V8 and V404 may be put in place for this specific purpose. After the tanks have been filled, the spool piece must be promptly removed and replaced with blind flanges. Only one system is fed from the deep well pumps: the makeup demineralizer raw water storage tank, which is a pressure break between the well and the nonradioactive makeup demineralizer system. Since domestic water is supplied from the Consolidated Water District No. 13 Water Supply System, groundwater radioactive contamination is averted. Radiation detection and fire protection systems are not provided for the domestic water system or the sanitary drains and disposal system.

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9.2.4.4 Testing and Inspection Requirements

The domestic water and sanitary drains and disposal systems are in continuous use and do not require any testing after the initial testing. Before placing in service, the domestic water system will be inspected and tested hydrostatically. Sanitary waste is monitored by grab sampling on a weekly basis to verify that effluent is within discharge limitations of the NPDES permit.

9.2.4.5 Instrumentation Requirements

9.2.4.5.1 Domestic Water System

Domestic water is provided by the Consolidated Water District No. 13 Water Supply System.

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Each domestic hot water generator is provided with an integral thermostat to control hot water at a nominal 140°F.

9.2.4.5.2 Sanitary Drains and Disposal System

Local controls are provided for manual or automatic operation of the lift station.

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In the automatic mode of operation, the lift station sewage pumps start and stop according to the liquid level in the wet well. A high level condition from lift station SLS1, which serves the protected area, activates an alarm in the auxiliary control room.

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9.2.5 Ultimate Heat Sink

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The standby cooling tower and water storage basin forms a part of the standby service water system which functions as the ultimate heat sink (UHS) for River Bend Station (Fig. 9.2 11). The location of the UHS standby cooling tower with respect to the reactor building is shown in Fig. 1.2 2. Service water piping to and from the UHS is shown schematically in Fig. 9.2 1b through 9.2 1f.

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9.2.5.1 Design Bases

The UHS is designed in accordance with the following criteria:

1. The UHS is designed to provide sufficient cooling water to permit safe shutdown and cooldown of the unit and to maintain it in a cold shutdown condition, i.e., reactor temperature below 105°F, when normal cooling towers are unavailable. Cooling water for normal station operation, including shutdown, is provided by the normal cooling towers.

2. The capacity of the UHS water storage basin is designed to provide necessary cooling for the period of time (30 days) needed to evaluate the situation, to take corrective action to mitigate the consequences of an accident, and if required to take any necessary measures to permit water replenishment. In addition, alternate methods are available for ensuring the continued capability of the sink beyond 30 days (Section 9.2.5.2).

3. The UHS cooling tower and storage basin is designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods as described in Sections 3.2, 3.3, 3.5, and 3.8.

4. The UHS is designed to withstand the effects of external missiles and internally generated missiles as described in Section 3.5 and pipe whip and jet impingement forces associated with high and moderate energy pipe breaks as described in Section 3.6.

•→6

5. The UHS is designed to operate under emergency conditions only. Normal cooling for service water including shutdown is accomplished by the cooling tower in the service water cooling system and the normal service water heat exchangers as described in Sections 9.2.1 and 9.2.12.

6←•

6. The UHS is designed to perform its intended safety function assuming any single active or passive failure coincident with a loss of offsite power.

7. The UHS is designed to be capable of isolating individual components, systems, or piping if required so that safety functions are not compromised.

8. The UHS is designed to Seismic Category I criteria as described in Section 3.7.

9. The UHS is designated Safety Class 3 as defined in Section 3.2.3.3.

•→11

10. The UHS design performance was verified by test runs during initial plant operation in accordance with the procedures set forth in ASME Performance Test Code 23, "Atmospheric Water Cooling Towers"[(2)] (the issue in effect at the time of the tests).

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9.2.5.2 System Description

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The UHS at River Bend Station consists of one 200 percent Seismic Category I cooling tower and one 100 percent capacity water storage basin. The basin holds approximately 6,426,014 gal of usable water at the minimum water level of 111 ft 10 in to the minimum pump submergence level of 65 ft 0 in, which is available to make up for drift and evaporative losses over 30 days of operation. Major component design data are given in Table 9.2-15.

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The cooling tower is designed to nominally remove 379.5 x 10^6 Btu/hr at a maximum service water flow of 33,000 gpm. Design temperature for cold water leaving the tower is 93°F, corresponding to a design tower inlet water temperature of 116°F.

The design ambient wet-bulb temperature of 81°F, for evaluating peak UHS water storage basin temperature, was based upon the maximum mean 1-day wet bulb temperature of 80.3°F recorded on July 27, 1969.

For evaluating UHS evaporative losses, the 30-day weather data used, starting June 6, 2009, was based on the worst average combination of controlling parameters having the highest evaporation potential.

The maximum allowable cold water temperature is nominally 95°F, corresponding to the value assumed for evaluation of the containment heat removal systems (Section 6.2.2).

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Heat transfer to standby service water is seen to occur immediately after a DBA, postulated as a large break of a main steam line (DBA-MSL) coincident with a complete loss of offsite power. The loss of offsite power is assumed to last for the full 30 day post shutdown period. The single failure of the Division II diesel generator is postulated to occur immediately after trip.

The maximum heat transfer rate to standby service water is calculated to occur 4 to 5 hrs after station trip when heat rejection to standby service water occurs as follows in the unit.

14←•

Heat rejection to the standby service water system by the RHR heat exchanger and containment unit cooler is postulated to begin 0.5 hr after the DBA. Calculation of heat rejection rates for the period 0.5 hr through 3 days from the RHR heat exchanger and containment unit cooler is described in Section 6.2.1 and shown graphically on Fig. 6.2-19 and 6.2-21.

Heat rejection rates for the period 4 days to 30 days were determined as follows. The RHR heat exchangers are postulated to remove the total quantity of core decay heat produced during that interval. Containment unit cooler heat rejection rates during this interval are approximated by a straight line continuation of Fig. 6.2-21.

•→14
The analysis for the decay heat input from the reactor core to the UHS is based upon Branch Technical Position ASB 9.2. A 10 percent margin is added to the fission product heat rate to cover the uncertainty in nuclear properties for the time interval 10^1 to 10^7 sec. Decay heat rates due to fission products and heavy elements, as well as combined decay heat rates, are tabulated in Table 9.2-4.

Total integrated decay heat input to standby service water from core decay heat due to fission products and heavy elements is given in Table 9.2-5.

The integrated heat rejection from the plant auxiliaries is given in Table 9.2-6. The plant auxiliaries heat input to the standby service water system is presented in Table 9.2-7.

Heat rejection due to pump heat is given in Table 9.2-9.

The total integrated decay heat input to the standby service water from reactor core decay heat, sensible heat, pump heat, and plant auxiliaries heat is tabulated in Table 9.2-10. The operating status for safeguard equipment operating during the 30-day period is listed in Table 9.2-13.

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The maximum rate of heat rejection to standby service water from all sources, for evaluating peak UHS water storage basin temperature, as shown in Table 9.2-11 is 1.561 x 10^8 Btu/hr and occurs 5.0 hrs after shutdown. This corresponds to a maximum service water supply temperature of 92.18°F at 15,363 gpm flow.

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Cold and hot water temperatures are listed in Table 9.2-11.

6←•
Cold water temperatures exiting the UHS cooling tower were calculated using the following methods.

Cold water temperatures were determined using vendor-supplied tower performance curves which relate cold water temperature and ambient wet bulb temperature for varying values of cooling tower range and constant tower water flows. The vendor has supplied curves for 50 percent through 110 percent at 10 percent intervals of the design tower flow of 33,000 gpm. The vendor curves are provided as Figures 9.2-19a through 9.2-19g. These curves are based on both the Cooling Tower Institute Test Code ATC-105, "Acceptance Test Code for Water Cooling Towers"[3], and vendor's proprietary data for the ceramic tile fill material.

Heat rejection rates and service water flow rates were determined at specific periods of time following shutdown. Tower cooling ranges were calculated using the relationship:

$$\Delta T = \frac{(HR)}{Q\ C_p}$$

where:

ΔT = Cooling range (°F)

HR = Heat rejection rate (Btu/hr)

Q = Service water flow (lbm/hr)

C_p = Specific heat of water (Btu/lbm °F)

Cold water temperatures were then interpolated from the performance curves. Hot water temperatures were found from the following relationship:

Hot Water Temp = Cooling Range + Cold Water Temp

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Values of hot water temperature calculated using the above methods are conservative, yielding results higher than expected actual temperatures. A cooling tower operating in a closed loop dissipates all the heat rejected to it by allowing hot water temperatures to rise or fall to an equilibrium point defined by the amount of heat the ambient air is capable of picking up. For conservatism, the analysis of cooling tower operation disregards the dampening effect the large volume of water stored in the basin has upon the system operating temperatures.

During operation, some portion of increasing or decreasing plant heat loads goes toward raising the basin water's sensible heat, while the remainder is discharged by the tower through forced evaporation. As a result, cold water temperatures tend to follow the changes in heat rejection rates, but reach the calculated values only in the long term. The calculated values of cold water temperatures, therefore, should be considered as conservative upper boundaries instead of actual temperatures.

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During the first 1 hr after shutdown, all of the heat rejected from the station is assumed to go directly toward increasing the temperature of the water stored in the SCT basin. During this time, no credit is taken for heat removal by natural evaporation from either the pool surface or in the tower fill. Based on the analysis, at shutdown there is a total of approximately 6,415,000 gal of water in the basin corresponding to a water level of 111 ft 10 in (this includes water to an elevation of 65 ft 0 in, which is the minimum pump submergence level). From Table 9.2-10, 8.238×10^7 Btus are rejected to service water during the first 1 hr. This will raise the average temperature of the basin water by 1.55°F.

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•→16 •→14 •→12
The anticipated maximum SCT basin temperature prior to shutdown is 88°F. At 1 hr after shutdown, the average basin water temperature would be 88°F + 1.55° or 89.55°F. The first 1 hr represents all of the heat rejected to standby service water, which raises the sensible heat of the basin. The cooling tower fans may be started at 1 hr after shutdown without affecting the ability of the ultimate heat sink to remove plant heat.
6←•
For evaluating peak UHS water storage basin temperature, forced evaporation was calculated by the following relationship:

$$E = \frac{(TH)\ C}{(LH)\rho}$$

where:

E = Evaporation (gal)
TH = Total integrated heat (Btu)
LH = Latent heat of incoming water (Btu/lbm)
ρ = Density of incoming water (lbm/ft^3)
C = Conversion factor of 7.481 qal/ ft^3

As stated previously, a fraction of the heat load goes to raising the sensible heat of the air. Actual forced evaporation is expected to be less than the calculated value.

The UHS water inventory loss due to evaporation for the 30-day period following the DBA is calculated using the computer program UHSSIM (Reference 4). The UHSSIM program provides a tool for predicting the transient temperature, mass, and dissolved solids content of power plant ultimate heat sinks that consist of a basin and cooling tower. The program performs an analysis of UHS cooling tower heat and mass transfer characteristics coupled with the mass and energy balance for the basin. It simulates the response of cooling towers and basins to varying weather conditions during and following a postulated accident. The UHSSIM computer program methodology was originally developed by the University of Illinois, at Urbana-Champaign, under a contract with the NRC, specifically for evaluating UHS forced draft cooling tower designs for compliance with Regulatory Guide (RG) 1.27 (Reference 5). In the UHSSIM program, the algorithms in the original program methodology have been enhanced to provide more stringent convergence criteria, and to include additional physical phenomena and more modern methods of analysis.

RG 1.27, Rev. 2 states that, for evaluation of the UHS, the meteorological conditions resulting in the maximum evaporation and drift should be the worst 30-day average combination of controlling parameters based on regional climatological information. The weather search capabilities of UHSSIM were used to identify which 30-day summer period would produce the highest evaporation. The U.S. National Climatic Data Center (NCDC) of the National Oceanographic and Atmospheric Administration (NOAA) publishes historic hourly weather observations for the United States. River Bend Station is approximately 20 miles north of the Baton Rouge Metro Airport, for which the NCDC has digital hourly weather records back to July 2, 1948. The raw weather observations for the Baton Rouge Metro Airport were obtained from the NCDC for the time period of July 2, 1948 to November 29, 2014. The 30-day time period starting on June 6, 2009 was found to result in the highest evaporation from the UHS.

The following estimated maximum losses occur for the UHS during the 30-day period with the highest evaporation potential:

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	Loss up to 24 hr (gal)	Total Loss for 30 days (gal)
Natural Evaporation	7.86×10^{2}	2.359×10^{4}
Forced Evaporation and Drift	3.50×10^{5}	5.93×10^{6}
PVLCS Air Compressor (cooling water not recovered)	2.16×10^{3}	6.48×10^{4}
Total	3.53×10^{5}	6.02×10^{6}

which is 6.02×10^{6} gal of water lost.

6←• 12←• 14←• 16←•

The quantity of water naturally evaporated from the surface of the UHS storage basin is minimal for a semi-enclosed basin such as this. For natural evaporation to occur, the vapor pressure of the ambient air must be lower than the vapor pressure of the water. During UHS operation, the air near the surface of the water is saturated at the temperature of the cold water leaving the fill material. Correspondingly, the water surface temperature is at or below this temperature, thus inhibiting natural evaporation.

•→12 •→6

A net solar and atmospheric heat load of 6.819×10^6 Btu/day was assumed to be impressed upon the water surface through the 54 ft x 54 ft center plenum and a corresponding natural evaporation rate to dissipate this heat added into the total integrated evaporation and drift values to determine the available basin volume shown in Table 9.2-12. Sun heat load is based conservatively on solar radiation incident to a horizontal surface at 30°-45' north latitude and assuming no cloud cover.

6←•

Maximum cooling tower drift loss is assumed to be 0.01 percent of the standby service water flow rate, based upon data furnished by the UHS supplier. Drift loss is a function of the internal tower design and is independent of ambient conditions (e.g., wind speed, temperature, humidity). Cooling towers of similar design were tested at Oak Ridge National Laboratory by the Environmental Systems Company for the EPA. In their report <u>Development and Demonstration of Low-Level Drift Instrumentation</u>, October 1971, average drift losses of 0.005 percent were found. The towers tested at Oak Ridge National Laboratory had two-pass wood slat drift eliminators. The towers described herein utilize three-pass, close space polyvinyl chloride drift eliminators with lower air velocities which should be more efficient. Thus, basin capacity calculations, based upon 0.01 percent drift loss, conservatively predict tower drift loss.

•→14 •→6

The cooling tower storage facility has approximately 6,415,000 gal at the minimum basin water level of 111 ft 10 in (as mentioned earlier). This excludes the approximate 70,000 gallons, which represents the water from the minimum pump submergence el. of 65 ft 0 in to the basin floor elevation of 64 ft 6 in. During the first 30 days of operation following a DBA, approximately 6.02×10^6 gal of water are lost due to non-returned cooling water supply to PVLCS, evaporation and drift. Based on the analysis, 393,200 gal remain available as a design safety margin (see Table 9.2-12).

6←• 12←• 14←•

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•→8
The increase in water chemistry concentration due to the absence of blowdown from the system has no effect on the operation of the UHS or the standby service water system during 30 days of operation. However, the system is operated with a controlled makeup if the normal plant makeup wells are operable following an accident.
8←•
The makeup water required after 30 days of operation is a maximum of approximately 168,000 gal/day. Primary makeup water is provided by the normal plant makeup wells which are described in Section 9.2.3. Makeup to the basin is manually controlled to maintain the water level above el 111 ft 10 in which is the minimum basin operating level. Should the primary makeup water source become unavailable, this makeup can be supplied by any of the following alternate methods:

1. Use temporary power to power the plant deep/shallow well pumps and provide makeup through the existing 4"-diameter pipeline into the SCT basin. Also, Fire Protection System can be used to provide make-up water into the SCT basin.

2. Temporary diesel driven pump, hoses, and valves can be used to pump CWS flume basin water into the SCT basin.

3. Temporary tank trucks, hoses and diesel driven pumps to transfer Mississippi River water into the SCT basin.

•→8 •→1
A hypochlorite feed system is provided to inhibit biological growth in the UHS water storage basin. This system consists of a 1,000-gal. feed tank, a metering pump, a recirculation pump, and a network of distribution piping to allow treatment of separate compartments within the basin from the surface to the bottom elevation. A programmable controller sequences the opening and closing of solenoid valves on each branch of the piping network for a set amount of time to allow an adequate chemical dosage in each zone. The recirculation pump is a self-priming type which draws from the basin water surface and provides a medium for injection of the chemical and adequate dispersion through the diffuser pipes. An alternate means of adding chemicals can be achieved by using the systems tank drain valve, direct addition to the basin will allow for dispersion of the chemical through out the basin.
1←• •→11 11←•
Sodium hypochlorite or alternative biocides or corrosion inhibitors may periodically be added to the UHS basin as needed, based on sampling and analysis performed by the chemistry department.
8←•

•→8 8←•
Failure of any portion of the hypochlorite feed system inside the UHS as a result of safe shutdown earthquake or other condition will not adversely affect the standby service water system. These components are plastic pipe and fittings routed in each of the basin compartments, except the one in which the standby service water pumps are located. Water velocity in the basin will be low when the pumps are operating, and sufficient forces will not be developed to draw failed components into the pumps.

The UHS can be used to dissipate residual heat produced when a reactor is shut down for refueling. During this period and during normal plant testing the cooling towers operate with a controlled blowdown and makeup.

Under normal operation, the fuel pool makeup is taken from the condensate storage tanks. Should this source become unavailable, provision is made to draw necessary makeup from the standby cooling tower basin (Fig. 9.2-1).

Under normal operation, water for fire protection is supplied from the fire protection storage tanks. Should this source become unavailable, 150 gpm of standby service water can be provided from the UHS for a maximum of 2 hr to hose stations in critical areas.
•→6
The grade elevation at the standby cooling tower storage facility is 95 ft. The minimum tower basin operating level is at el 111 ft 10 in. After 30 days of operation without makeup, the tower basin operating level is above 65 ft 0 in, the minimum pump submergence level.
6←•
The standby cooling tower consists of four equal area cells, each having an induced draft fan system. The cells are completely isolated from each other and have separate missile protected inlet distribution piping systems. Each cell has a design flow rate of 8,250 gpm. Two fully operating cells are required for safe shutdown.

The standby cooling tower is of counter flow induced mechanical draft design. The distribution system supplies the hot water evenly over the area of fill. The water flows through the multicell dense vitreous clay fill which is approximately 8 ft deep. By dividing the flow through the cells of the fill, enough water area is exposed to the air stream to provide sufficient evaporation for the removal of the required amount of heat. The induced draft fans draw air through the cells to aid the evaporation rate. Located above the distribution system and before the fans are the drift eliminators. Drift eliminators are a zigzag pattern of channels which prevent water carryover via the central discharge plenum.

The standby cooling tower is 158 ft 6 in inside diameter and is supported by a foundation above its storage basin. The storage basin has a normal water depth of 55 ft 6 in. The top of the tower is approximately 47 ft above the normal water level in the basins. The structure is tornado missile protected and designed to Seismic Category I requirements (Section 3.8.4). Sixty percent of the water storage basin is located below grade and is conservatively designed to prevent seepage. The standby cooling tower basin utilizes watertight concrete in the construction of mat and walls.

The standby cooling tower uses five vaneaxial fans for each of four tower cells in an induced draft system arrangement. The fans and tower internals are located inside the tower structure and are protected by the walls and roof, which are designed to withstand both horizontal and vertical tornado missiles (Section 3.5.1).

•→12

Electric power to the four groups of five fans is supplied by two feeders from two standby 4.16-kV buses via two standby 4.16-kV - 480-V, 1-MVA transformer and two standby 480-V motor control centers in the cooling tower. The two standby 4.16-kV buses are those associated with the standby diesel generators A and B. Each feeder has the capability to provide electric power to only two groups of five fans of the cooling tower.

12←•

The cooling tower water storage facility is filled with well water, which is treated for bacteria control. A biocide additive is manually injected into the basins in quantities necessary to control seasonal variations in bacteria growth.

The drift eliminators are of the zigzag type (three pass close space) and have enough passes to ensure a maximum free water carryover of 0.01 percent. They are assembled in sections which are supported from the fan deck by steel rods. The drift eliminators are fire resistant polyvinyl chloride (PVC) with a flame spread rating below 25.

Fig. 9.2-11 gives further details of the cooling tower arrangement.

•→6

The standby service water pumps take suction from the cooling tower water storage facility. The pumps are located in fully missile protected Seismic Category I pump well structures. Pump well structures are designed such that sufficient net positive suction head (NPSH) is available for the standby service water pumps to drain the water to el 65 ft 0 in (Section 9.2.7). A minimum pump submergence of approximately 34 in is provided for vortex free operation.

6←•

9.2.5.3 Safety Evaluation

The ultimate heat sink consists of one 200 percent cooling tower and one 100 percent water storage basin. The cooling tower water storage facility is a partially below grade, missile protected, Seismic Category I structure which can withstand each of the most severe natural phenomena expected, other site related events, and reasonable combinations of less severe natural phenomena and/or site related events. The method of analysis is similar to that used for other Seismic Category I structures.

The cooling tower structure is designed to withstand the safe shutdown earthquake (SSE). The fill, drift eliminators, fans, and piping are seismically analyzed. The seismic analysis of structures is discussed in Section 3.7.

The cooling tower structure is designed to withstand tornadoes and tornado missiles (Section 3.3 and Section 3.5, respectively). Tower internals are fully protected by the structure.

The cooling tower and the walls of the water storage facility are above the probable maximum flood level (el 95 ft 1 in) (Section 3.4).

Valves and other components essential to the operation of the system are located inside tunnels or inside the standby service water pumphouse. These structures prevent rainwater or snow from impinging on the components of the system, therefore protecting it from freezing or icing.

The water pump suction is more than 50 ft below the water level in the basin, therefore, even in extreme low ambient temperatures it does not experience a freezeup condition. The basin is partially below grade, hence ground temperatures contribute to maintain a water temperature above freezing.

The winter climate extreme minimum temperatures are of such rare occurrence and short-term duration that the plant operation of safety-related systems is not be adversely affected by icing (Section 2.3.1.2).

With the exception of the drift eliminators as described in Section 9.2.5.2, all materials in the UHS complex are designed to be nonflammable in order to negate the possibility of loss of sink function due to fire.

The failure of one diesel generator is considered to be an unlikely event. However, should this event occur, the safe operation of the UHS is not inhibited. Each diesel generator has the capacity required for operating two sets of five fans.

•→8A •→8 8←• 8A←• •→9
In determining the worst case post-LOCA SSW temperature, the worst single failure of one division of standby cooling tower fans with both Division of SSW otherwise responding to design basis event (i.e., LOP-LOCA). This is referred to as a Maximum Safeguard Loads (MSL) case. In order for the standby cooling tower basin water temperature to be maintained at or below 95°F and to ensure the SSW System pumps provide sufficient flow to the safety related components during a LOP-LOCA, procedures require the following actions:

1. Start SCT fans one hour into a LOP-LOCA.

2. Throttle the SSW flow to the RHR Heat Exchangers from 5,800 gpm to approximately 3,000 gpm when the SCT water level drops to an elevation of 90 ft (conservatively).

3. If one of the divisions of the SCT fans fails, at any time, operations may start equipment on affected division provided SCT basin temperature controlled < 95°F.

In determining the acceptability of the UHS, with respect to the 30 day inventory requirement, the analysis described in Section 9.2.5.2 is applicable (failure of Division II diesel). The UHS is designed to be a 100 percent storage water basin. This assumes that the minimum required equipment is used to shutdown the reactor. Separate analyses were performed for scenarios where more than the minimum required equipment is used to shutdown the unit. For DBA scenarios where no diesel generator failure occurs, operation with more than the minimum required equipment is controlled to maintain inventory.
9←•
The safety analysis of the standby service water system is described in Section 9.2.7.

9.2.5.4 Testing and Inspection Requirements

The fans, pumps, and electrical apparatus serving the UHS are tested at regular intervals to ensure their availability. Isolation valves are also tested on a regular basis to ensure their operability. Tests can be performed with either normal station power or standby power. Tests of the standby service water system pumps and valves are discussed in Section 9.2.7.
•→11
The UHS can be used to dissipate residual heat produced when a reactor is shut down for refueling. To demonstrate continued acceptable thermal performance of the UHS, surveillance tests are run on the active components (SSW pumps and fans). Contribution to thermal performance by passive components such as the ceramic tile fill and spray nozzles is verified by periodic inspections.
11←•

9.2.5.5 Instrumentation Requirements

Control switches are provided in the main control room for manual operation of the Division I and II standby cooling tower fans. Interlocks are provided to automatically start up a group of fans (one at a time in a timed sequence) when the respective Division I or II standby service water pump has been started.

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Interlocks are also provided to trip each running fan in the event of fan motor overload.

A Division I and II fan inoperative condition activates the respective standby service water system inoperative alarm in the main control room. An alarm is activated after a time delay in accordance with the system logic when loss of function occurs for any fan in a division when its associated standby service water pump is running.

The water levels in the standby cooling water basin is recorded in the main control room. High and low level alarms for the standby cooling tower basin are provided in the main control room.

The water temperature in the standby cooling water basin is measured at selected elevations throughout the basin, and a composite average is recorded in the control room.

•→1

Four wide range (0-100°F) and eight narrow range (70-85°F) RTD's are installed evenly around the center basin with sensors at various depths.

•→8

The temperature monitoring system provides continuous temperature indications. When the UHS basin water temperature exceeds 84°F, control room annunciation is activated.

1←• 8←•

9.2.6 Condensate Storage Facilities

The condensate storage facilities provide initial makeup water to the condensate makeup and drawoff system, in the event of a loss of reactor coolant inventory, and condensate for any continuous service needs or intermittent batch type services. The condensate storage tank receives makeup from the makeup water system. The system is shown in Fig. 9.2-21.

9.2.6.1 Design Bases

The condensate storage tank is furnished in accordance with ANSI-B96.1 and has sufficient capacity to fill the condensate, feedwater, and reactor systems while maintaining a reserve volume for use by the high pressure core spray (HPCS) and reactor core isolation cooling (RCIC) systems. Piping is furnished in accordance with ANSI B31.1. The condensate makeup and drawoff system is a nonsafety-related system.

9.2.6.2 System Description

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The condensate storage tank is fabricated from aluminum and has a maximum usable capacity of 620,000 gal, with a normal operating capacity of 405,200 gal, a maximum of 125,000 gal of which is a reserve for the HPCS and RCIC systems. The tank overflows to a drain sump. The contents of the sump are pumped to the radioactive liquid waste treatment system by a sump pump. In addition to supplying the HPCS and RCIC systems, the condensate makeup and draw off system supplies the condenser with makeup water and receives the condenser drawoff when the hotwell level reaches high or low level set points. Water requirements for the fuel pool cooling pumps, which are used to supply demineralized water for refueling purposes, condensate demineralizer system regeneration, and the control rod drive (CRD) pumps are also supplied from the condensate storage tank. The condensate storage tank is also capable of receiving HPCS system test discharges, RCIC system test discharges, the CRD pump surplus flow, fuel pool purification system discharges, and recovered water from the recovery sample tank pumps.

12←• 16←•

9.2.6.3 Safety Evaluation

The condensate makeup and drawoff system maintains the required water level in the condenser hotwell by drawing off water on increasing hotwell level and by supplying makeup water on decreasing hotwell level. Should this system fail during normal operation, condenser makeup can be supplied by the makeup water system. In the event of a failure due to leakage or contamination, an operator isolates the condensate storage tank and opens the line from the demineralized water transfer pumps by means of a manual block valve arrangement.

The condensate storage tank normally supplies the HPCS and RCIC systems. However, automatic shutoff valves are provided to close on low condensate storage tank level and transfer HPCS and RCIC pump suctions to the suppression pool, which is the primary safety design source of core spray water.

The level instruments, together with their power supplies, transmitters, readout equipment, etc, that provide this transfer signal are safety related. The level instruments are connected to the safety-related suction piping leading to the HPCS and RCIC pumps, and are physically located within a Seismic Category I structure.

That portion of the condensate makeup and drawoff system which penetrates the containment and forms part of the containment boundary (Fig. 6.2-65) is Safety Class 2 and Seismic Category I (Table 3.2-1).

Failure of the condensate storage tank during normal operation would not result in the loss of water supply for the control rod drive hydraulic system since the normal CRD system supply is from the condensate system pump discharge. The catastrophic failure of the condensate storage tank (CST) does not flood any safety-related equipment. Figure 9.2-25 shows the finish plant grading in the area of the CST, and the approximate area that would be covered by 6 inches of water from CST failure; i.e., to an elevation of 95 ft 0 in. Since the ground is relatively level, water from CST failure spreads over a wide area. Exterior openings exposed to this flooding in buildings which contain safety-related equipment are an access door at el 98 ft 0 in and a truck door at el 94.75 ft, both in the north wall of the fuel building. These doors are designed to be watertight. The design of safety-related structures is based on a probable maximum flood level of 96 ft 0 in. msl. Flood protection of the plant is further discussed in Section 3.4.

Failure of the condensate storage tank during accident conditions would not preclude plant safe shutdown or post-accident mitigation processes. The systems which draw water from this tank are all capable of performing their safety function without this water supply. Specifically, the HPCS and RCIC suction would automatically shift to the suppression pool; the CRD accumulators provide enough stored energy to insert control rods; and the fuel pool cooling system receives any required makeup water from the standby service water system.

•→16

Level in the condensate storage tank is normally maintained by the demineralized water transfer pumps.

16←•

Continuous level monitoring of the condensate storage tank provides practical assurance that leakage does not go undetected or uncontrolled and meets the requirements of General Design Criterion 60. Tank overflow and drains are retained by the sump. Water collecting within the sump is pumped to the radioactive liquid waste treatment system by a sump pump. The overflow system is designed for the maximum influent from the largest single source. The tank vent is provided with a screen to prevent the entry of birds or animals. The vent is sized for a maximum pressure differential of 25 lb/sq ft.

The condensate storage tank is fabricated of aluminum to mitigate the effects of corrosion.

A crack in the suction piping for the HPCS and/or RCIC pumps, when either or both are operating and taking suction from the condensate storage tank (CST), was postulated in various locations and sizes in accordance with the provisions of Branch Technical Position MEB 3-1 for through-wall leakage in moderate energy piping systems. Conservative results were ensured by applying the following assumptions in the evaluations:

1. For net positive suction head available (NPSHA) calculations, water in the CST is assumed to be at the lowest possible level, i.e., the discharge nozzle.

2. Water temperature is assumed to be 40°F for pressure drop calculations and 140°F for water vapor pressure. This maximizes frictional losses in pressure drop computations and imposes the most limiting vapor pressure for NPSHA calculations.

3. Leakage flow rate is calculated assuming no flow beyond the crack and maximum water level in the CST, i.e., overflow.

The worst case crack was determined to be 1.81 sq in at the suction flange of the HPCS pump. This crack represents the maximum leakage rate (350 gpm) and causes the greatest degradation of NPSHA, since the increased flow exits through the entire length of the suction piping, thereby increasing frictional losses. New NPSHA values were calculated for both pumps for the postulated condition with the following results:

1. The HPCS pump NPSHA of 29.2 ft remained above the NPSH required of 5.0 ft, and

2. The RCIC pump NPSHA of 27.7 ft remained above the NPSH required of 21.0 ft.

A crack of 0.42 sq in was calculated and postulated in the RCIC piping at the pump suction flange. This resulted in a leakage flow rate of 82 gpm. Although this leakage rate is substantially less than that postulated in the HPCS line, its effect on the RCIC pump NPSHA was evaluated because the increased flow could have resulted in a significantly greater friction loss. However, the calculations resulted in an NPSHA of 27.2 ft for this condition.

Neither of these postulated conditions jeopardizes the ability to conduct a safe shutdown of the plant, nor does the crack affect the availability of the other ECCS systems. The postulated leakage into the HPCS cubicle exceeds the capacity of that compartment's two sump pumps (2 x 50 gpm) and causes water to accumulate. However, Seismic Category I automatic level switches, mounted on the HPCS cubicle walls, provide both alarm and water level indication in the main control room. The instrument set point is established at a level below the location of any safety-related equipment. Refer to Sections 5.2.5 and 9.3.3 for additional leak detection provisions. Operator action is then taken to isolate the HPCS system by shutting down the pump and remote manually closing the pump suction valve. The RCIC pump is still available since the common suction piping remains intact. Loss of the HPCS system does not jeopardize safe shutdown of the plant since the other ECCS systems (LPCS, LPCI, and ADS) are available. The crack in the RCIC suction piping does not result in flooding since the sump pump capacities are greater than the calculated leakage flow rate of 82 gpm.

The possibility of air induction through postulated cracks was also evaluated. This condition could occur when a crack is postulated at a point in the suction piping where system pressure is below atmospheric. Pressure drop calculations were performed with the same conservative assumptions and leakage conditions as described above, and it was shown that pressures greater than atmospheric are maintained throughout the entire length of the suction piping. At the respective pump suction flanges, the point of lowest pressure, the following gauge pressures were calculated: 7.8 psig for the HPCS pump and 5.5 psig for the RCIC pump.

A discussion of the environmental design considerations, including the radioactivity concentration limits and the consequences and mitigating provisions for failure of the condensate storage tank, are provided in Section 15.7.3.2.

9.2.6.4 Testing and Inspection Requirements

Continuous monitoring of the tank level and periodic visual inspection of the system ensures the operability of the system.

9.2.6.5 Instrumentation Requirements

Hotwell level is indicated and a hotwell high/low level alarm is provided in the main control room. Hotwell level is maintained at its setpoint during normal makeup by modulating an air-operated valve in the makeup line from the condensate storage tank. Emergency hotwell makeup control is provided by modulating an air-operated valve which also draws water from the condensate storage tank when the hotwell level drops below normal. High hotwell level is controlled by modulating an air-operated valve which returns excess water from the condensate system to the condensate storage tank.

Condensate storage tank level is indicated in the auxiliary control room and a condensate storage tank high/low level alarm is provided in the main control room. Normal and emergency condensate makeup flows are monitored by the plant computer.

A manual control switch is provided in the main control room to open and close the condensate line fill valve.

Control switches are provided in the auxiliary control room for either automatic or manual operation of the condensate storage tank sump pumps. A mechanical alternator is provided for selecting the lead and backup pumps. Both pumps run on extreme high sump level and stop on extreme low sump level when operating in the automatic mode. The level in the sump is indicated and extreme high level is annunciated in the auxiliary control room.

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A manual control switch is provided in the main control room for operation of the condensate makeup containment isolation valve. The valve closes automatically on a LOCA signal.

A control switch is provided in the auxiliary control room for either manual or automatic operation of the condensate storage tank makeup valve. In the automatic mode, level control opens the valve when the condensate storage tank level is low and closes the valve when the level is high.

Pushbutton controls are provided in the auxiliary control room for either manual or automatic control of the condensate transfer pumps. When operating in the automatic mode, pump startup occurs on either low pump discharge pressure or high pump discharge flow. Pump discharge flow is monitored in the auxiliary control room. A low discharge flow condition when both pumps are running activates a condensate demand low alarm in the auxiliary control room. Alarms are activated in the auxiliary control room when a pump that is running automatically trips and when a pump automatically starts. A manual control switch is provided in the auxiliary control room for opening and closing of the condensate makeup to radwaste system isolation valve.

9.2.7 Standby Service Water System

The standby service water (SSW) system operates under emergency conditions, in conjunction with the ultimate heat sink, to remove heat from those plant components required for the safe shutdown and cooldown of the unit.

•→12

A flow diagram for the standby service water system is included in Fig. 9.2-1b through 9.2-1f. Table 9.2-14 lists the essential components served by the standby service water system. Table 9.2-15 lists the major components in the standby service water system and the design cooling water flows for each. Table 9.2-16 presents a single passive failure analysis of the standby service water system. Quantities of heat rejected to standby service water are detailed in Section 9.2.5.

12←•

9.2.7.1 Design Bases

The standby service water system is designed in accordance with the following requirements:

1. The system provides all the necessary cooling water to the reactor plant components required to safely bring the reactor to a cold shutdown condition and to maintain it in cold shutdown for a 30-day postaccident period.

2. The system automatically performs its emergency cooling function assuming any single active or passive failure coincident with a loss of offsite power.

3. The system is designed to Safety Class 3 requirements, as defined in Section 3.2.2.1.3 for pumps, piping, and valving.

4. The system is designed to Seismic Category I requirements, as defined in Section 3.7.

5. Protection is provided from extreme natural phenomena such as earthquakes, tornadoes, and floods, as described in Sections 3.2, 3.3, 3.5, and 3.8.

6. Protection is provided from the effects of externally and internally generated missiles, as described in Section 3.5.

7. Protection is provided from the effects of pipe whip and jet impingement from high- and moderate-energy line breaks, as described in Section 3.6.

•→15

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9. Redundancy is provided to permit isolation of inoperable components, subsystems, or piping without compromising their intended safety functions, as described in Section 9.2.7.3.

10. Provision is provided to permit operational functional testing of safety-related equipment during shutdown, as described in Section 9.2.7.4.

11. Nonseismic pipe, ductwork, or components are analyzed to ensure that their failure or collapse during an SSE does not compromise the system's safety function.

9.2.7.2 System Description

The standby service water system is composed of the following:

1. Two equally sized, redundant piping systems, each supplying the components listed in Table 9.2-15. During normal plant operation, the normal service water pumps use standby service water piping to supply safety-related components.

2. Four 50 percent capacity, 7,690 gpm, motor-driven, wet pit, vertical centrifugal standby service water pumps. Two pumps are provided on each redundant supply header. Operating characteristics of the SSW pumps are given in Fig. 9.2-22. A wall in the SSW pumphouse physically separates each set of two pumps. All four pumps take suction from a common pump well in the ultimate heat sink water storage basin.

3. One ultimate heat sink cooling tower and associated storage basin, as described in Section 9.2.5. Each redundant header may be remotely aligned to the two redundant cells on the ultimate heat sink cooling tower

•→12
The standby service water system is shown in Fig. 9.2-1b through 9.2-1f, with all piping and components lined up for normal operation.
←•12
All SSW piping between the standby cooling tower and the reactor complex is routed in Seismic Category I tunnels (Fig. 9.2-26). All nonsafety-related piping in these tunnels is seismically supported as described in Section 3.7.3.13A, ensuring the functional capability of the SSW piping during a seismic event.
•→8
Standby service water is pumped from the standby cooling tower water storage basin through the discharge line of each pump. Discharge lines from each set of redundant standby service water pumps combine into two equally sized redundant supply headers. The redundant headers are cross-connected in the pipe tunnel by two normally closed redundant motor-operated valves.
←•8
Two takeoffs from the header, one from each side of the isolation valve, are routed to the fuel building, auxiliary building, containment, drywell, control building, and diesel generator building to supply standby cooling water to the various components essential to safety. Return lines from the components are collected in redundant headers and returned to the standby cooling tower.
•→6
The essential components served by the standby service water system are listed in Table 9.2-14. These and other major components and their design data are listed in Table 9.2-15. Interfaces between the normal service water system and the standby service water system terminate in a Safety Class 3 check valve to allow for automatic initiation of the standby service water system cooling upon loss of normal service water system cooling.
6←•
During operation, the standby service water pumps take suction from the standby cooling tower water storage basin, which is maintained at a normal water level of approximately 116 ft 4 in msl.
•→9
During the operation of the standby service water system, service water flows through cross tie piping at a normal rate of approximately 70 GPM from the discharge of the standby service water pumps back to the standby cooling tower. The function of the cross tie piping is discussed in normal service water section 9.2.1.2.
9←•
The standby service water pumps are specified to have the minimum pump submergence required to operate at the extreme low water level of 65 ft 0 in msl.

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Service water pump motors are mounted above el 118 ft 4 in msl (Fig. 9.2-23) in the standby service water pumpwell (SSWP). The maximum flood level for this area is 95 ft 1 in msl (Section 2.4.2), and basin water level is maintained at approximately 116 ft 4 in msl, is below the water level in the basin at overflow conditions. Electrical components for the standby service water pumps are located at a minimum of 20 ft above the probable maximum flood level.
12←• 14←•

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The standby service water pumps are capable of operating within the extremes of maximum and minimum basin water level. Basin level is manually controlled to maintain the water level above el 111 ft 10 in, which is the minimum basin operating level.

Electric power for the standby service water system may be supplied from either the preferred or standby power supplies. The preferred power supply is drawn from either of two offsite power sources. Standby electrical power is provided from Class 1E systems (Section 8.3.1). Standby service water pump 2A is supplied by the 4-kV bus to which standby diesel generator 1EGS*EG1A is connected. Pumps 2B and 2D are supplied from the 4-kV bus to which standby diesel generator 1EGS*EG1B is connected. Standby service water pump 2C is supplied by the 4-kV bus to which the HPCS diesel generator (1E22*S001) is connected. Details on the electric system are discussed in Section 8.3.1.

•→6 •→2

Piping wall thicknesses are increased over standard design requirements by corrosion allowance of 0.125 in which has been provided for all standby service water system piping, and internal protective coatings have been applied on certain components to prevent the degradation of system performance by long-term corrosion.

2←•

Provision for the control of corrosion, siltation, and organic fouling is discussed in Section 9.2.5.2 for the UHS water storage basin and Section 9.2.1.2 for service water during normal plant operation.

6←•

A connection with the residual heat removal system is provided to one of the two standby service water supply headers. The connection contains two remote manually operated isolation valves which can be opened from the main control room.

The standby service water system operates at a higher pressure than the component heat exchangers which it serves, with the exception of RHR heat exchangers. During the long-term cooling mode following a LOCA, the service water outlet pressure (tube side) is approximately 56 psig and the shell inlet pressure is approximately 100 psig at the RHR heat exchanger. Radiation monitors are installed in the standby service water piping downstream of the RHR heat exchangers, as discussed in Section 9.2.1, to detect radioactivity present in the heat exchanger effluent.

9.2.7.3 Safety Evaluation

The standby service water system has the capability to provide cooling water to essential equipment through two separate supply lines. Each supply line is capable of providing sufficient cooling water for all of the following minimum conditions which are essential to the safe shutdown of the reactor:

1. Two residual heat removal pumps operating

2. One standby diesel generator and the high pressure core spray diesel generator operating

•→12

3. One of four water chillers which supply cooling water to the main control room air-conditioning system operating

12←•

4. Auxiliary building unit coolers operating

5. One of two containment unit coolers operating.

The design margin for individual components served by the SSW system is based upon a consideration of maximum duties for the components. In addition, redundancy is provided in the individual systems, supplied by service water to accommodate the loss of a component due to loss of either redundant standby service water system. Heat duty for the standby service water system and components is described in Section 9.2.5.

Service water flow rate to the main control room chilled water chillers is based upon heat removal requirements with the chilled water system at maximum capacity, i.e., maximum ambient temperature plus maximum heat gain from control building equipment. Service water flow rate to the diesels is based on diesels operating at rated capacity for the accident duration. RHR heat exchanger flow rates are based on heat transfer requirements for fully fouled heat exchangers, as are flow rates for the containment unit coolers.

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Maximum standby service water total design flow requirements is approximately 6,900 gpm per pump. An additional flow margin is available through specification of 7,690 gpm pump capacity. Standby cooling tower heat removal capacity is discussed in Section 9.2.5.

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During the initial phase of recovery from a LOCA, the standby service water pumps initiate per section 7.3.1.1.8 although one standby service water pump satisfies the cooling requirements of all the previously listed equipment, except the RHR heat exchangers. RHR heat exchangers are not required during this phase of recovery. When the residual heat removal heat exchangers are required, two standby service water pumps must operate. Automatic isolation of the normal service water header serving the control, diesel generator, and auxiliary buildings allows standby service water to cool essential components within these buildings under all accident conditions. Each standby service water system can, if required, be isolated into two separate redundant standby service water systems by closing the appropriate isolation valves.

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The two redundant systems merge to supply a single component in two locations. These are:

1. HPCS diesel generator jacket water cooler

2. HPCS pump room unit cooler.

In these locations, component cooling water supply lines are provided with motor-operated valves and check valves, while return lines are provided with motor-operated valves. These valves can be closed by operator action, either to isolate the component should a failure occur, or to isolate an operating SSW system from an inoperable redundant system.

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On loss of pressure to the normal service water or reactor plant component cooling water systems and with offsite power available, the standby service water pumps start without introducing transients on the reactor coolant pressure boundary. At the same time, the normal service water is isolated automatically and the standby service water system lines are opened to the required components. If the standby service water pumps and fans are operating and a loss of offsite power occurs, the pumps and fans trip. Upon transfer to standby diesel generator power, the fans restart manually and the pumps restart according to the load sequencing and maximum elapsed time listed in Tables 8.3-2a, 8.3-2b, and 8.3-3 for the emergency diesel generators. In addition, pump P2C, which is fed from the Division III bus, also trips when the HPCS pump starts and the HPCS diesel generator is the only source of power. Pump P2C is sequenced back on after the HPCS pump starts. The other standby service water pumps also trip on a LOCA signal if the only source of power supply is the standby diesel generators.

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Initiation of the SSW system is described in Section 7.3.1.1.8. SSW system control logic is shown in Fig. 7.3-11.

•→6

Automatic vacuum release equipment is provided on upper elevation return headers from the drywell unit coolers and the auxiliary building unit coolers. Solenoid valves at each location open automatically on loss of normal service water pressure to admit air into the service water lines. This air refills voids which potentially could result from partial system draindown following a loss of or a severe leak in the normal service water or standby service water systems.

6←•

In the auxiliary building, vacuum release air is provided by opening to the ambient building atmosphere. In the containment, instrument air stored in safety-related accumulator tanks is used to prohibit potentially contaminated air from entering the service water system.

As the system refills following automatic closure of header isolation valves 1SWP*MOV57A and B and 1SWP*MOV96A and B and start of the standby service water pumps, entrapped air is swept outward and exits the system at the standby cooling towers.

The standby service water system is capable of accommodating any single component failure or loss of any single emergency power supply, i.e., Division I, II, or III power without affecting the overall system capability of effecting safe shutdown and cooldown or postaccident heat dissipation, as detailed in Table 9.2-16 and the FMEA. Operator actions may be required to isolate a failed component from the remainder of the standby service water system, or to transfer cooling to the redundant portion of the system, if the redundant portion was in a shutdown state.

A failure of Division I power will result in the unavailability of 1SWP*P2A and all associated motor-operated isolation valves. Pump 1SWP*P2C will start automatically on Division III power but is not required since the 100 percent redundant B subsystem will be fully operable on Division II power.

Operator action to close the NSW return valve will be required after 20 min to limit water loss from the unisolated A subsystem to the nonsafety-related normal service water subsystem.

A failure of Division II power will result in a loss of the B subsystem. Division I pump 1SWP*P2A and Division III pump 1SWP*P2C in the A subsystem will operate to provide all required cooling.

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A failure of Division III power will result in the unavailability of 1SWP*P2C. The three operable pumps will provide for all short-term cooling requirements. With the HPCS pump unavailability due to the loss of Division III power, operator action may be required after 20 min to ensure the availability of LPCS for long-term cooling. The fully operable B subsystem can handle RHR heat exchanger cooling with two pumps. Operator action may be required to limit water demands on the remaining A subsystem pump 1SWP*P2A. Equipment can be operated on Division I as long as the following essential equipment remains operable:

Auxiliary building unit coolers required to support LPCS operation

Standby diesel generator A

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A transient analysis was performed based on the following initial conditions:

1. A main steam line (or recirculation suction line) double-ended-rupture (DER) long-term response

2. The redundant portion of the system is in a shutdown state

3. Suppression pool temperature has not yet peaked.

A single passive or active failure (e.g., fan trip, flow, level, pressure, or temperature condition) in the standby service water system initiates an alarm in the main control room. Upon annunciation, the operator responds by initiating the necessary valve action to isolate standby service water to the independent redundant portion of the system or to isolate a failed component or portion of the system initiating the alarm condition from the remainder of the standby service water system. The conservative assumption is made that standby service water to the residual heat removal heat exchanger in the suppression pool cooling mode is lost for 10 min while the operator is establishing shell side flow to the residual heat removal heat exchanger in the redundant portion of the system. A transient analysis indicates that the suppression pool temperature increase is less than 1°F, and the containment pressure increase is less than 0.1 psi. This transient analysis shows that the design objectives of the system can be met following the failure of a single component.

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A fire in Fire Area PT 1 (E, F & G Tunnels) could potentially render the standby service water system inoperable. Normal service water and its required support system (including the necessary portions of the Off Site Power Distribution System) has been analyzed to remain free from fire damage during a fire in Fire Area PT 1. In this area only, normal service water is credited for cooling the required safe shutdown systems and components.

15←•

Large scale leakage from the standby service water system due to major piping or component failures can be detected by the following methods:

1. Standby service water flows in each redundant header are monitored in the pump discharge and service water flow recorder. A mismatch in these flows indicates large scale leakage.

2. Pump discharge header pressure transmitters alarm required header pressure.

Small scale leakage from standby service water piping or components can be detected by the following methods:

1. Routine maintenance and inservice inspection

2. Monitoring building and tunnel sump levels

3. Monitoring the operation of components cooled by the standby service water system.

9.2.7.4 Testing and Inspection Requirements

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The standby service water system will be tested periodically in accordance with Regulatory Position 2.b of Regulatory Guide 1.22 and the requirements of the ASME OM Code.

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The reactor plant component cooling water system and the plant chilled water system (that supply the containment unit coolers during normal plant operations) are both demineralized water systems. Since the service water system is chlorinated, the above valves are not operated during normal plant operation to prevent the introduction of chlorinated water into these demineralized water systems. These valves can be tested when the reactor is shut down. All of these valves are accessible during

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reactor operation for visual surveillance and any routine preventive maintenance that does not necessitate actual stroking of the valve. In addition, each division of the standby service system can be tested in its entirety during plant refueling outages.

The standby service water pumps (4) for RBS have been identified as deep draft pumps as described in I&E Bulletin 79-15, dated July 1979. The program for assuring long-term operability for these pumps is described below.

Preoperational/Startup Program

As part of the plant startup program, vibration measurements are taken in accordance with the following standard test procedures in order to establish baseline data for comparison to later functional testing and surveillances. Prior to full power operation of the plant, each deep draft pump will have experienced a minimum of 100 hrs of operation under full system flow and pressure.

Within the first 40 hrs of operation in the plant, at least 24 hrs is continuous operation during which vibration levels are measured every 3 hrs (- 30 min). Readings are taken during stable operating conditions. All readings taken are recorded. Anomalies in vibration levels are explained. Following the 24-hr continuous running period, and on about the 50th hr and 100th accumulative hr of plant pump running time, vibration measurements are to be repeated. These readings are taken during a period of stable running conditions as near to the 50-hr and 100-hr running time as possible but at least 40 hrs apart.

While measuring vibration, the following parameters are also measured: bearing temperature, inlet pressure, differential pressure, flow rate, and vibration (peak to peak composite or filtered or unfiltered velocity). Vibration readings are performed in accordance with the method described in Section XI, paragraph IWP-4500 of the ASME B&PV Code with the allowance for plant-specific relief request. "Alert" and "Required Action" vibration levels are established during this portion of the testing.

Vibration measurements are compared to the acceptable vibration range specified by the vendor. An "alert range" vibration level, in accordance with ASME Section XI, IWP-3100, is established from an acceptable vibration level with due consideration of sufficient margin to assure that the pump can still perform its safety function when this alert range vibration level is reached and is maintained as the lower bound "required action" value for the performance of inservice vibration testing. In addition, each of the readings is to be compared for signs of degradation in the pump bearings or for the radial vibration amplitude changes.

Preventive Maintenance Program

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Preventive maintenance and surveillance testing are performed at scheduled intervals in accordance with site policy.

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Following pump disassembly and reassembly, the pump is manually turned to assure that there is no major misalignment. Vibration measurements are performed as described below prior to return to operation.

Functional Testing and Surveillance

Each deep draft pump is scheduled to be functionally tested in accordance with the time interval specified in ASME OM Code, Subsection ISTB. Pump inlet pressure differential pressure, flow rate, and vibration are taken. Engineering analyses are performed to identify changes or pump performance trends that may be indicative of off normal operating conditions. Functional testing and surveillance requirements are specified in technical specifications, surveillance procedures, and inservice inspection programs.

On a schedule concurrent with in service tests, as a minimum, vibration levels are measured for these pumps. Prior to performing these measurements, the pump is run continuously until stable reference conditions are reached. These measurements are performed in the same manner as for the base line data and the same parameters are recorded. Results are compared to the base line data for signs of degradation or radial changes. Values are evaluated, if necessary, to predict pump bearing life.

If vibration levels measured during this period show signs of degradation or reduced bearing life, the cause is determined and corrective action taken as appropriate (i.e., whenever the threshold or "Required Action" values are exceeded). Following corrective action, vibration levels are measured to determine adequacy of corrective action.

9.2.7.5 Instrumentation Requirements

The standby service water supply header pressure in each loop (A and B) is recorded in the main control room. Supply header temperature for each loop is indicated in the main control room. High header temperature and low header pressure alarms are provided in the main control room. The flow in the standby service water supply and return headers for each loop (A and B) is recorded in the main control room.

Control switches are provided in the main control room for manually opening and closing the isolation valves in the standby service water supply header. Controls for other service water system isolation valves are described in Section 9.2.1.5. These controls enable the transfer from normal to standby service water mode of operation. Alarms are provided in the main control room for standby service water system valving misalignment.

Pushbutton controls are provided in the main control room for manual initiation of the standby service water system. Automatic initiation of the standby service water system occurs on extreme low pressure in the respective interconnected normal service water system header or reactor plant component cooling water system header (Section 7.3.1.1.8).

Control switches are provided in the main control room for manual operation of the standby service water pumps. During loss of offsite power, the standby service water pumps start in their proper standby bus loading sequence (Table 8.3-2). Interlocks prevent startup of a standby service water pump unless its discharge valve is fully closed, and start opening the valve when the pump running condition has been established.

Standby service water system inoperative alarms are provided in the main control room.

Manual control switches are provided in the main control room for opening and closing isolation valves in the standby service water supply and return headers for the containment unit coolers. A LOCA signal automatically opens the respective valves after a time delay. Automatic closure of these valves occurs on high containment to annulus differential pressure.

A LOCA signal automatically closes the standby service water supply and return valves for the drywell unit coolers.

The radiation level of the service water leaving each RHR heat exchanger is monitored, and alarms are provided in the main control room and the auxiliary control room when the radiation level reaches a high limit.

9.2.8 Turbine Plant Component Cooling Water System

The turbine plant component cooling water (TPCCW) system is designed to remove heat from the designated heat exchangers in the turbine building and the radwaste building. The system is an intermediate cooling distribution loop, which transfers heat from designated equipment to the station normal service water system. The TPCCW system is shown in Fig. 9.2-7a through 9.2-7d.

9.2.8.1 Design Bases

The TPCCW system is designed in accordance with the following criteria:

1. The TPCCW pumps are designed in accordance with the Hydraulic Institute Standards.

2. The heat exchangers are designed in accordance with ASME Code for Boiler and Pressure Vessels Section VIII, Division 1, and also comply with the requirements of Tubular Exchanger Manufacturers Association Standards.

3. The piping is designed in accordance with ANSI B31.1.

4. The surge tank is designed in accordance with ASME Section VIII, Division 1.

9.2.8.2 System Description

The TPCCW system consists of a single closed loop, with three half-capacity centrifugal pumps in parallel (one on standby) feeding three half-capacity component cooling water heat exchangers also arranged in parallel (one on standby), all arranged to deliver demineralized cooling water (at 105°F maximum) to nonsafety-related turbine plant, radwaste, and electrical equipment listed in Table 9.2-17. The cooling water flowing in the shell of the heat exchangers is cooled by the normal service water flowing in the tubes (Section 9.2.1).

The TPCCW loop has a design pressure of 150 psig. The heat exchangers associated with the radwaste system handle potentially radioactive material at an operating pressure lower than the component cooling water that cools it. Any tube leakage, therefore, results in a flow from the component cooling water system to the radwaste system.

A surge tank accommodates system volume changes due to temperature variations, maintains static head on the pumps, and allows detection of gross leaks in the system; it also makes up for normal leakage in the closed loop portion of the system. The surge tank is blanketed by nitrogen at a pressure of 16 psig. Makeup water to the TPCCW system is supplied by a line from the demineralized water transfer pump to the surge tank. The water level in the surge tank is maintained at the operating level by a level controller and a level control valve. The surge tank is equipped with a pressure relief overflow line, which drains to the turbine building equipment drains.

System components are specified with sufficient wall thickness to preclude degradation of system performance by long-term corrosion. No chemical additives are used to inhibit corrosion, because a sufficient corrosion allowance is provided on all equipment and piping.

9.2.8.3 Safety Evaluation

The TPCCW system is not a safety-related system. This system is not necessary for a safe shutdown of the plant, or required during or after a design-basis LOCA.

9.2.8.4 Testing and Inspection Requirements

Pumps in the TPCCW system are proven operable by their use during normal plant operations. The standby heat exchangers and pumps are placed in service periodically to ensure their operability. System subsections normally closed to flow are tested in accordance with technical specifications to ensure their operability and the integrity of the system.

9.2.8.5 Instrumentation Requirements

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An alarm in the main control room is activated when the TPCCW pump suction pressure reaches a low limit.

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Manual control switches are provided in the main control room for manual operation of the TPCCW pumps. TPCCW pumps discharge header pressure is monitored in the main control room. Low TPCCW pumps discharge header pressure or an automatic trip of a running pump automatically starts the standby pump. An alarm in the main control room is activated when the TPCCW system pressure reaches a low limit. Interlocks prevent a pump from starting when its discharge valve is open.

14←•

The outlet temperature and pressure of the TPCCW heat exchangers are monitored, and alarms are provided in the main control room for a high-temperature or a low-pressure condition. The outlet temperature of the heat exchangers is maintained at its set point by modulating a control valve in the bypass line of the heat exchangers.

Control logic is provided to maintain the TPCCW surge tank level within design limits by operating an air-operated valve in the makeup water line to the surge tank. The valve opens when the level reaches a low limit and closes when the level is normal. High and extreme low surge tank level alarms are provided in the main control room to alert the operator of a possible malfunction of the makeup valve or a system leakage.

9.2.9 Ventilation Chilled Water System

The ventilation chilled water system is designed to remove heat from designated areas and to provide required cooling for equipment located in these areas.

The ventilation chilled water system consists of two subsystems. One subsystem, located in the turbine building, serves the turbine building, turbine building sample room, condensate demineralizer off gas building, and the containment. The second subsystem, located in the radwaste building, serves the radwaste building and fuel building. The subsystems are not interconnected.

The subsystems are not required to be in operation during accident conditions; therefore, they are non-nuclear safety systems.

9.2.9.1 Design Bases

The ventilation chilled water system is designed in accordance with the following criteria:

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1. To cool auxiliary plant equipment located in the turbine building, turbine building sample room, condensate demineralizer off gas building, containment, radwaste building, and fuel building over the full range of normal plant operation.

1←•

2. The ventilation chilled water subsystems are not designed to Seismic Category I criteria, with the exception of the containment unit coolers' piping and valves, and piping and valves required for the containment and drywell isolation. Containment isolation valves and piping are Safety Class 2. Valves and piping to the containment unit coolers interfacing with the standby service water system are Safety Class 3 and are described in Section 9.2.7. The remainder of the ventilation chilled water subsystems are non-nuclear safety related.

3. Piping and valves are designed in accordance with the Power Piping Code, ANSI B31.1. Safety Classes 2 and 3 piping and valves are designed in accordance with ASME Code Section III. The miscellaneous equipment conforms to the applicable codes and standards of IEEE, NEMA, and ASME Section VIII.

9.2.9.2 System Description

The configuration of the ventilation chilled water system is shown in Fig. 9.2-8a through 9.2-8j and design data of principal system components are listed in Table 9.2-18.

The turbine building chilled water subsystem has three 50-percent capacity electric motor-driven centrifugal liquid chillers, three 50-percent capacity chiller condenser cooling water pumps, two 100-percent capacity chilled water recirculation pumps, and a compression tank. The chiller condenser cooling water pumps derive 7,250 gpm cooling water, at a maximum temperature of 95°F, for the chiller condenser from the normal service water system, as described in Section 9.2.1. All equipment in this subsystem is located on the basement floor of the turbine building. During normal plant shutdown, chilled water from this subsystem can be diverted manually to the drywell unit coolers to provide comfortable working conditions for personnel in the drywell.

The radwaste building chilled water subsystem has three 50-percent capacity electric motor-driven centrifugal liquid chillers, three 50-percent capacity chiller condenser cooling water pumps, two 100-percent capacity chilled water recirculation pumps serving the radwaste building, two 100-percent capacity chilled water recirculation secondary pumps serving the fuel building, and a compression tank. The chiller condenser cooling water pumps derive 2,400 gpm cooling water, at a maximum temperature of 95°F, for the chiller condenser from the normal service water system, as described in Section 9.2.1. All equipment in this subsystem is located on the upper floor of the radwaste building.

9.2.9.3 Safety Evaluation

In each subsystem, a spare 50-percent capacity centrifugal liquid chiller is provided to ensure continuous cooling capability upon malfunction of a chiller unit. A 100-percent capacity redundant chilled water recirculation pump is also provided. No redundant compression tanks or piping are provided.

Ventilation chilled water supply and return branches, to serve drywell unit coolers during normal plant shutdown, are isolated from the service water system with Safety Class 3 manual shutoff and check valves.

The ventilation chilled water system is not required for safe shutdown or post-accident mitigation.

Containment penetrations are protected by isolation valves and the containment and reactor vessel isolation control system (CRVICS). For a detailed description of the CRVICS, see Section 7.3.1.1.2.

9.2.9.4 Testing and Inspection Requirements

Subsystem equipment, piping, and controls are tested and inspected as separate components and as integrated subsystems. All water flow rates are balanced and set to design flow conditions. Periodic inspections of equipment and flow rates are performed to ensure proper operation. Containment leakage testing and inspection are described in Section 6.2.6.

Service water system post-accident mode testing is described in Section 9.2.7.

9.2.9.5 Instrumentation Requirements

9.2.9.5.1 Turbine Building Ventilation Chillers

Local controls are provided for manual operation of the chillers.

Interlocks are provided to ensure that sufficient water flows, and temperatures and oil conditions are met.

Local controls are provided for manual operation of the turbine building ventilation chilled water pumps and discharge valves. Interlocks are provided to prevent startup of a chilled water recirculation pump (P1A, B) unless a chiller discharge valve (MOV24A, B, C) is fully open. The pump discharge valve (MOV4A, B) opens automatically when its associated pump (P1A, B) is running.

Local controls are provided for either automatic or manual operation of the turbine building ventilation chilled water compression tank makeup water valve. Control logic is provided for controlling compression tank level by opening and closing the makeup valve. Compression tank level is monitored in the main control room, and an extreme high or an extreme low tank level condition activates an alarm in the main control room.

A control valve is provided for controlling the ventilation chilled water pressure drop across the turbine building unit coolers.

Local controls are provided for manual operation of the turbine building chiller condenser cooling water pumps and associated inlet valves. Interlocks prevent pump startup unless the inlet valve is fully open.

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9.2.9.5.2 Radwaste Building Ventilation Chillers

Control switches are provided in the auxiliary control room for either manual or automatic operation of the radwaste building chilled water compression tank makeup water valve. Control logic is provided for controlling the compression tank level by opening and closing the makeup valve. Compression tank level is monitored in the auxiliary control room, and an extreme high or an extreme low tank level condition will activate an alarm in the auxiliary control room.

A control valve is provided for controlling the ventilation chilled water pressure drop across the radwaste building unit coolers.

Control switches are provided in the auxiliary control room for manual operation of the radwaste building chilled water recirculation pumps (P4A, B) and chiller discharge valves (MOV45A, B, C). Interlocks are provided to prevent startup of a radwaste building chilled water recirculation pump unless a chiller discharge valve (MOV45A, B, C) is fully open. A pump discharge valve (MOV55A, B) opens automatically when its associated pump is running.

Control switches are provided in the auxiliary control room for manual operation of the chilled water recirculation secondary pumps (P2A, B). Control logic is provided to prevent startup of a secondary pump unless one of the radwaste building chilled water recirculation pumps (P4A, B) is running. The pump discharge valve (MOV63A, B) opens automatically when its associated chilled water recirculation secondary pump is running.

Controls are provided in the auxiliary control room for manual operation of the radwaste/fuel building chiller compressors.

Local controls are provided for manual operation of the radwaste/fuel building chiller compressor lube oil pumps. Control logic is provided to prevent startup of the radwaste/fuel building ventilation chillers unless operating conditions similar to those for the turbine building ventilation chillers exist.

Automatic shutdown of the radwaste/fuel building ventilation chillers occurs when any of the conditions similar to those for the turbine building ventilation chillers are present.

Local alarms are provided for the radwaste/fuel building ventilation chiller trips due to chilled water flow failure, condenser service water flow failure, and lube oil failure. Computer inputs are provided for the radwaste building ventilation chiller trips.

9.2.10 Control Building Chilled Water System

The system removes the heat generated by personnel and equipment in the main control, standby switchgear, and chiller equipment rooms.

9.2.10.1 Design Bases

The control building chilled water system is designed in accordance with the following criteria:

1. Seismic Category I and Safety Class 3.
2. Piping, coils, pumps, and chillers are built and "N" stamped according to ASME Code Section III subsection ND Class 3(1).
3. Coils support sections are built in accordance with ASME Code Section III subsection NF Class 3(1).

9.2.10.2 System Description

The control building chilled water system consists of two redundant, closed loop chilled water trains.

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The control building chilled water system is shown in Fig. 9.2-8. The nominal capacity and performance data of the principle system components supplied by the equipment manufacturer are listed in Table 9.2-19.

9←•

The chilled water system supplies chilled water during normal, shutdown, and DBA conditions to the cooling coils in the main control room air conditioning units, in the standby switchgear rooms air conditioning units, and in the chiller equipment rooms air conditioning units.

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The main control room cooling coils extract heat and moisture from the main control room return air to maintain main control room ambient temperature at 80°F maximum and the relative humidity at 70 percent maximum. The cooling coils for the standby switchgear rooms and the chiller equipment rooms limit the temperature in these areas to a maximum of 104°F. Relative humidity is not controlled in these areas and ranges from 20 to 90 percent. These conditions are achieved by supplying chilled water to the cooling coils of the main control room, standby switchgear rooms, and chiller equipment rooms air handling equipment at 101 gpm, 62.3 gpm, and 28 gpm, respectively. The cooling coil entering water temperatures are maintained at 52.5°F. Water temperatures leaving the cooling coils of the main control room, standby switchgear rooms, and chiller equipment rooms are approximately 72°F, 83°F, and 64.3°F, respectively under design conditions.

2←• 9←•

•→3
Chilled water is supplied by two independent trains, either one of which is capable of meeting the total chilled water demand. Each train contains two 100-percent capacity electric
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motor-driven, centrifugal liquid chillers, two 100-percent capacity chilled water recirculation pumps, two 100-percent capacity condenser cooling water pumps, and one chilled water compression tank. The service water systems provide the chiller condenser cooling water as described in Sections 9.2.1 and 9.2.7.
•→10 •→8A •→8
The chilled water system is started manually and operates continuously. One supply air thermostat with humidity override controlled by space thermostat for each main control room air conditioning unit controls the chilled water flow to the main control room air conditioning unit cooling coil. Similarly, return air thermostats control the flow of chilled water to the standby switchgear rooms' air conditioning unit cooling coils.
3←• 8←• 8A←• 10←•
Each chilled water train, A and B, has separate connections to the corresponding service water train. During normal operation, water to the chiller condenser cooling circuits is supplied from the normal service water system. During an accident or loss of offsite power, the water is supplied from the standby service water (SSW) system. The SSW system is also connected to the chilled water circuit. In the event both chilled water trains fail, partial cooling can be achieved by using the standby service water instead of the chilled water as described in Section 9.2.10.3.

Makeup water for the chilled water system is normally supplied by the plant makeup water system as described in Section 9.2.3. During accident conditions the makeup water is supplied by the SSW system.

9.2.10.3 Safety Evaluation

The control building chilled water system provides a reliable source of cooling water for the chilled water coils of air conditioning units located in the control building. The system is designed to operate during normal, shutdown, or accident conditions without loss of function. The chilled water system is designed to Seismic Category I criteria and is connected to the standby ac power supplies. All equipment is located in the control building which is a tornado proof, Seismic Category I structure. In the unlikely event of loss of main control room air conditioning, plant shutdown can be performed from the remote shutdown panel as discussed in Section 7.4.

Two redundant and independent trains are provided. The system equipment is physically separated and protected with a barrier as described in Section 3.5.3. The system conforms to the single failure criterion. The consequences of control building chilled water system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) Report submitted under separate cover.

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Each redundant train consists of two 100-percent capacity water chillers, two 100-percent capacity condenser cooling water pumps, and two 100-percent capacity chilled water recirculation pumps. Each train (one 100-percent capacity chillers and one 100-percent chilled water recirculation pump) is capable of meeting the total chilled water demand.

During a LOCA, with loss of offsite power, one 100-percent chiller is capable of removing the reduced heat load generated in the control building.
3←•
Standby service water is provided as backup to the normal service water system for chiller condenser cooling as described in Section 9.2.7.

The refrigeration system is an integral part of the water chiller packages. The chillers are located in the equipment room used for no other purpose than for the control building chilled water system mechanical equipment. The chillers' refrigeration systems utilize a nonflammable refrigerant R-114 (dichlorotetrafluoroethane). A Safety Code for Mechanical Refrigeration (ANSI 9.1) classifies refrigerant R-114 in Group 1, the least hazardous.

The following provisions are made to prevent sudden refrigerant barrier failure. The condenser discharge temperature is the first indication of rising refrigerant system pressure. Increase in condenser cooling water temperature above a preset level initiates an alarm in the main control room. If corrective action is not taken, the refrigerant system high pressure cutout stops the chiller and an alarm is annunciated in the main control room.

The chillers' refrigeration systems are provided with relief valves designed to relieve excess pressure. Discharge of the relief valves is piped to the outside of the building. To further reduce the possibility of a refrigeration system experiencing high temperatures (as in the case of a fire outside the equipment room that could cause the refrigerant barrier to fail), the walls, floor, and ceiling of the equipment room are 3-hr fire rated construction. Doors are Class A fire doors designed following guidance provided by the NFPA 80 fire protection code as described in Section 9.5.1.

To preclude the possibility of refrigerant decomposition, no flame-producing devices or hot surfaces above 290°F are located in the equipment room. Smoke and fire detectors are located in the equipment room to give early warning to the main control room operators. The room is provided with continuously operating mechanical cooling and ventilation with outside air as described in Section 9.4.1. The air supply and exhaust ducts used for room ventilation serve no other area and are outside the main control room pressure envelope.

9.2.10.4 Testing and Inspection Requirements

Instruments and controls are provided for periodically testing the performance of the system during normal station operation or scheduled shutdown. After testing each individual component of the system, the entire system is tested. All water flow rates are balanced and set to the design flow conditions. Periodic inspections of equipment and flow rates are scheduled to ensure the proper operation of the system. Flow elements for flow measurement are provided.

9.2.10.5 Instrumentation Requirements

•→8 •→3

Manual control switches are provided in the main control room for operation of the chiller compressors (CHL 1A, B, C, D). Control logic is provided to prevent starting a compressor until normal chilled water flow through the evaporator and normal service water through the condenser have been established. An extreme low flow condition stops the chiller compressor. A chiller automatic trip alarm is provided in the main control room. A chiller compressor pretrip alarm is also provided in the main control room. A data acquisition system is provided to monitor the status of safety controls during chiller compressor startup, operation, and trips for HVK-CHL1A and HVK-CHL1B. HVK-CHL1C and HVK-CHL1D have data acquisition locally displayed at control panels HVK-PNL1C and HVK-PNL1D, respectively. Control logic is provided so that the redundant system will start automatically. During loss of off-site power, the pre-selected chiller compressor 1B or 1D starts up automatically in their proper standby bus loading sequences in Division II. In the event the Division II chiller fails to start automatically, the pre-selected chiller compressor 1A or 1C in Division I starts automatically after a time delay.

8←• •→11

The Division II chillers are required to operate in the event of a fire in the Control Building. A fire may damage certain instrumentation cables resulting in false low flow signals to the chiller logic circuits. For this reason key locked selector switches are provided in the main control room to allow manual bypass of the flow permissives and allow continued operation of the Division II chillers.

11←•

Control switches are provided in the main control room for either manual or automatic operation of the chilled water pumps (P1A, B, C, D). Automatic trip of chiller compressors or low airflow through an air-conditioning unit trips the associated operating chilled water recirculation pump. Control logic is provided so that low chilled water flow through a chiller automatically starts the redundant system's chilled water recirculation pump.

3←•

The chilled water recirculation pumps are interlocked with their respective discharge valves (MOV 20A, B, C, D) so that the valve is open when the pump is running and closed when the pump is not running.

Control switches are provided in the main control room for either manual or automatic operation of the compression tank makeup water valves (MOV 10A, B). Level control logic is provided for opening and closing the makeup valve while in the automatic mode of operation. The valve automatically closes when a LOCA signal is present.

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•→12
Compression tank level is monitored and extreme high or low tank level activates an alarm in the main control room. Manual control switches are provided in the main control room for opening and closing the compression tank alternate makeup water valves (MOV 10A,B).
12←• •→3
Control switches are provided in the main control room for either manual or automatic operation of the chiller condenser cooling water pumps (1SWP*P3A, B, C, D). In automatic mode, these pumps start when their associated service water recirculation inlet valve (ISWP*MOV 27A, B, C, D) is full open. Upon loss of power, pumps start on restoration of power to the motor control center if it was running in manual mode. Upon loss of power in automatic mode, pumps start on restoration of power to the motor control center and the inlet valve full open permissive. Control logic is provided for opening the condenser cooling water pump inlet valves when the associated chiller compressor start signal is present and for closing when the chiller compressor auto trip or stop condition exists.
3←• •→4
Locked partially open chilled water bypass valves HVK*V3007 and *V3008 are provided to insure minimum chilled water flow through the evaporator and stable operation of chilled water pump during all cooling demands. Modified valves also insure maximum design chilled water flow through control building air conditioning units.
4←•
Control building chiller inoperative alarms are provided in the main control room.

9.2.11 Cooling Tower Makeup Water System

The cooling tower makeup water system has an interface with the normal service water system and the circulating water system as described in Sections 9.2.1 and 10.4.5, respectively.

9.2.11.1 Design Bases

The normal cooling tower makeup water system is designed in accordance with the following criteria:
•→6
1. To supply makeup water to the circulating water system cooling tower discharge flume and to the service water cooling system cooling tower discharge flume to makeup for losses resulting from evaporation and drift from the cooling towers.

•→10
2. To supply makeup water to the circulating water system and to the service water cooling system to replenish a blowdown rate up to 4,400 gpm from the circulating water system cooling towers, while allowing for blowdown from the service water cooling system backwash filters via the combined filter backwash/blowdown line to the circulating water system.

6←• 10←•

•→6

3. To remove suspended solids from the water drawn from the Mississippi River by means of chemical flocculation and clarification.

6←•

9.2.11.2 System Description

•→12

The cooling tower makeup water system (Fig. 9.2-24 and 9.2-24b) consists of the following equipment:

12←•

1. Two full-capacity, motor-driven, vertical, centrifugal, cooling tower makeup water pumps operate in parallel and are located in a dry-pit pumphouse at the Mississippi River. One pump is normally operated and the second pump is reserved for standby operation. Each pump is capable of delivering the maximum cooling tower makeup water requirement 15,300 gpm. The pumps take suction from the Mississippi River and discharge through one 36-in diameter line to a flow splitter box feeding the two clarifiers.

•→14 •→8

2. The intake flow enters through two intake screens located as shown in Fig. 2.4-31. One 36-in diameter intake line for each intake screen conveys water to the makeup pumphouse. Within the pumphouse, two 36-in diameter intake lines manifold through a common header into two 24-in diameter lines, each directly connected to a makeup water pump. The intake screens can be backwashed one at a time by starting the second makeup water pump and diverting a portion of the combined flow back through the selected intake screen. The screens are anticipated to require backwashing once per day for about 30 min. The actual frequency and duration are determined by operator experience. Each screen unit is equipped with a collapsible panel fixed by a shear pin. The pin is designed to shear upon a 5-ft differential pressure, allowing the panel to swing open relieving the pressure.

8←•

3. The pumphouse is constructed to ensure a minimum submergence head over the pump impellers and to protect the pumps from the probable maximum flood level. The entrance to the structure is at el 60 ft 6 in msl.

14←•

•→14 •→11 •→10 •→8

4. Two full-flow clarifiers remove suspended solids from the Mississippi River water. The clarified effluent is discharged over a weir into the circulating water flume. Each clarifier is designed to satisfactorily treat the entire requirement of makeup water for the normal cooling towers of River Bend Station in the event that one clarifier is out of service. Polyelectrolyte is added to the raw water to enhance flocculation and settling of suspended solids. A 5,000 gal storage tank and three metering pumps are provided for storage and feeding of polyelectrolyte. A 5,500 gal storage tank is provided for storage of sodium hypochlorite. The chemical feed rate(s) may vary with changing influent conditions and the metering pumps are provided with manual stroke control for maintaining a proper treatment rate. The solids which settle are intermittently discharged to the sludge dilution tank where the solids concentration is adjusted to a level suitable for pumping to the river. Clarified water under pressure is used to remove any buildup of solids in either clarifier sludge discharge pipe during a sequence of backflushing prior to each discharge of sludge. Two backflush pumps taking suction from each clarifier clear water zone are provided for this purpose.

8←• 10←• 11←• •→3

5. One sludge dilution tank is provided near the clarifiers to receive clarifier bottoms sludge blowdown. The blowdown from the clarifiers flows to the dilution tank where river water from the makeup water pipeline is continuously fed and mixed in the sludge dilution tank, other sources of water can be fed to the sludge dilution tanks. The dilution tank is equipped with two full-capacity vertical mixers and two 100% capacity centrifugal pumps. Each mixer is capable of mixing dilution water with the maximum clarifier bottoms blowdown for two reactor units. The diluted clarifier blowdown is pumped through one pipeline to an outfall in the Mississippi River.

3←• 14←•

9.2.11.3 Safety Evaluation

The cooling tower makeup water system is not safety-related. The cooling tower makeup water system pumps are designed in accordance with the guidelines of the Hydraulic Institute Standards, and the piping is designed to ANSI B31.1.0 and AWWA.

9.2.11.4 Testing and Inspection Requirements

Pumps in the cooling tower makeup water system are proven operable by use during normal plant service and are rotated periodically to equalize wear. System components normally closed to flow are tested periodically to ensure operability.

9.2.11.5 Instrumentation Requirements

•→14

Controls are provided in the auxiliary control room for manually stopping and starting the cooling tower makeup water pumps. Control switches at the 4 kV switchgear permit local operation of the pumps. Interlocks are provided to discontinue operation of a pump if its discharge valve remains in a not fully open position for a specified time.

14←•

Controls are provided for either remote operation from the auxiliary control room or local operation from the 4 kV switchgear of the cooling tower makeup water pump discharge valves. Interlocks are provided for automatically opening the valve when its pump is running and stopping the pump when the valve is fully closed. A local control switch is provided for manual operation of the cooling tower makeup water pump suction valves.

•→12

A makeup water pump house trouble alarm is provided in the auxiliary control room for cooling tower makeup water pumps auto trip.

12←• •→6 •→2

Circulating water flume level is indicated and recorded in the auxiliary control room, and a high or low level alarm is provided.

2←• 6←• •→14

14←• •→10 •→8A •→8 •→3

Control switches are provided locally in the clarifier area control panel for either manual or automatic operation of the diluted clarifier blowdown pumps (P2B,C). Control logic is provided to prevent automatic starting of the pump until the sludge dilution tank water level is high, or to prevent manual starting of the pump if the sludge dilution tank water level is low. Low water level in the sludge dilution tank will stop the pump. Interlocks are also provided to discontinue operation of the pump if its discharge valve remains in a not fully open position for a specified time.

8←• 8A←• ←•10 •→14

Local control switches are provided for manual operation of the clarifier sludge mixers.

3←• 14←•

•→2
Inlet water flow to the clarifiers is indicated and recorded in the auxiliary control room, and totalized and recorded in the local control panel.
•→10
Controls are provided for manual operation of circulating water system blowdown valve CWS-MOV104, as discussed in Section 10.4.5.5.
2←• 10←• •→6
9.2.12 Service Water Cooling System

The service water cooling system provides cooling water to remove heat from the normal service water system during all modes of plant operation. The service water cooling system operates during normal plant operation, as described in this section. In emergency situations, the safety-related standby service water system operates as described in Section 9.2.7.

The service water cooling system is shown on Fig. 9.2-1j and 9.2-1k. Table 9.2-20 lists the flow requirements for the service water cooling system.

9.2.12.1 Design Bases

The service water cooling system is designed in accordance with the following criteria:

1. The service water cooling system components are designed in accordance with the safety classification listed in Table 3.2-1.

2. The service water cooling system is designed to remove the heat loads accepted by the normal service water system as listed in Table 9.2-1.

3. The service water cooling system is designed to provide cooling water to the normal service water system heat exchangers which cool the normal service water system during normal plant operation and planned unit outages.

4. The service water cooling system is cooled by the service water cooling system cooling tower.

9.2.12.2 System Description

The service water cooling system utilizes three 50-percent capacity, motor-driven, vertical pumps. These pumps each have a capacity of approximately 31,500 gpm. Service water cooling system water is pumped from the service water cooling system cooling tower pump pit. Each pump discharges into the service water cooling system pump discharge header/common service water cooling system heat exchanger supply header. The service water cooling system is shown on Figure 9.2-1j through k.
6←•

•→6
The service water cooling system common heat exchanger outlet/cooling tower supply header is routed to the service water cooling system cooling tower. Five (5) risers carry the water to the top of the cooling tower where it is cooled before recirculation through the system.

Major component design data is listed in Table 9.2-20.

During normal operation and unit cooldown, two of the three service water cooling system pumps are required to dissipate the auxiliary heat loads. The third is a spare to accommodate maintenance or failure of either of the two operating pumps. However, analysis shows that using Operations procedural guidance, operating one service water cooling pump is sufficient to dissipate heat load generated during plant normal operations and plant outages.
•→16
The water quality of the service water cooling system is controlled in order to minimize scaling, corrosion, and biological fouling. This is accomplished by injecting multifunctional chemicals (Fig. 10.4-4). A sodium hypochlorite/sodium bromide solution (Fig. 10.4-4) is periodically injected into the service water cooling tower basin to inhibit biological growth in the service water cooling system. An alternate method to inhibit biological growth is the injection of granules into the flume water by the Towerbrom subsystem. Sulfuric acid (Fig. 10.4-4) is also injected into the basin to control cooling water pH so that scaling and corrosion in the system is minimized. At this pH range, the water is nonscaling and noncorrosive. Additionally, a corrosion inhibitor and a dispersant (Fig. 10.4-4) are injected into the service water cooling tower basin to maintain proper water quality.
16←•
Piping wall thicknesses are increased over normal design requirements by a corrosion allowance, which is provided for all piping to ensure against degradation of system performance due to the effects of long-term corrosion. Additionally, the water in the service water cooling system is chemically treated and protective coatings are applied to the internals of certain components to control corrosion.

9.2.12.3 Safety Evaluation

The service water cooling system is a non-nuclear safety system used to provide cooling to the normal service water system. Cooling water for safe shutdown and maintenance of the safe shutdown condition is provided by the Standby Service Water System (Section 9.2.7).

9.2.12.4 Testing and Inspection Requirements

The service water cooling system water pumps are proven operable during continuous plant operation. Selection of the two operating and one spare pump is rotated periodically to equalize wear.
6←•

•→6

9.2.12.5 Instrumentation Requirements

The service water cooling system pump discharge header pressure and temperature are monitored in the main control room, and controls are provided for automatic startup of a third pump on low service water cooling system pump discharge header pressure or automatic trip of either of the two running pumps. Low and extreme low header pressure alarms are provided in the main control room. Interlocks are provided to prevent the startup of a service water cooling system pump unless its discharge valve is partially open. Control switches are provided in the main control room as well as locally on the switchgear for manual operation of the service water cooling system pumps.

6←•

References - 9.2

1. ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1974 Edition and Addenda through the Winter 1974 addenda.

2. ASME Performance Test Code 23, Atmospheric Water Cooling Towers (the issue in effect at time of tower acceptance testing).

•→6

3. Cooling Tower Institute, Test Code ATC-105, Acceptance Test Code for Water Cooling Towers, 1990.

6←•

4. "Ultimate Heat Sink Simulator" (UHSSIM) Computer Program 03.7.870-1.0.

5. ML12146A145, "Method for Analysis of Ultimate Heat Sink Cooling Tower Performance", by S. M. Sullivan and W. E. Dunn, University of Illinois at Urbana-Champaign, Department of Mechanical and Industrial Engineering, April 1986 (contains UHSSIM program).

9.3 PROCESS AUXILIARIES

9.3.1 Compressed Air Systems

•→8

The compressed air systems are composed of the instrument, service, and breathing air systems that are shown in Fig. 9.3-1a through 9.3-1h and Fig. 9.3-2a through 9.3-2f.

8←•

9.3.1.1 Design Bases

9.3.1.1.1 Breathing Air System

The breathing air system is designed to supply clean air through the service air system to strategically located service air stations throughout the unit for use by unit personnel during the following conditions:

1. When extensive in-place maintenance is expected on equipment in radioactively contaminated systems.

2. When extensive work is expected in areas of potentially high airborne activity.

3. When work is required in cubicles where no ventilation is presently provided.

4. When special operations occur that create high airborne contamination (e.g., draining, sampling, repairing or handling equipment, systems, or materials).

5. When special handling of noxious or toxic chemicals is required.

In designing the plant breathing air system, the following regulatory guidelines regarding limiting personnel exposure to airborne radioactivity and maintaining breathing air quality were considered:

1. U.S. Nuclear Regulatory Commission Guidelines (NRC)

   U.S. NRC 10CFR20, Standards for Protection Against Radiation, Section 20.103, Exposure of Individuals to Concentrations of Radioactive Materials in Air in Restricted Areas.

   U.S. NRC NUREG 0041/1976, Manual of Respiratory Protection Against Airborne Radioactive Materials.

2. Occupational Safety and Health Act Requirements (OSHA)

   29CFR1910.94 (A)(6), Air Supply and Air Compressors.

   29CFR1910.134 (D)(1), Air Quality of Compressed Air.

3. Department of the Interior Bureau of Mines/NIOSH Equipment Standards

   ANSI Z88.2-1969, American National Standard, Practices for Respiratory Protection.

The breathing air system is not intended to provide a source of breathing air for routine activities, emergency situations such as firefighting, or for situations that would require a person to perform normal duties in a hazardous area for a full workshift. For these activities, a source of breathing air would be provided by the regular building ventilation system or by air packs.

The breathing air system is designed to accommodate any combination of respiratory equipment (e.g., half-mask facepieces, full facepieces, air hoods, air helmets, and air suits). The design capacity for the breathing air system is 470 scfm.

9.3.1.1.2 Instrument Air System

The instrument air system is designed to supply clean, dry air for plant instrumentation and controls at a minimum pressure of 100 psig and a design dew point of -40°F.

•→2

Instrument air supplied to safety-related equipment complies with the requirements of ANSI MC11.1-1976 (ISA-S7.3), Quality Standard for Instrument Air, with regard to dewpoint depression at least 18°F below the minimum expected ambient temperature, oil content below 1 ppm during normal operating conditions, and freedom from all corrosive contaminants and hazardous gases, flammable and toxic.

2←•

The maximum particle size in the air supplied to safety-related equipment is listed in Table 9.3-4. Maximum allowable particle sizes are based on manufacturers' requirements. Filters capable of removing particles larger than maximum allowable size have been provided for each safety-related service.

•→3

Some safety related air actuated valves/dampers may have Category 2 actuators because the valve/damper has no safety function open or closed (e.g., RWCU filter demineralizer AOV's; these valves are Category 1 because reactor water flows in them, but the actuators are Category 2 because the valves' positions have no safety function). The maximum particle size limits in Table 9.3 4 do not apply to these Category 2 actuators.

3←•

The main air receiver tanks and supplemental air accumulator tank are designed to the ASME Unfired Pressure Vessel Code, Section VIII, Division I. Piping is designed to ANSI B31.1. Piping which penetrates the containment and drywell walls is ASME III Safety Class 2 (Sections 6.2.4 and 3.1.2.57). Instrument air piping inside the drywell is non nuclear safety class. Intercoolers and aftercoolers are designed to TEMA Class R.

•→3

Supplementary ASME III Safety Class 3 accumulator tanks are provided to ensure adequate air supply to dampers in the fuel, auxiliary, and control buildings in the case of a loss of offsite power or a LOCA. Eight compressed air bottles are connected to each supplementary accumulator tank in the control building. The additional air reserve capacity of the air bottles supplements the usable air capacity of the accumulator tank. The provision of air bottles; therefore, ensures continuous availability of the instrument air to the dampers in the control building in the event of the loss of offsite power or a LOCA.

3←• •→8A •→8

9.3.1.2 System Description

•→12

The compressed air supply to the instrument, service, and breathing air systems is provided by six, electric driven, oil free compressors. Three air compressors will serve the Instrument Air System and the other three air compressors will serve the Service Air System. The Instrument Air System will have two 100% capacity air compressors with one 100% capacity standby air compressor (IAS compressors are not each 100% capacity during the system repressurization time frame). The service air system will also have two 100% capacity air compressors with one 100% capacity standby air compressor. The Service Air System air compressors will be crosstied to the Instrument Air System, so any Service Air System air compressor can be fed into the Instrument Air System. Each air compressor is provided with a trim cooler and moisture separator for the discharged compressed air. After passing through the moisture separator the air is passed through one of two 100% capacity pre filters, one of two 100% capacity desiccant type air dryers and then filtered through one of two 100% capacity after filers. Breathing air is taken directly from the service air stations. The instrument air is then distributed to various plant instrument services.

•←8 8A←• 12←•

•→8
The major components of the compressed air system are located in the Instrument Air and Service Air Compressor Building located at E1. 95 ft. and adjacent to the west side of the Turbine Building, with some of the equipment located in the Turbine Building basement at E1. 67 ft. -6 in. Environmental design considerations are discussed in Section 3.11.

9.3.1.3 Safety Evaluation

•→12 •→4
Under normal station use, two electric-driven instrument air compressors are operational, one running and one in automatic standby, with a third electric-driven compressor on automatic standby for emergency use and backup for maintenance. Also, under normal station use, two electric-driven service air compressors are operational, one running and one in automatic standby, with a third electric-driven compressor on automatic standby for emergency use and backup for maintenance. The air compressors are operated from the normal plant power supply. The instrument air headers, receivers and bottles have sufficient capacity to meet air requirements for all instrument and control needs required to safely shut down station operations following a loss of power incident. Loss of the air storage capacity causes the air-operated valves to fail to the appropriate safe position by the action of springs or separate air accumulators at the valves. Upon a loss of power incident the standby diesel-driven air compressor pressurizes the instrument air, service air, and breathing air systems with oil free, pressurized air after manual actuation.
4←• 12←•
With the exception of the containment and drywell penetrations and the three independent Safety Class 3 air damper air accumulator systems, the instrument, service, and breathing air systems are not safety-related. The service air piping system is ANSI B31.1 nonnuclear safety class up to two gate valves just outside of the primary containment. The gate valves, the check valve just inside the primary containment, and the piping between them are ASME III nuclear Safety Class 2. Distribution piping following the check valve and piping up to the gate valve immediately outside the drywell wall are ANSI B31.1 nonnuclear safety class. The gate valves just outside the drywell wall, the check valves just inside the inside drywell wall, and piping between them are ASME III nuclear Safety Class 2. Distribution piping inside the drywell wall is nonnuclear safety class.
8←•

•→8
Instrument air system piping up to two gate valves outside the primary containment is ANSI B31.1 nonnuclear safety class. The gate valves just outside the primary containment, the check valve inside the primary containment, and the piping between them is ASME III nuclear safety Class 2. Distribution piping following the check valve inside the containment and piping up to the gate valve just outside the drywell wall is ANSI B31.1 nonnuclear safety class. The gate valve outside the drywell wall, the check valve just inside the drywell wall, and the piping between are ASME III nuclear Safety Class 2. Distribution piping inside the drywell wall is ANSI B31.1 nonnuclear safety class. The safety-related function of penetrations is described in Section 3.1.2.57.
•←8 •→4
The air compressor inlet filters remove all particles 3 microns or larger in size and 98 percent (by weight) of all particles 1.5 microns or larger in size. To ensure cleanliness, instrument air including air pressurized by the diesel-driven air compressor is filtered again after leaving the dessicant dryers. Periodic maintenance checks of all filters coupled with the duplicity in design of the instrument air filters ensure system reliability.
4←•
The following air-operated valves are required for safe shutdown:

1. Main Steam Isolation Valves

   On loss of air supply, the main steam isolation valves fail closed. A main steam air accumulator is located near each isolation valve to provide pneumatic pressure for the purpose of assisting in valve closure in the event of failure of pneumatic supply pressure to the valve operator system. In addition, three parallel strainers are located inline to ensure air cleanness (<50 micron) by filtering particles from the air to the MSIVs.

2. Scram Valves

   On loss of air supply, spring action and system pressure force the scram valves to fail open causing control rod drive water to force the piston upward, inserting the control rods.

3. Scram Volume Vent and Drain Valves

   On loss of air supply, spring action forces the scram vent and drain valves to fail closed to prevent loss of reactor water discharged from all the scram valve drivers during a scram, and also to contain the reactor water that leaks past the drivers following a scram.

•→7 7←•

4. Feedwater Check Valves Outside the Containment Wall

   On loss of air supply, spring action forces the feedwater check valve off its back seat, allowing it to float with system flow.

The consequences of compressed air system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) Report.

9.3.1.4 Testing and Inspection Requirements

•→4

The instrument and service air systems operate continuously and are observed and maintained during normal operation and during loss of power. No special inspection and testing are required following preoperational testing. The breathing air system is tested periodically for human use in accordance with normal unit operating procedures.

9.3.1.5 Instrumentation Requirements

9.3.1.5.1 Air Compressors

9.3.1.5.1.1 Electric-Driven Air Compressors

4←• •→8

Manual control switches are provided in the main control room and auxiliary control room for operation of the IAS and SAS air compressors, respectively.

Control logic is provided so that a low air receiver pressure condition automatically starts the standby air compressor.

Loading and unloading of the compressors are accomplished by automatic controls. A pneumatic unloader allows the air compressor to start unloaded.

An IAS compressor trouble alarm is provided in the main control room and an SAS trouble alarm is provided in the auxiliary control room. The air compressor automatically stops if an extreme abnormal condition occurs.

•←8 •→4

9.3.1.5.1.2 Standby Diesel-Driven Air Compressor

A manual control switch mounted on the standby diesel-driven air compressor is provided for operation of the standby diesel-driven air compressor.

The cooling water system of the diesel-driven air compressor is contained completely within the diesel-driven air compressor skid. Upon high cooling water temperature the diesel-driven air compressor will automatically shut down.

4←•

9.3.1.5.2 Instrument Air System

•→4

Operation of the drying and purging cycle for the instrument air dryers is normally controlled by a desiccant moisture probe. During the minimum 8 hour cycle, one vessel is pressurized for a minimum of 4 hours while drying the air. At the same time, the other vessel is at atmospheric pressure while the desiccant is being dried (regenerated) using heated atmospheric air from a centrifugal blower. A dryer trouble alarm is provided in the main control room.

4←•

Instrument air header pressure is monitored and a low pressure alarm is provided in the main control room.

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Manual control switches are provided in the main control room for opening and closing the instrument air leakage control valve.

The Division I instrument air containment isolation valve automatically closes when a LOCA signal is present. Manual control switches are provided in the main control room for opening and closing of the valve.

9.3.1.5.3 Service Air System

Manual control switches are provided in the main control room for opening and closing of the service air containment isolation valves.

The Division I service air containment isolation valve automatically closes when a LOCA signal is present.

Service air header pressure and engineering shop cleaning air pressure are maintained at their set points by control valves in the respective supply lines.

9.3.2 Process Sampling System

The process sampling system consists of three subsystems: turbine plant sampling subsystem, reactor plant sampling subsystem, and radwaste sampling subsystem.

9.3.2.1 Design Bases

The process sampling system is designed:

1. To continuously monitor the operation of station process equipment.

2. To ensure that sample points are located in turbulent flow zones that allow for rapid purging and high velocities to obtain representative samples.

3. To provide representative samples in forms and quantities which can be analyzed in a radiochemical laboratory or a conventional chemical laboratory to determine station equipment effectiveness.

4. To direct the majority of the samples to sample sinks for grab sampling.

5. To minimize radiation effects to personnel by providing hooded, ventilated sample sinks and area radiation monitors at the sample sink locations.

6. To ensure that tank samples are taken from bulk tank volumes and not from low points or sediment traps.

•→15

7. To ensure that piping originating from ASME III pipes, up to and including the outer isolation valves, conforms to ASME Section III, Classes 1, 2, and 3 as required, and that valves and tubing downstream of the outer isolation valves conform to ANSI B31.1. ASME Section III piping is designed against failure from high- and moderate-energy pipe breaks, and from missiles generated internally or externally to the drywell. The 1/4-in sample tubing meets design conditions of 1,000°F at a mean working pressure of 6,960 psig, and the 3/8-in sample tubing meets design conditions of 1,000°F at a mean working pressure of 4,266 psig. These design conditions exceed the sampled systems' design conditions. Primary sample tubing is ASTM A213, grade TP 316 stainless steel. Sample system valves are TP 316 stainless steel.

15←•The seismic design and safety classifications of sample lines and their components conform to the classification of the system to which they are connected, up to and including the outer isolation valve.

•→15

All sample lines originating inside the containment terminate at the reactor plant sample station located inside the containment or at the post accident sampling station located in the auxiliary building.

15←•

Sample coolers are designed to ASME VIII.

9.3.2.2 System Description

The process sampling subsystems and the parameters to be measured are shown in Fig. 9.3-3a through 9.3-5b. Within the process sampling subsystems, samples are taken at various locations as indicated in Table 9.3-1. The following sample station panels accommodate the process sampling subsystem analyzers and associated equipment:

1. Turbine plant sampling system consists of three sample stations located as follows:

    a. Turbine building sample station

b. Condensate demineralizer area sample station

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c. Water treatment building sample station (Not Used)

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2. Reactor plant sampling system consists of three sample stations located as follows:

   a. Reactor sample station (by NSSS)

   b. Reactor plant corrosion product monitor

   c. Fuel building sample station

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   d. Post accident sample station

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3. Radwaste sampling system sample station.

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The main condenser evacuation system (off gas system) is sampled by the process radiation monitoring system, described in Section 11.5. Provisions for sampling in accordance with the guidelines of Regulatory Guide 1.21, Position C.6, are provided. Liquid radwaste tank volumes are recirculated by the associated system pump to assure adequate mixing before sampling. The tank samples are taken from the recirculation lines by sample root taps which are routed to the radwaste sample panel. Attaining representative samples from gaseous process streams and tanks is described in Section 11.5. The containment and drywell equipment and floor drain sump pumps' discharges are routed to the radwaste system (Section 9.3.3). The sumps inside the containment can be sampled through a local grab sample point outside the containment in accordance with General Design Criterion 64. System pressure and temperature requirements vary throughout the process sampling system. Individual sampling lines are designed in accordance with the system pressure and temperature requirements from which the sampling line originates. Four general types of samples are obtained by the sampling system:

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1. High-temperature and high-pressure samples (temperature greater than 120°F, pressure greater than 100 psig)

2. High-temperature and low-pressure samples (temperature greater than 120°F, pressure less than 100 psig)

3. Low-temperature and high-pressure samples (temperature less than 120°F, pressure greater than 100 psig)

4. Low-temperature and low-pressure samples (temperature less than 120°F, pressure less than 100 psig).

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High-temperature samples are reduced to 120°F, or less, by passing them through sample coolers. The cooling of high-temperature samples minimizes the release of radioactive gases into the hooded, ventilated sample sinks and/or reduces sample temperatures to levels low enough for safe handling. High-pressure samples are reduced in pressure by the use of suitable pressure-reducing devices, such as manual globe valves. Local instrumentation at the sample sinks is provided to permit manual control of sampling operations and to ensure that the samples are of suitable temperatures and pressures before diverting flow to the sample sinks. Sample points are grouped as much as possible at accessible locations, and equipment drains are provided at these locations to reduce the risk of contamination. Sample panel drains are returned to the liquid radwaste system for treatment prior to disposal, except for samples from the circulating water system, which may be directed to the circulating water discharge line. Sample system instruments are provided wherever necessary for continuous monitoring of equipment as shown in Table 9.3-1.

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The sample locations are arranged as follows:

1. Two in the turbine building, including one in the condensate demineralizer area

2. One in the reactor building

3. One in the fuel building

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4. One in the water treatment building (Not Used)

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5. One in the radwaste building.

These sample locations are provided to collect the majority of samples at hooded, ventilated sample sinks. Detailed radiochemical analyses are run at the radiochemistry laboratory (Section 12.3). Sampling lines are sized to maintain turbulent flow (i.e., Reynolds number greater than 4000) in accordance with the NSSS vendor recommendations. Sampling line routes are as short as possible. The routing avoids traps and dead legs and, where possible, dips upstream of the sample line discharge. The River Bend Station process sampling systems utilize two types of sample lines:

1. Continuous flow to provide continous sampling

2. Normally isolated grab sample lines.

Both types of sample lines have an in-line manual pressure-regulating valve to maintain the proper sample flow rate and turbulence. The continuous flow sample line will not have any stagnant lines, therefore a purge will not be necessary. The grab sample lines, normally stagnant until samples are taken, are sized to maintain a turbulent flow as stated above. Representative samples are provided by sample probes which are inserted into the process piping being sampled or by piping wall taps located in the turbulent flow zones.

The appropriate purge time will be established by operating procedures. If required, the operator can fully open the manual pressure-regulating valve to purge at a faster rate. In either situation, a proper purge can be obtained.

9.3.2.3 Safety Evaluation

The sampling system is not required to function during an emergency condition, nor is it required to function to prevent an emergency condition.

Reactor coolant is sampled through a sample nozzle which has a 3/4-in diameter inlet port facing into the flow stream. This type of sampling nozzle is suitable for obtaining a representative sample and also provides a restriction to limit reactor coolant loss at normal system pressure from a rupture of a sample line that would create a small break loss of coolant of 125 gpm, which is well within the capability of the reactor coolant makeup system.

The sample lines that contain primary coolant consist of the reactor coolant recirculation sample lines and the reactor water cleanup sample lines. The reactor coolant recirculation sample line can be remotely isolated by the in-line drywell isolation valves (Fig. 5.4-2). The reactor water cleanup sample lines can be manually isolated with the sample nozzle root valves (Fig. 5.4-15). In either situation, the leakage is either contained inside the drywell or collected by the floor drainage system and directed to the floor drain sumps inside the drywell.

9.3.2.4 Testing and Inspection Requirements

Most components are used regularly during power operation, shutdown, and/or cooldown, thus continuously ensuring the availability and performance of the process sampling system. The continuous monitors are periodically tested, calibrated, and checked to ensure proper instrument response and operation of alarm functions.

9.3.2.5 Instrumentation Requirements

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The sample stations continuously monitor plant systems for conductivity, turbidity, dissolved oxygen, and corrosion products as indicated in Table 9.3-1. The process sampling system also provides grab sample points for obtaining local samples. Grab sample sinks are also provided for the sample stations. Except for the water treatment building sample station, grab sample sinks include fume hoods due to the radioactivity of the samples.

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A feedwater corrosion product monitor is provided in the turbine building. A filter sample at the condensate demineralizer area sample station is periodically analyzed to ensure protection against corrosion product buildup. A panel that contains a corrosion product filter is located at the reactor building sample station to provide the capability of monitoring the reactor building sample panel flow paths for corrosion products.

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Local analyzers are provided where insertion-type conductivity cells, immersion-type pH electrodes, or local turbidity detectors are required.

Recorders and alarms are provided for the process sampling system in both the main and auxiliary control rooms.

9.3.2.6 Post-Accident Sampling System

The River Bend Station (RBS) manual grab post-accident sampling system (PASS) is designed to provide representative liquid and gas samples from within the primary containment for radiological and chemical analysis in association with the possible consequences of a loss-of-coolant accident (LOCA). The PASS consists of a liquid and gas sample station located outside the containment building at elevation 114 ft along the east side wall of the auxiliary building adjacent to the stairwell (see Fig. 1.2-14 and Fig. 12.3-17).

The PASS is a nonsafety-related system powered from the normal station service ac supply. The preferred offsite ac power supply provides for all PASS loads when the normal station service ac power source is unavailable. The preferred offsite power is taken from two physically and electrically independent 230-kV circuits, providing two reliable backup sources of power as described in Section 8.2. The onsite normal station service power supply is described in Section 8.3. Power to onsite laboratories is designed with the same configuration.

The 230-kV transmission system connected to RBS is designed to a standard which equals or exceeds the standards for the systems connecting to all other plants within the GSU grid system. A study was performed to determine the reliability of the transmission connections on the GSU grid system. The calculated reliability is well above the industry standard conservatively calculated in EPRI NP-2301, Loss of Offsite Power Plants, Data and Analysis.

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Radiation exposures are maintained within the levels specified in GDC 19, assuming Regulatory Guide 1.3 source terms, by minimizing the required sample sizes, providing dilution capability, and optimizing the weight of shielded sample containers to facilitate movement through potentially high-level radiation areas. Person-motion studies, training, and drills were performed to demonstrate compliance with GDC-19 for sampling, transport, and analysis of liquid and gaseous samples. The sampling system and analysis capability will provide an assessment of the pH, dissolved oxygen, hydrogen, chloride, boron, conductivity, and radionuclides. Stripping of hydrogen and oxygen gases at the panel will preclude taking pressurized reactor coolant samples. Reactor coolant and containment atmosphere sampling during post-accident conditions does not require an isolated auxiliary system to be placed in operation to use the sampling system. RBS does not have brackish water; therefore, chloride analyses results are not required to be obtained within 24 hr but will be available within a 4-day period. Radiological analysis of gaseous or liquid samples will be provided within 3 hr from the time a decision is made to take a sample. The PASS is capable of providing at least one sample per day for 7 days following

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the onset of an accident and at least one sample per week for up to 1 year after the accident. A general arrangement of the post-accident sample station is shown in Fig. 12.3-17.
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The PASS samples can be analyzed in the lab to identify and quantify the following radionuclides: noble gases (indicative of cladding failure), iodines and cesiums (indicative of high fuel temperatures), and nonvolatile isotopes (indicative of fuel melting). The gamma detection system allows the monitoring of the reactor coolant activity over a range of 10^{-7} to 10^{+1} Ci/cc and the containment atmosphere activity over a range of 10^{-9} to 10^{-1} Ci/cc. To inform the operator of the ambient radiation level at the sample station, a local area radiation monitor is provided.

Instrumentation is provided with adequate ranges and sensitivities to allow the operator to obtain pertinent data to describe the radiological and chemical status of the reactor coolant system. Reactor coolant sample lines are of a diameter such that the rupture of a sample line will limit reactor coolant loss. All sample return lines are routed back to containment. The PASS sampling and analyses parameters, design basis ranges, design basis accuracies, and design basis time are included in Table 9.3-5. The laboratory equipment procured for the RBS PASS has been successfully used in similar environments at other nuclear facilities such as Peach Bottom. Operability of the PASS will be demonstrated annually. RBS will utilize procedures and instruments which have been proven acceptable at other BWR facilities using the GE PASS panel. PASS operators will be provided with initial and refresher training in post-accident sampling, analysis, and transport. RBS post-accident procedures will incorporate the BWR Owners Group Generic Core Damage Estimation Procedure which has been approved by the NRC in meeting minutes dated September 1, 1983, from Jan A. Norris (NRC, Division of Licensing) to David R. Helwig (Vice-Chairman, BWROG). Plant-unique programs will address post-accident sampling system testing and operational training programs.

The inaccessible PASS supply and return solenoid operated valves located in a harsh environment will be qualified to operate under their post-LOCA environmental conditions. These valves will be qualified by analysis in accordance with 10CFR50.49.
•→6
The RBS position on Regulatory Guide 1.97 for post-accident instrumentation is provided in USAR Section 1.8.
6←•

9.3.2.6.1 Gas, Iodine, and Particulate Samples

Provision has been made to obtain gas samples from both the drywell and containment atmospheres. The sample system is designed to operate over the range of potential pressures starting at 1 hr after a LOCA. Heat-traced sample lines are used to prevent condensation of moisture and resultant loss of iodine in the sample lines. The gas samples may be passed through a particulate filter and activated carbon cartridge for determination of particulate activity and total iodine activity by subsequent counting of the samples on a gamma spectrometer system in the lab.

Alternately, the sample flow can bypass the iodine sampler and be chilled to remove moisture and associated iodine. A 15-ml grab sample can then be taken for determination of gaseous activity and for gas composition by gas chromatography. The sample size is consistent with present off-gas sample vial counting factors. Provisions will be made in the laboratory to prepare aliquot fractions of the initial vial contents to other vials if the activity is too high to count directly.

9.3.2.6.2 Liquid Samples

A sample line is provided to obtain reactor coolant samples from the jet pump pressure instrument system when the reactor is at pressure. This sample location is recommended over the normal reactor coolant sample points in the reactor cleanup system since this system is expected to be isolated under accident conditions, and it is possible that the recirculation line containing the normal reactor water sample lines may not be representative of actual core coolant conditions. The jet pump instrumentation system has been determined to be an optimum sample point for accident high pressure conditions. The pressure tap is well-protected from damage and debris. There is normally excellent natural circulation of the bulk of the coolant past this tap, and the pressure tap is located sufficiently low to permit sampling at a reactor water level below the lower core support plate.

A single sample line is also connected to the RHR pump discharge lines downstream of the RHR heat exchangers in both loops. This provides a means of obtaining a reactor coolant sample when the reactor is depressurized and at least one of the RHR loops is operated in the shutdown cooling mode. Similarly, a suppression pool liquid sample can be obtained from the RHR loop lined up in the suppression pool cooling mode. The containment isolation valves for the sample lines are controlled from the control room. Purging of the panel is done to reduce operator exposure while taking manual samples.

All liquid samples are taken into septum bottles mounted on sampling needles. The sample panel is basically a bypass loop as the sample flows through a conductivity cell (readable range 0.1 to 1000 microhmos/cm) and then through a ball valve bored out to 0.10 ml volume. Flow through the sample panel is established, the valve is rotated 90 degrees, and a syringe is used to flush the sample plus a measured volume of dilutent (generally 10 ml) through the valve and into the sample bottle. This provides an initial dilution of 100:1 and supplies a sample for further dilution and subsequent counting on a gamma spectrometer. Alternately, the sample flow can be diverted through a 70-ml cylinder to obtain a large liquid volume containing dissolved gases. This 70-ml volume can be circulated and the dissolved gases vented into a gas sampling chamber. Determination of the total dissolved gas is achieved by measurement of the pressure rise in the gas expansion chamber and application of the ideal gas law. To determine the concentration of individual species, a 5-ml vial gas sample can then be obtained for gas chromatography and quantitative analysis of the dissolved gases associated with the 70-ml liquid volume. Ten-ml aliquots of this degassed liquid can also be taken for offsite chemical analyses requiring a relatively large sample. A radiation monitor in the liquid sample enclosure monitors liquid flow from the sample station to provide immediate assessment of the sample activity level. This monitor also provides information as to the effectiveness of the demineralized water flushing of the sample system following sample operation.

A gas sampler vial positioner and gas vial cask are included. The gas vial is installed and removed by use of the vial positioner through the front of the gas sampler. The vial is then manually dropped into the cask with the positioner, which allows the vial to be maintained about 3 ft from the individual performing the operation.

The particulate filters and iodine cartridges are removed via a drawer arrangement. The quantity of activity which is accumulated on the cartridges is controlled by a combination of flow orificing and time sequence control of the flow valve opening. In addition, the deposition of iodine is monitored during sampling using a radiation detector installed adjacent to the cartridge. These samples are limited to activity levels which will not require shielded sample carriers to transport the samples to the laboratory.

•→11
Fig. 9.3-4b shows the arrangement for the sample station equipment. The equipment includes a piping station, sample station, and control panels. The piping station which is installed in the auxiliary building includes sample coolers and control valves which select liquid sample points. The station consists of a wall-mounted frame and enclosures. Included within the sample station are equipment trays which contain modularized liquid and gas samplers. Each of these modules is approximately 18 in x 14 in x 20 in high. The lower liquid sample portion of the sample station is shielded with 6 in of lead brick, whereas the upper gas sampler requires 2 in of lead. The total weight of the wall-mounted portion of the system is approximately 7,000 lb. The dimensions of the sample station, including shielding, are approximately 29 in wide x 27 in deep x 72 in high. The frame is mounted so that the bottom of the frame is approximately 20 in off the floor. The control instrumentation is installed in a 2-ft x 4-ft x 6-ft-high standard cabinet control panel. The panel contains the conductivity and temperature indicators, and various control valves, radiation level monitor, and switches. The typical front panel arrangement is shown in Fig. 9.3-22.
11←•
The dilute liquid sample is remotely obtained through the bottom of the sample station by use of the small volume cask and cask positioner. The cask positioner holds the cask and positions the cask directly under the liquid sampler. Appropriate sample handling tools are included with the basic sample station.

The sample vial is manually raised within the cask to engage the hypodermic needles. When the sample vial has been filled, the bottle is manually withdrawn into the cask. The sample vial is always contained within lead shielding during this operation. The cask is then lowered and sealed prior to transport to the laboratory.

A large volume cask and cask positioner are used to remotely obtain the undiluted liquid sample. The positioner contains the cask and vial.

The cask is transported to the required position under the sample station by a four-wheel dolly cask positioner. When in position, this cask is hydraulically elevated approximately 1.5 in by a small hand pump for contact with the sample station shielding under the liquid sample enclosure. The sample bottle is raised, held, and lowered by a simple push/pull cable. The cask is sealed by a threaded top plug inserted above the sample bottle. The weight of this large volume cask is approximately 700 lb.

A 15-ml bottle is contained within the lead-shielded cask. This sample bottle is raised from its location in the cask to the sample station needles for bottle filling. The sample station will only deliver 10 ml to this sample bottle. When filled, the bottle is withdrawn into the cask. The sample bottle is always shielded by 5 to 6 in of lead when in position under the sample station and during the fill and withdraw cycles; thus, operator exposure is minimized. The cask may be used for offsite shipment of the undiluted sample; however, it will require additional packaging.

The post-accident sampling station defined above is designed to satisfy the requirements of NUREG-0737 Item II.B.3.

9.3.3 Equipment and Floor Drainage Systems

The floor and equipment drainage systems are schematically shown in the following figures:

Turbine building	Fig. 9.3-6 and 9.3-8
Reactor building	Fig. 9.3-7
Fuel building	Fig. 9.3-10
Diesel generator building	Fig. 9.3-11
Radwaste building	Fig. 9.3-12
Miscellaneous buildings	Fig. 9.3-16

9.3.3.1 Design Bases

The design bases of equipment drainage systems are:

1. Sumps for the collection of equipment drainage are located in the turbine building, reactor building, and fuel building. Influent to these sumps is non-oily waste from radioactive, potentially radioactive, and nonradioactive sources (excluding all types of floor drainage), such as:

   a. Pump casings

   b. Air conditioning condensate drains

   c. Valve stem leakoffs

   d. Relief valves

e. Other similar equipment.

2. Contamination of equipment drainage with floor surface drainage is prevented by having the equipment drainage sump covers located on elevated concrete curbs and by terminating equipment drainage piping in raised-rim hubs.

3. Equipment drainage sump pumps discharge effluent to the condensor hotwell for reuse in the steam generation system. A conductivity element located in the discharge piping header continuously monitors the effluent conductivity level (Section 9.3.2). When conductivity exceeds the set point, the effluent is diverted automatically to the radioactive liquid waste (radwaste) system for processing (Section 11.2.2).

4. The systems are designed such that there is no potential for inadvertent transfer of segregated equipment drainage to floor drainage systems or the storm drainage system.

5. Sumps and sump pumps are sized to handle the calculated discharge from the equipment served by each sump. Each sump is provided with duplex sump pumps for redundancy and to handle any surges in flow.

6. The equipment drainage systems are not safety related and are designated nonnuclear safety (NNS), except for the sump pump discharge piping containment penetrations which are Safety Class 2.

The design bases of radioactive and potentially radioactive floor drainage systems are:

1. Sumps for the collection of radioactive and potentially radioactive floor drainage are located in the reactor building, fuel building, auxiliary building, turbine building, condensate demineralizer/off gas building, radwaste building, services building, and piping tunnels. Influent to these pumps is non-oily waste from radioactive and potentially radioactive sources, such as:

   a. Maintenance washdown water

   b. Miscellaneous surface spillage

c. Equipment drainage from all sources (radioactive, potentially radioactive, and nonradioactive) other than those terminating in segregated equipment drainage sumps

d. Accumulated fire protection water after actuation of any fire protection sprinklers.

2. All floor drainage in the preceding buildings is considered to be either radioactive or potentially radioactive. Floor drainage from the hot machine shop located in the auxiliary building terminates in the floor drainage system of the adjoining radwaste building. Sump pumps discharge effluent to the radwaste system for processing (Section 11.2.2). There is no potential for inadvertent transfer of the effluent to the segregated equipment drainage systems or the storm drainage system.

3. Sumps and sump pumps are sized to handle the calculated flow from the area and equipment served by each pump. Each sump is provided with duplex sump pumps for redundancy and to handle any surges in flow, except in the piping tunnels where simplex pumps are used because the area is served by multiple pumps.

4. The radioactive and potentially radioactive floor drainage systems are not safety related and are designated NNS, except for the following:

   a. Sump pump discharge piping containment penetrations which are Safety Class 2.

   b. Sump pump discharge piping between redundant check valves at wall penetrations from the following cubicles in the auxiliary building:

      (1) LPCS

      (2) RHR A

      (3) RCIC

      (4) RHR B

      (5) RHR C

      (6) HPCS

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Check valves and penetration piping are Safety Class 3.

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The design bases of nonradioactive floor drainage systems are:

1. Sumps for the collection of nonradioactive floor drainage are located in the control building, electrical tunnels, and the makeup water pump house. Influent to these pumps is oily or non-oily waste from nonradioactive sources, such as:

    a. Maintenance washdown water

    b. Miscellaneous surface spillage

    c. Equipment drainage from nonradioactive sources, other than those terminating in segregated equipment drainage sumps

    d. Accumulated fire protection water after actuation of any fire protection sprinklers.

2. Floor drainage from the auxiliary boiler/water treatment building terminates in the acid and caustic waste sump (Section 9.2.3).

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3. Sump pumps discharge effluent to the sanitary wastewater treatment system (PBS). The sump pump for makeup water pump house drain is discharging into makeup water suction line.

4. Sumps and sump pumps are sized to handle the calculated flow from the area and equipment served by each sump. Sumps in the control building and makeup water pump house are provided with duplex sump pumps for redundancy. Sumps in the electrical tunnels are provided with simplex pumps because the area is served by multiple pumps.

5. Floor drainage systems in nonradioactive buildings that are not provided with sumps and sump pumps discharge by gravity to the sanitary wastewater treatment system (PBS).

6. Where the potential for oil spillage exists in nonradioactive buildings, the floor drainage effluent is routed to an oil separator prior to connection with the sanitary wastewater treatment system (PBS).

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7. The nonradioactive floor drainage systems are not safety related and are designated NNS.

9.3.3.2 System Description

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Each floor and equipment drainage sump receiving radioactive or potentially radioactive influent is provided with a nonporous liner to prevent migration of its contents. Sumps receiving nonradioactive influent for discharge to the sanitary wastewater treatment system (PBS) are unlined. Each sump is sized to contain the influent from the equipment or area it serves, while limiting sump pump starts to a maximum of six per hour.

The drywell pedestal pit sump is served by remotely located duplex self-priming horizontal centrifugal pumps. Sumps in the piping tunnels contain simplex vertical extended shaft centrifugal pumps. Other floor and equipment drainage sumps receiving radioactive or potentially radioactive influent each contain duplex vertical extended shaft centrifugal pumps. Sumps handling nonradioactive influent for discharge to the sanitary wastewater treatment system (PBS) each contain a simplex or duplex (determined on the basis of sump function and location) fully submersible pump.

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Each sump is provided with either an open grating or a solid cover. Solid covers contain atmospheric vents to prevent pressurization of the sump. All sumps are provided with level and alarm controls, and, except for duplex pumps in the reactor building which are manually alternated to comply with leak detection criteria (Section 5.2.7), all duplex pump sets are provided with mechanical alternators to reverse the lead/standby modes on successive pump starts. Influent to floor and equipment drainage sumps in the reactor building is monitored continuously on a rate-of-rise basis in accordance with leak detection criteria (Section 5.2.7).

Capacities of sumps, drain tanks, and sump pumps in the equipment and floor drainage system are listed in Table 9.3-1a.

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Floor drainage in buildings that do not contain sumps is routed to the sanitary wastewater treatment system (PBS) through embedded gravity flow piping. Prior to discharge into the sanitary wastewater treatment system (PBS), all potentially oily effluent is routed through a coalescing corrugated parallel-plate pack type oil separator. Accumulated oil is trucked from the site on an as-needed basis.

9.3.3.3 Safety Evaluation

Equipment and floor drainage systems are designed to prevent contamination of the sanitary wastewater treatment system (PBS) with radioactive

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or potentially radioactive effluent from sumps. Except for segregated equipment drainage which is discharged to the condenser hotwell, the effluent from all sumps in a given building is discharged either to the radwaste system or to the sanitary wastewater treatment system (PBS), but not to both.
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In the unlikely event of an inadvertent transfer or error in conductivity measurement of the segregated equipment drainage effluent, the small amount of water introduced into the condenser would be processed by the condensate demineralizers (Section 10.4.6).

•→3
The floor drainage systems serving buildings which house equipment needed for safe shutdown and accident prevention or mitigation have sufficient capacity to minimize water buildup that could hamper those activities. Evaluation of flooding due to pipe breaks or cracks is addressed in Section 3.6.1 and Appendix 3C.
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The discharge piping from each sump pump contains a check valve to prevent backflow from one sump to another.

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The LPCS, RHR (3), RCIC, and HPCS cubicles in the auxiliary building each contain a sump with duplex pumps, which discharge to a common header located outside the cubicle walls. The cubicles are constructed to be watertight. To prevent the transfer of water to other cubicles, should one cubicle flood, an additional spring-loaded check valve is located on each side of the penetrations where the sump pump discharge piping passes through the cubicle walls. The spring-loaded check valves, and the penetration piping between them, are Safety Class 3. Each cubicle is also provided with a Safety Class 2 level transmitter, wall mounted near the floor, to detect a rising water condition which annunciates an alarm and provides level indication in the main control room.
8←•

All sumps, with the exception of sumps in the reactor building, are provided with high water and low water level alarms which annunciate in either the main control room or auxiliary control room, depending on sump function and location. The sumps in the reactor building are provided with high-water level alarms that annunciate in the main control room.

9.3.3.4 Testing and Inspection Requirements

Piping encased in concrete is leak tested in accordance with the governing piping code in lieu of ACI 318. Piping from floor drainage collection hubs is tested via a static head test as part of the overall floor drainage collection system.

All other drainage piping is tested for leaks after installation in accordance with the governing piping code except for lines which are normally open to atmosphere, e.g., vent/overflow lines from atmospheric tanks, equipment drip pan drain lines, and equipment vent/drain lines beyond last isolation valve.

Initial service leak rate tests, when utilized, are done to the normal operating pressure.

All leaking pipes or joints are repaired. All sump pumps and sump pump discharge piping are tested to ensure that their performances meet the required design flows and pressures.

9.3.3.5 Instrumentation Requirements

9.3.3.5.1 Reactor Building/Fuel Building Equipment Drains

Drywell and Containment Equipment Drains

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Control switches are provided in the main control room for either automatic or manual operation of the drywell and containment equipment drain sump pumps (P1A, B and P2A, B). The level in the drywell and containment sumps (TK1 and TK2) is continuously monitored, and control logic is provided for automatic starting and stopping of the sump pumps.

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Excess leakage to the sump as determined by the leak detection system (Section 5.2.5) is alarmed in the main control room.

Containment isolation valves are provided in the drywell and containment equipment drain line to provide automatic isolation on a LOCA signal. Manual control switches are provided in the main control room for operation of these air-operated valves.

Fuel Building Equipment Drains

Level controls are provided for the fuel building equipment drain sump (TK3) to automatically start and stop the sump pumps (P3A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps run with an extreme high water level. Local control switches are provided for either automatic or manual operation of the fuel building equipment drain sump pumps.

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Extreme high or low water level activates a fuel building/reactor building equipment drain sump trouble alarm in the main control room.

16←•

9.3.3.5.2 Turbine Building Equipment Drains

Level controls are provided for the turbine building equipment drain sumps (TK1A, B, C) to automatically start and stop the sump pumps (P1A through P1F). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps run with an extreme high water level. Local control switches are provided for either automatic or manual operation of the turbine building equipment drain sump pumps.

The conductivity of the turbine building equipment drain sumps discharge is monitored. Controls are provided so that the flow is directed to the condenser when the conductivity is normal (i.e., low) and diverted to radwaste when the conductivity is high. Control switches are provided in the main control room for either automatic or manual operation of the air-operated flow diverting valves.

•→8

Extreme high or low water level activates a turbine building equipment drain sump trouble alarm in the main control room.

8←•

9.3.3.5.3 Turbine Building Floor Drains

Level controls are provided for the turbine building floor drain sumps (TK1A, B, C; TK2A,B; TK3; and TK7) to automatically start and stop the sump pumps (P1A through P1F; P2A through P2D; P3A, B; and P7A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps will be running on extreme high water level. Local control switches are provided for either automatic or manual operation of the turbine building floor drain sump pumps. Extreme high or low water level activates a turbine building floor drain sump level alarm in the main control room.

9.3.3.5.4 Radwaste Building Floor/Equipment Drains

Level controls are provided for the radwaste building floor/equipment drain sumps (TK1A, B and TK2) to automatically start and stop the sump pumps (P1A through P1D and P2A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps are running on extreme high water level. Local control switches are provided for either automatic or manual operation of the radwaste building floor/equipment drain sump pumps.

Extreme high or low water level activates a radwaste building floor drain sump level alarm in the auxiliary control room.

9.3.3.5.5 Reactor Building Floor Drains

Drywell, Containment, and Pedestal Floor Drains

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Control switches are provided in the main control room for either automatic or manual operation of the drywell floor drain sump (TK1), containment floor drain sump (TK2), and pedestal drain sump (TK6) pumps. The level in the sumps is continuously monitored, and control logic is provided for starting and stopping the sump pumps (P1A, B; P2A, B; and P6A, B) while operating in the automatic mode.

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Excess leakage to the sump as determined by the leak detection system (Section 5.2.5) is alarmed in the main control room.

Containment isolation valves are provided in the drywell and containment floor drain line to provide automatic isolation on a LOCA signal. Manual control switches are provided in the main control room for operation of these air-operated valves.

Auxiliary Building Floor Drains

The water level in the auxiliary building floor drain sumps (TK3A through TK3F and TK5C) is continuously monitored, and when the level reaches a high limit, an alarm is activated in the main control room. Level controls are provided for the auxiliary building floor drain sumps to automatically start and stop the sump pumps (P3A through P3M and P5C and P5F). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps run with an extreme high water level. Local control switches are provided for either automatic or manual operation of the auxiliary building floor drain sump pumps.

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Control switches are provided in the main control room for either automatic or manual operation of the auxiliary building floor drain sump pumps (P5A, P5B, P5D, P5E). The level in the sumps (TK5A and TK5B) is continuously monitored, and control logic is provided for starting the sump pumps while operating in the automatic mode. Extreme high or high sump water level activates an auxiliary building floor drain sump alarm in the main control room.

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9.3.3.5.6 Fuel Building Floor Drains

Level controls are provided for the fuel building floor drain sump (TK4) to automatically start and stop the sump pumps. A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps run with an extreme high water level and both pumps automatically stop on extreme low water level. Local control switches are provided for either automatic or manual operation of the fuel building floor drain sump pumps. Extreme high or low water level activates a fuel building floor drain sump level alarm in the auxiliary control room.

9.3.3.5.7 Condensate Demineralizer/Off Gas Area Floor Drains

Level controls are provided for the condensate demineralizer and off gas area floor drain sump (TK7) to automatically start and stop the sump pumps (P7A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps operate on a high-high water level. Local control switches are provided for either automatic or manual operation of the condensate, demineralizer and off gas area floor drain sump pumps. Extreme high or low water level activates a condensate demineralizer and off gas area floor drain sump level alarm in the auxiliary control room.

9.3.3.5.8 Piping Tunnel Floor Drains

Level controls are provided for the piping tunnel floor drain sumps (TK7, TK8, TK9, and TK11) to automatically start and stop the sump pumps (P7, P8, P9, and P11). Local control switches are provided for either automatic or manual operation of the piping tunnel floor drain sump pumps. An extreme high or low water level activates a piping tunnel sump level alarm in the auxiliary control room.

9.3.3.5.9 Services Building Floor Drains

Level controls are provided for the services building floor drain sump (TK6) to automatically start and stop the sump pumps (P6A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps operate on high-high water level. Local control switches are provided for either automatic of manual operation of the services building floor drain sump pumps. Extreme high or low water level activates a services building floor drain sump level alarm in the auxiliary control room.

9.3.3.5.10 Control Building Floor Drains

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Level controls are provided for the control building floor drain sump (TK4) to automatically start and stop the sump pumps (P4A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps operate on high-high water level. Local control switches are provided for either automatic or manual operation of the control building floor drain sump pumps. Extreme high or low water level activates a control building floor drain sump level alarm in the auxiliary control room. These drains are routed to sump 1PBS-TK2 and pumped by submersible pumps 1PBS-P5A, -P5B to sanitary manhole MH-619 for treatment by the sanitary Wastewater Treatment Plant (WWTP) facility. Effluent from MH-619 is received by lift station SLS1, pumped to Train No. 1 of the WWTP, processed and discharged to the CWS Blowdown System.

9.3.3.5.11 Electrical Tunnels Floor Drains

Level controls are provided for the electrical tunnel floor drain sumps (TK1, TK2, and TK3) to automatically start and stop the sump pumps (P1, P2, and P3). Local control switches are provided for either automatic or manual operation of the electrical tunnel floor drain sump pumps. An extreme high or low water level activates an electrical tunnel floor drain sump level alarm in the auxiliary control room. Drains from pump 1DFM-P1 are routed to sump 1PBS-TK2 by submersible pumps 1PBS-P5A, -P5B to MH619. Drains from pumps 1DFM-P2, -P3 are pumped to MH620. Drains from MH619 and MH620 flow by gravity to east lift station 1PBS-SLS1, which are pumped to the WWTP facility. Effluent from SLS1 is pumped to Train No. 1 of the WWTP, processed, treated, sampled/monitored and then discharged to the Mississippi River via the CWS Blowdown System.

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9.3.3.5.12 Makeup Water Pumphouse Floor Drains

Level controls are provided for the makeup water pumphouse floor drain sump (TK5) to automatically start and stop the

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sump pumps (P5A, B). A mechanical alternator is provided for selecting the lead and standby pumps. Both pumps operate on a high-high water level. Local control switches are provided for either automatic or manual operation of the makeup water pumphouse floor drain sump pumps.

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9.3.3.5.13 Standby Diesel Generator Building Floor Drains

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Floor drains from the Standby Diesel Generator Building are collected through an oil trap 1SRW-SP1 in the collection sump 1PBS-TK2. This collection sump tank is sized for 13,000 gallons of storage capacity, a 20 minutes supply from the sprinkler system actuation. These drains from collection sump tank 1PBS-TK2 are pumped by submersible pumps 1PBS-5A, -P5B to MH-619. Level controls are provided in the collection sump tank 1PBS-TK2 to automatically start and stop submersible pumps at pre-determined levels. These submersible pumps are designed to operate for 10 minutes at a time. A mechanical alternator is provided for selecting the lead and standby pump. These drains flow by gravity to east lift station 1PBS-SLS1, where these are pumped to the WWTP. Effluent from SLS1 is pumped to Train No. 1 of the WWTP, processed, treated, sampled/monitored and then discharged to the Mississippi River via the CWS Blowdown System.

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9.3.4 Chemical and Volume Control System

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9.3.5 Standby Liquid Control System

9.3.5.1 Design Bases

The standby liquid control system (SLCS) has a safety-related function and is designed as a Seismic Category I system. It meets the following safety design bases:

1. Backup capability for reactivity control is provided, independent of normal reactivity control provisions in the nuclear reactor, to be able to shut down the reactor if the normal control ever becomes inoperative.

2. The backup system has the capacity for controlling the reactivity difference between the steady-state rated operating condition of the reactor with voids and the cold shutdown condition, including shutdown from the most reactive condition at any time in core life.

3. The time required for actuation and effectiveness of the backup control is consistent with the nuclear reactivity rate of change predicted between rated operating and cold shutdown conditions. A fast scram of the reactor or operational control of fast reactivity transients is not specified to be accomplished by this system.

4. Means are provided by which the functional performance capability of the backup control system components can be verified periodically under conditions approaching actual use requirements.

5. The neutron absorber is dispersed within the reactor core in sufficient quantity to provide a reasonable margin for leakage or imperfect mixing.

6. The system is reliable to a degree consistent with its role as a special safety system; the possibility of unintentional or accidental shutdown of the reactor by this system has been minimized.

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7. The system has the control capacity equivalent to a 66 gpm(1) system with 13 percent by weight natural sodium pentaborate solution as required by 10CFR50.62.

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8. The Standby Liquid Control System sodium pentaborate solution functions to control suppression pool pH following a design basis LOCA event with no functioning ECCS injection. This function was added to the Standby Liquid Control System in conjunction with the River Bend implementation of Alternate Source Term (AST) per Regulatory Guide 1.183.

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9.3.5.2 System Description

Each standby liquid control system pump loop (Fig. 9.3-9) is manually initiated through a single keylocked switch in the main control room to pump a boron neutron absorber solution into the reactor if the operator determines the reactor cannot be shut down or kept shut down with the control rods. Once the operator decision for initiation of the SLCS is made, the design intent is to simplify the manual process by providing a keylocked switch. This prevents inadvertent injection of neutron absorber by the SLCS. However, insertion of the control rods is expected to assure prompt shutdown of the reactor, should it be required.

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The keylocked main control room switches are provided to assure positive action from the main control room, should the need arise. Procedural controls are applied to the operation of the keylocked main control room switches.

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The SLCS is required only to shut down the reactor and keep the reactor from going critical again as it cools.

The SLCS is needed only in the improbable event that not enough control rods can be inserted in the reactor core to accomplish shutdown and cooldown in the normal manner.

The boron solution tank, the test water tank, the two positive displacement pumps, the two explosive valves, the two motor operated pump suction valves, and associated local valves and controls are located in the containment. The liquid is piped into the reactor vessel and discharged near the bottom of the core, so it mixes with the cooling water rising through the core (Section 5.3, "Reactor Vessel," and Subsection 3.9.3B, "ASME Code Class 1, 2, and 3 Components, Component Supports and Core Support Structures," and Subsection 3.9.5B, "Reactor Pressure Vessel Internals").

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The boron-10 isotope (19.8 atom percent in natural boron) absorbs thermal neutrons and thereby terminates the nuclear fission chain reaction in the uranium fuel.

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The specified neutron absorber solution is sodium pentaborate ($Na_2B_{10}O_{16}$ $10H_2O$) enriched to a nominal 80 atom percent boron-10. It is prepared by dissolving dry sodium pentaborate in demineralized water or by dissolving stoichiometric quantities of borax and boric acid in demineralized water. An air sparger is provided in the tank for mixing. To prevent system plugging, the tank outlet is raised above the bottom of the tank.

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At all times when reactor criticality is possible, the SLCS can deliver the quantity of sodium pentaborate into the vessel required to assure reactor shutdown. This is accomplished by maintaining a net solution volume in the tank which contains the quantity of boron-10 required (including margin for leakage and imperfect mixing) to bring the reactor to the cold shutdown condition. The solution can be diluted with water to the minimum allowable solution concentration for compliance with the ATWS Rule to allow for evaporation losses or to lower the saturation temperature.

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The minimum temperature of the fluid in the tank and piping corresponds to the saturation temperature at the solution concentration, plus a minimum margin of 5°F. The saturation temperature ranges from a maximum of 39°F (at 9.5% by weight) to a minimum of less than 32°F (at 6.5% by weight). During initial solution mixing, the mixing heaters are used to increase the solubility of the sodium pentaborate or, if borax and boric acid are used, to maintain the endothermic reaction and solution temperature above 100°F. The SLCS mixing heater is a manually operated, 40-kw, electrical resistance, multiple element, stainless steel sheathed, immersion heater. The equipment and tank containing the solution are installed in a room in which the air temperature is maintained within the range of 70°F to 100°F. The ambient temperature of this room is the normal heat source for maintaining the operating temperature range of the SLCS storage tank. A second installed electrical resistance heater system provides a backup heat source. The backup (operating heater) is an automatic controlled, 10-kw, electrical resistance, single element, stainless steel sheathed, immersion heater. This automatic operation heater (controlled from an installed temperature switch and automatic controller) is used to maintain the solution temperature above the precipitation point during storage when ambient temperatures approach the precipitation temperature. The heater element wattage of the operating heater is sufficient to maintain the solution from 75°F to 85°F at area ambient temperature as low as 40°F. This heater is removable without draining the SLCS storage tank.

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A separate in-tank temperature switch and a level indicating switch are provided to monitor SLC storage tank temperature and level. These switches provide level indication and high/low level and temperature alarms on the ECCS benchboard main control room annunciator.

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Each positive displacement pump is sized to inject the solution into the reactor in 35 to 125 minutes, independent of the amount of solution in the tank. The pump and system design pressure between the explosive valves and the pump discharge is 1,400 psig. The two relief valves are set slightly under 1,400 psig. To prevent bypass flow from one

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pump in case of relief valve failure in the line from the other pump, a check valve is installed downstream of each relief valve line in the pump discharge pipe.

The two explosive-actuated injection valves provide assurance of opening when needed and ensure that boron does not leak into the reactor even when the pumps are being tested.

Each explosive valve is closed by a plug in the inlet chamber. The plug is circumscribed with a deep groove so the end readily shears off when pushed with the valve plunger. This opens the inlet hole through the plug. The sheared end is pushed out of the way in the chamber; it is shaped so it does not block the ports after release.

The shearing plunger is actuated by an explosive charge with dual ignition primers inserted in the side chamber of the valve. Ignition circuit continuity is monitored by a trickle current, and an alarm occurs in the main control room if either circuit opens. Indicator lights show which primary circuit opened.

The SLCS is actuated by either of two keylocked, spring-return switches on the main control room console. This assures that switching from the "off" position is a deliberate act. Actuating either switch starts an injection pump, actuates one of the explosive valves, opens one pump suction motor operated valve, and closes either the reactor cleanup system outboard or inboard isolation valve to prevent loss or dilution of the boron.

A light in the main control room indicates that power is available to the pump motor contactor and that the contactor is deenergized (pump not running). Another light indicates that the contactor is energized (pump running).

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Decrease in storage tank liquid level, tank outlet valve in open position, high pump discharge pressure, and loss of continuity on the explosive valves indicate that the system is functioning. If these indications show that the liquid may not be flowing, the operator immediately actuates the other switch to the "run" mode thereby activating the redundant train of the SLCS. The local switch is a stop/run maintained contact switch. Pump discharge pressure and valve status are indicated in the main control room.

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Equipment drains and tank overflow are not piped to the radwaste system but are typically directed to separate containers (such as 55-gal drums) that can be removed and disposed of independently to prevent significant quantities boron from inadvertently reaching the reactor.

Instrumentation consisting of solution temperature indication and control, solution level, and heater system status is provided locally at the storage tank. Table 9.3-2 contains the process data for the various modes of operation of the SLCS. Seismic category and safety class are included in Table 3.2-1.

9.3.5.3 Safety Evaluation

The standby liquid control system is a reactivity control system and is maintained in an operable status whenever the reactor is critical. The system is never expected to be needed for safety reasons because of the large number of independent control rods available to shut down the reactor.

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To assure the availability of the SLCS, two sets of the components required to actuate the system - pumps, explosive valves, and pump suction valves - are provided in parallel.

The system is designed to bring the reactor from rated power to a cold shutdown at any time in core life. The reactivity compensation provided is sufficient to reduce reactor power from rated to zero level and allow cooling the nuclear system to room temperature, with the control rods remaining withdrawn in the rated power pattern. It includes the reactivity gains that result from complete decay of the rated power xenon inventory. It also includes the positive reactivity effects from eliminating steam voids, changing water density from hot to cold, reduced Doppler effect in uranium, reducing neutron leakage from boiling to cold, and decreasing control rod worth as the moderator cools.

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The system is required to meet the equivalent control capacity criteria of 10CFR50.62, "Requirements for reduction of risk from anticipated transient without scram (ATWS) events for light-water-cooled nuclear power plants. "The control capacity must be equivalent to a 66[1] gpm system with 13 weight percent natural sodium pentaborate solution. The equivalency is achieved through the use of a sodium pentaborate solution enriched in the boron-10 isotope (80 atom percent boron-10). The enrichment, solution concentration, and flow rate at which the solution is pumped to the reactor must satisfy the following equation:

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$$\frac{Q}{66\ \text{gpm}} \times \frac{E}{19.8\ \text{Atom percent}} \times \frac{C}{13\ \text{Weight percent}} \geq 1$$

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where: Q= Solution injection flow rate, in gallons per minute (pump flow rate minus the maximum flow rate of demineralized water added to the system by the fill system) with the pump operating against a maximum system head of 1250 psig

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E= Boron-10 enrichment, in atom percent

C= Sodium pentaborate solution concentration, in weight percent

The minimum average concentration of boron-10 required in the reactor core to provide adequate shutdown margin, after operation of the SLCS, is 143 ppm (parts per million). Calculation of the minimum quantity of sodium pentaborate to be injected into the reactor is based on the required 143 ppm average concentration in the reactor coolant including recirculation loops, at 70°F and reactor normal water level. The result is increased by 25% to allow for imperfect mixing and leakage. Additional sodium pentaborate is provided to accommodate dilution by the RHR system in the shutdown cooling mode. This concentration is achieved if the solution is prepared as defined in Subsection 9.3.5.2 and maintained above saturation temperature.

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Cooldown of the nuclear system requires a minimum of several hours to remove the thermal energy stored in the reactor, cooling water, and associated equipment. The controlled limit for the reactor vessel cooldown is 100°F per hour, and normal operating temperature is approximately 550°F. Use of the main condenser and various shutdown cooling systems requires 10 to 24 hours to lower the reactor vessel to room temperature (70°F); this is the condition of maximum reactivity and, therefore, the condition that requires the maximum concentration of boron-10.

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The specified boron-10 injection rate ranges from 3.8 to 5.1 ppm per minute. This injection rate meets 10CFR50.62 requirements to ensure hot shutdown boron-10 concentration is delivered to the core at the rate to minimize potential plant impact from an ATWS event.

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The SLCS equipment essential for injection of neutron absorber solution into the reactor is designed as Seismic Category I for withstanding the specified earthquake loadings (Chapter 3). The system piping and equipment are designed, installed, and tested in accordance with requirements stated in Chapter 3.

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The SLCS is required to be operable in the event of a plant offsite power failure; therefore the pumps, valves and controls are powered from the standby a-c power supply. The pumps and valves are powered and controlled from separate buses and circuits so that a single active failure does not prevent system operation.

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The SLCS piping and pumps have sufficient pressure margin, up to the system relief valve setting of approximately 1400 psig, to assure solution injection into the reactor above the normal pressure in the bottom of the reactor. The nuclear system relief and safety valves begin to relieve pressure above approximately 1,100 psig. Therefore, the SLCS positive displacement pumps cannot overpressurize the nuclear system.

Only one of the two standby liquid control pumps is needed for system operation. If a redundant component (e.g., one pump) is found to be inoperable, there is no immediate threat to shutdown capability, and reactor operation can continue during repairs. The time during which one redundant component upstream of the explosive valves may be out of operation should be consistent with the following: the probability of failure of both the control rod shutdown capability and the alternate component in the SLCS; and the fact that nuclear system cooldown takes several hours while liquid control solution injection takes approximately two hours. Since this probability is small, considerable time is available for repairing and restoring the SLCS to an operable condition while reactor operation continues. Assurance that the system can fulfill its function during repairs is obtained by demonstrating operability of the redundant pump.

The SLCS is evaluated against the applicable General Design Criteria as follows:

Criterion 2: The SLCS is located in an area outside of the drywell and below the refueling floor. In this location it is protected by the containment and compartment walls from external natural phenomena such as earthquakes, tornadoes, hurricanes, and floods and internally from effects of postulated events (e.g. DBA-LOCA).

Criterion 4: The SLCS is designed for the expected environment in the containment. In this location, it is not subject to the more violent conditions postulated in this criterion such as missiles, pipe whip, and jet impingement.

Criterion 26: The SLCS is the second reactivity control system required by this criterion. The requirements of this criterion do not apply within the SLCS itself.

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Criterion 29: The SLCS pumps and valves outboard of the isolation valves are redundant. Two suction valves, two pumps, and two injection valves are arranged and cross-tied such that operation of one of each results in successful operation of the system. The SLCS also has test capability. A special test tank is supplied for providing test fluid for the periodic injection test. Pumping capability and suction valve operability may be tested at any time. A trickle current continuously monitors continuity of the firing mechanisms of the explosive injection valves.

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The SLCS is evaluated against the applicable 10CFR50.62 requirements as follows:

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The SLCS uses a sodium pentaborate solution enriched to 80 atom percent boron-10 in the concentration range of 6.5 to 9.5 weight percent. This enrichment and concentration in conjunction with a minimum solution flow rate, in gallons per minute (pump flow rate minus the maximum quantity of demineralized water added to the system by the fill system), with the pump operating against a maximum system head of 1,250 psig are equal to or greater than the equivalent control capacity of a 66 gpm[1] system with 13 weight percent natural sodium pentaborate.

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The SLCS is evaluated against the applicable regulatory guides as follows:

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Regulatory Guide 1.26 Rev. 2: Because the SLCS is a reactivity control system, all mechanical components necessary to inject neutron absorber into the reactor are at least Safety Class 2. Those portions which are part of the Reactor Coolant Pressure Boundary are Safety Class 1.

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Regulatory Guide 1.29 Rev. 1: All components of the SLCS which are necessary for injection of neutron absorber into the reactor are Seismic Category I.

Branch Technical Positions APCSB 3-1 and MEB 3-1

Since the SLCS is located within the containment, it is adequately protected from flooding, tornadoes, and externally generated missiles. (See Section 3.8.) SLCS equipment is protected from pipe break by providing appropriate distance between the SLCS and other piping systems. Where adequate protection cannot be assured, barriers have been considered to assure SLCS protection from pipe break. (Section 3.6.)

It should be noted that the SLCS is not required to provide a safety function during any postulated pipe break events. This system is only required under an extremely low probability event where all of the control rods are assumed to be inoperable while the reactor is at normal full power operation. Therefore, the protection provided is considered to exceed that required to meet the intent of APCSB 3-1 and MEB 3-1. The use of the SLCS system sodium pentaborate solution to provide suppression pool pH control post LOCA is an additional system function that does not require any change to the original system protection features.

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This system is used in special plant capability demonstration events cited in Appendix 15A (specifically Events 51 and 53 which are extremely low probability nondesign basis postulated incidents).

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The analyses given there are to demonstrate additional plant safety consideration beyond reasonable and conservative assumptions.

9.3.5.4 Testing and Inspection Requirements

Operational testing of the SLCS is performed in at least two parts to avoid inadvertently injecting boron into the reactor.

With the valves to the reactor and from the storage tank closed and the valves to and from the test tank opened, demineralized water in the test tank can be recirculated by locally starting either pump.

During a refueling or maintenance outage, the injection portion of the system can be functionally tested by valving

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the suction line to the test tank and actuating the system from the main control room. System operation is indicated in the main control room.

After functional tests, the injection valve shear plugs and explosive charges must be replaced and all the valves returned to their normal positions as indicated in Fig. 9.3-9.

After closing a local locked-open valve to the reactor, leakage through the injection valves can be detected by opening valves at a test connection in the line between the containment isolation check valves. Position indicator lights in the main control room indicate that the local valve is closed for tests or open and ready for operation. Leakage from the reactor through the first check valve can be detected by opening the same test connection in the line between the check valves when the reactor is pressurized.

The test tank contains demineralized water for approximately 3 minutes of pump operation. Demineralized water from the condensate storage system is available for refilling or flushing the system.

Should the boron solution ever be injected into the reactor, either intentionally or inadvertently, the operator verifies that the normal reactivity controls are adequate to keep the reactor subcritical, and then removes the boron from the reactor coolant system by initially flushing for gross dilution followed by operating the reactor water cleanup system. There is practically no effect on reactor operations when the boron concentration has been reduced below approximately 50 ppm.

The concentration of the sodium pentaborate in the solution tank is determined periodically by chemical analysis.

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Enrichment testing is performed any time boron is added to the sodium pentaborate solution.

Minimum required solution volume is determined by calculation and verified periodically.

Electrical supplies and relief valves are also subjected to periodic testing (Chapter 16).

The SLCS preoperational test is described in Section 14.2.12.1.3.

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9.3.5.5 Instrumentation Requirements

The instrumentation and control system for the SLCS is designed to allow the injection of liquid poison into the reactor and maintain the liquid poison solution well above the saturation temperature in the event ambient temperature is inadequate. A further discussion of the SLCS instrumentation is provided in Section 7.4.

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9.3.6 Penetration Valve Leakage Control System (PVLCS)

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The function of PVLCS associated with controlling the release of fission products to the environment has been removed. However, the PVLCS air compressors were retained as a backup air supply to ADS/SRV accumulators and an air supply for MS-PLCS.

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9.3.6.1 Design Bases

9.3.6.1.1 Design Criteria

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1. The PVLCS is designed to Seismic Category I requirements and is Safety Class 2.

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2. The PVLCS is designed to supply air to MS-PLCS following a design basis loss-of-coolant accident (LOCA). The PVLCS is designed to withstand: a) internally generated missiles, b) the dynamic effects associated with pipe whip and jet forces from postulated pipe break events, and c) environmental conditions consistent with the design basis event.

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3. The PVLCS is capable of performing its safety function following a loss of all offsite power.

4. The PVLCS is capable of performing its function assuming complete loss of non-nuclear safety-related lines during a design basis event.

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6. The PVLCS is manually initiated and capable of being actuated within about 20 min following a design basis LOCA.

7. Instrumentation and controls necessary for the functions of the PVLCS are designed in accordance with the standards applicable to nuclear plant safety-related instrumentation and control systems (Chapter 7).

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10. The PVLCS is designed to meet the single-failure criterion.

11. The PVLCS is designed to IEEE 279-1971, IEEE 323-1974,IEEE 344-1975, and IEEE 382-1972.

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9.3.6.2 System Description

9.3.6.2.1 General Description

The MS-PLCS uses air to pressurize valve bodies and the main steam and drain lines. The air does not flow through small passages (such as solenoid valves) or equipment with small operating clearances (such as air-operated pistons and cylinders); therefore, 3-micron filtration is not necessary. Since most of the pipes and valve bodies to be pressurized are initially filled with steam, air dryers would serve no purpose and are not provided. The compressors are water seal units which, by their design, have no oil contamination. There also are no hazardous or corrosive vapors. The requirements of ANSI MC 11.1-1976 are not applicable to the MS-PLCS air systems since they are service air applications, not instrument air.

The PVLCS is shown on Fig. 6.7-1. The PVLCS is composed of two independent and redundant systems including an air compressor and air receivers.

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9.3.6.2.2 Detailed Description

Each PVLCS consists of the following components as shown on Fig. 6.7-1.

Component	Description
•→8 Air compressor	Delivers sufficient volume of compressed air to meet the maximum post LOCA demand (long and short term) of 36 scfm from MS-PLCS, and main steam safety/relief valve system (SVV). It is equipped for water cooling and provides a nuclear safety-related air supply for the MS-PLCS, and the main steam safety/relief valve system. It is sized to accommodate the above systems.
8←• 10←• Air accumulator	Stores sufficient air at 101 psig minimum to fill the piping and valve body volumes being sealed. Downstream of the accumulator are two branch lines, one to the MS-PLCS and the other to the main steam safety and relief valve system. Each of the systems requires compressed air after an accident.
Pressure control valve	Maintains the system pressure at 1.1 times the peak calculated drywell pressure

Component	Description
Flow switch	Detects high flow and generates a signal to close the injection valve at 6.82 scfm
Injection valve	Opens when all interlocks are satisfied, to admit air to the header section. Closes when high flow or low differential pressure is detected
Isolation valves	Remain closed unless the downstream pressure is 40 psig or less
Piping	Process piping is 3/4-in, 1-in, or 2-in carbon steel pipe throughout. The pressure class and schedule is based on design conditions of each part of the system. All piping is designed and constructed to ASME Section III, Class 2. The components and piping installation are designed to withstand Seismic Category I loads.
Valves	All motor-operated valves in the system have approximately 4 in/min opening and closing speeds. The valves are designed and constructed to the ASME code class appropriate to the piping in which they are installed. The electrical operators are tested and qualified to the IEEE Standards 382, 323, and 344.

9.3.6.2.3 Sequence of Operation

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Each PVLCS air compressor may be manually actuated utilizing its individual remote manual initiating switch before opening the injection valves or after opening the isolation valves to prevent cycling of the compressors.

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The twin systems are pressurized within 5 min by the air compressors and their associated accumulators. The accumulators are sized so that the initial air requirements for the MS-PLCS, and main steam safety/relief valve system are met, thereby, allowing the air compressors to be on or off. However, as stated in Section 5.2.2.4, main steam safety/relief valve accumulators used for ADS must be pressurized to a minimum of 131 psig prior to the start of an accident. The air compressors' functions are to charge the accumulators and to provide the long-term air requirement of leakage for the various systems.

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The PVLCS air compressors provide air for at least 100 consecutive days without interruption.

9.3.6.3 Safety Evaluation

9.3.6.3.1 Normal Operation

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During normal operation, the MS-PLCS injection valves remain closed and do not place any demands on the PVLCS air compressors. However, the main steam safety/relief valves' associated accumulators may draw air from the PVLCS accumulators if their associated SVV compressors are unavailable. Refer to Section 5.2.2.4 for the operation of the SVV compressors. Pressure transmitters maintain the PVLCS accumulators at a predetermined set

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point, at which the accumulators maintain enough air to meet all short-term requirements of the MS-PLCS and the main steam safety/relief valve system. The air compressors are capable of an automatc start or manual operation from the control room to recharge the accumulators above the minimum set point as determined by the pressure transmitters.
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9.3.6.3.2 Design Basis Operation

Approximately 20 min after it has been ascertained that a LOCA has occurred, the PVLCS compressor is actuated. The 20-min time period serves as sufficient time for the reactor vessel pressure to decay to a pressure at which the PVLCS can function.

If, 5 min after initiation, high flow or low pressure is detected in one system, that system automatically isolates and the other system provides the seal. High flow and low pressure indicate that the process line valve is stuck open or partially open, or the system no longer maintains system integrity. Low pressure (sensed downstream of the isolation valve) by itself indicates that an injection valve or isolation valve has failed to open, or that the compressor is not operating correctly. The compressor is equipped with suitable instrumentation to detect and annunciate failures.

9.3.6.3.3 Single Failure Considerations

Effects resulting from a PVLCS single active component failure do not affect the integrity or operability PVLCS.

9.3.6.4 Testing and Inspection

All systems are tested and inspected as separate components and as an integrated system. Pressure readings are taken to ensure that the compressor air receiver assembly can deliver the required flow to establish the seal in the allotted time.
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Tests are made to determine that the proper control sequence is executed, including pressure set point interlocks to prevent inadvertent system operation and valve opening.

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Preoperational tests of the PVLCS are conducted prior to initial startup. The tests assure functioning of all controls, instrumentation, and active components. System reference characteristics such as timer set points and flow rates are documented during the preoperational testing and used as base points for measurements obtained in subsequent operational tests.

During plant operations, valves, piping, instrumentation, wiring, and other components of the PVLCS can be inspected visually at any time. Valves are capable of being exercised periodically during normal operation. Test frequency is consistent with the requirements of the plant operating technical specifications.

9.3.6.5 Instrumentation Requirements

Control switches are provided in the main control room for either automatic or manual operation of the PVLCS air compressors. In the automatic mode of operation, the compressor starts when the accumulator pressure drops below normal and stops when the pressure returns to normal. Air compressor start permissives and trip signals are provided by the manufacturer. In the manual mode of operation, manufacturer's trip signals and start permissives are bypassed. However, in all modes of operations, load sequence permissive is required for running the air compressors.

System supply air pressure is maintained at its set point by modulating the electrohydraulic pressure control valves. The supply air and accumulator pressures are monitored by the plant computer. A trouble alarm is provided in the main control room for each compressor. Abnormal conditions are individually indicated on a local panel.

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Leakage control system inoperability alarms are provided in the main control room.

Manual control switches are provided in the main control room for opening and closing the isolation valves (1SVV*MOV1A,1B) of the main steam safety/relief valves air accumulators. Sustained low system header pressure activates an alarm in the main control room. A system inoperability alarm is also provided in the main control room.

9.3.7 Suppression Pool Pumpback System (SPPS)

9.3.7.1 Design Basis

The SPPS, shown on Fig. 9.3-7p, is designed to assist in the identification and control of post-LOCA leakage from ECCS piping in the auxiliary building crescent area at el 70 ft 0 in. The system maintains suppression pool inventory while leak detection and isolation efforts are in progress. The SPPS also protects ECCS electrical components in this area from flooding from any other source of leakage following a LOCA.

The SPPS identifies area leakage resulting from a postulated passive ECCS failure by detecting abnormal water level in the floor drain sumps at el 70 ft 0 in. in the auxiliary building crescent area.

The use of pumps 1DFR*P5A,B,D,E to return this water to the suppression pool allows sufficient time for operator action to identify and isolate suspected leakage paths while continuing to maintain suppression pool water inventory and preventing excessive buildup of water at el 70 ft 0 in of the auxiliary building.

9.3.7.2 System Description

The SPPS consists of the following:

1. Two sumps with two seismically qualified vertical sump pumps per sump (1DFR*P5A,B,D,E) with total maximum combined capacity of approximately 260 gpm.

2. Floor drain sump level detection instrumentation.

3. Containment isolation valves.

4. Associated piping, valves, and process instrumentation.

The pump motors, isolation valves, and sump level detection instrumentation are provided with Class 1E power. The pumps and isolation valves can be controlled from the main control room.

The pumps also can be automatically started based on level sensors in the sumps. Control and instrumentation is described in Section 7.6.1.12.

All piping is nonnuclear safety class, but is seismically analyzed and supported, except for the interface with the high pressure core spray system suppression pool return piping, which is Safety Class 2.

9.3.7.3 Design Evaluation

The ECCS piping components can experience passive failures following a LOCA, such as a pump seal or valve packing failure. The maximum leakage, due to a failure of this nature, is postulated to be as high as 50 gpm.

Following a postulated LOCA event, the sump pump control switches are taken out of automatic and placed in the off position. This action prevents inadvertent pumping to the liquid radwaste system during post-LOCA operation. The sumps are provided with Class 1E level devices that will initiate a high and high-high level alarm in the main control room based on rising level in the sumps. The operator may then open the motor-operated containment isolation valve, thereby providing a flowpath back to the suppression pool. Opening of the containment isolation valve automatically closes the flowpath to the radwaste system by closing the two air-operated isolation valves. At this point, the sump pumps are manually placed in automatic, and flow to the suppression pool is thereby established.

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9.3.8 Suppression Pool Cleanup, Cooling, and Alternate Decay Heat Removal System

The Suppression Pool Cleanup, Cooling, and Alternate Decay Heat Removal (SPC) system is intended to provide cleaning and cooling of the water in the Suppression Pool during normal plant operation and alternate decay heat removal (ADHR) capability during shutdown conditions. The system can provide suppression pool cleanup and cooling during shutdown conditions, in the event the system is not required for alternate decay heat removal.

9.3.8.1 Design Basis

The Suppression Pool Cleanup, Cooling and Alternate Decay Heat Removal (SPC) system is designed as a non-safety related system to perform the following functions, depending on the reactor operating mode and valve alignments:

a. Provide a method to process Suppression Pool water during plant power operation in order to achieve and maintain Suppression Pool water clarity and chemistry.

b. Provide a method to routinely remove heat added to the Suppression Pool as a result of safety relief valve leakage and testing of the Reactor Core Isolation Cooling (RCIC) system, as an alternative to using the Suppression Pool Cooling mode of the Residual Heat Removal system.

c. Provide an alternate method of reactor vessel decay heat removal during plant shutdowns.

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d. Provide an alternate capability to discharge water to the liquid radwaste system for suppression pool or reactor level reduction.

The SPC system suction and discharge interface with the residual heat removal loop C piping is equipped with safety-related automatic isolation valves. The interfacing piping and valves are designed to seismic Category I and ASME Code, Section III, Class 2, requirements. The SPC system interface with the fuel pool cooling and cleanup system piping is provided with a safety-related manual isolation valve. The interfacing piping and valve are designed to seismic Category I and ASME Code, Section III, Class 3 requirements. The SPC system piping beyond the outermost isolation valves is designed to ANSI B31.1 requirements. SPC piping and components located in the Auxiliary Building are seismically qualified and supported.

During normal operation, the SPC system is designed to maintain bulk suppression pool water quality at the following nominal parameters:

Turbidity	≤ 0.5 NTU
Conductivity	≤ 1 μS/cm at 25°C
Suspended solids	≤ 5 ppm

The suppression pool cooling function is designed to reduce bulk suppression pool temperature from 100°F to 95°F in 12 hours, based on assumed heat load of 3.5 million BTU/hr.

During plant shutdowns, the alternate decay heat removal (ADHR) function of the SPC system is designed to:

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- Maintain reactor coolant temperature ≤ 200°F in Operating Mode 4 at 20 hours post shutdown with a design heat load of 70.86 million BTU/hr;

- Reduce reactor coolant temperature to ≤ 140°F in Operating Mode 5 at 120 hours after shutdown with a design heat load of 40.12 million BTU/hr;

- Reduce reactor coolant temperature to ≤ 120°F in Operating Mode 5 at 144 hours after shutdown with a design heat load of 37.67 million BTU/hr;

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- Maintain reactor coolant temperature ≤ 120°F thereafter.

Heat exchanger design is based on a nominal Normal Service Water (SWP) inlet temperature of 83°F. The SPC system is capable of performing its design functions at the minimum SWP design temperature of 95°F, but the time required to reach the desired target process temperature may increase.

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The level reduction function will provide a maximum of 100 gpm water rejection to liquid radwaste from the suppression pool, reactor or upper containment pools depending on system alignment. The reject capacity of 100 gpm is based on normal radwaste processing capacity and ensuring that a potential Operation with the Potential to Drain the Reactor Vessel (OPDRV) path is not created.

9.3.8.2 System Description

The SPC system consists of two 100% capacity horizontal centrifugal pumps with a discharge flow capacity of 2250 gpm, one 100% capacity plate and frame heat exchanger, a filter demineralizer skid, instrumentation, and valves as shown on Figures 9.3-24a and 24b.

The SPC suction piping interfaces with the RHR loop C suction piping via safety-related isolation valves RHS-AOV62 and RHS-AOV63, located on the 70’ elevation in the Auxiliary Building crescent area. The SPC piping also interfaces with the Fuel Pool Cooling and Cleanup (SFC) system via safety-related manual valve SFC-V3014. The SPC connection to the SFC system can function as a suction or return flowpath.

The SPC pumps and heat exchanger are located in the E-Tunnel. The process stream is split downstream of the heat exchanger, with 800 gpm flow directed to the filter demineralizer skid, located on the 136’ elevation of the Radwaste Building. The remaining nominal 1450 gpm bypass flow is directed to the SPC return line. Bypass flow is controlled by remote-manual valve SPC-AOV20 and the bypass line has the capacity for full system process flow. The SPC heat exchanger is also provided with a full flow bypass line and manual isolation valves.

The SPC heat exchanger is cooled by Normal Service Water, with a design service waer flow of 2500 gpm. A remote-manual valve, SPC-AOV16, is provided on the service water outlet of the heat exchanger for service water flow and process outlet temperature control.

The cleanup stream is processed by the SPC filter demineralizer skid. The skid consists of one 800 gpm capacity backwashable filter, one 400 gpm capacity mixed bed demineralizer, demineralizer resin strainer, backwash tank, air receiver tank, connecting piping, valves, and instrumentation.
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The SPC filter will typically utilize 1 micron absolute backwashable elements, but has the capability to utilize alternative non-backwashable filter elements and/or elements of different micron ratings. The demineralizer will typically contain a mixed bed bead resin with a 1:1 cation to anion ratio, however other granular media, such as activated carbon, or differing cation to anion ratios may be used. The use of alternative media in the filter or demineralizer will be based on the chemical and radiological parameters of the process stream.

The SPC air receiver tank provides air to the filter vessel during the backwash process, and is supplied by the Service Air System. The SPC backwash tank receives the filter backwash cycle solids, water, and air and directs the solids and water to the Liquid Radwaste system, and the air to the Radwaste HVAC system via a demister. SPC demineralizer media is directly discharged to the Liquid Radwaste system.

The demineralizer resin strainer is provided to prevent introduction of resin into the process stream in the unlikely event of a demineralizer failure.

Discharge from the filter demineralizer skid is directed to the SPC return line, which connects to the RHR test return piping via safety-related isolation valve, RHS-AOV64, or to the SFC system via safety-related manual valve, SFC-V3014. The filter demineralizer discharge line is also equipped with a water reject connection to the Liquid Radwaste system. The reject flow is controlled via remote-manual valve, SPC-AOV22, which is equipped with manual stops set to limit reject flow to 100 gpm.

The SPC system has four primary operating configurations or flowpaths. The Suppression Pool Cooling and Cleanup configuration takes suction from the suppression pool via the RHR loop C suction line, and returns to the suppression pool via the RHR C test return line. The suppression pool water will be cooled, as needed, by the SPC heat exchanger and processed via the SPC filter demineralizer skid. The SPC system can be operated in this configuration in any reactor power mode of operation.

ADHR Configuration 1 takes suction from the reactor vessel via the RHR shutdown cooling valves, E12-MOVF008 and E12-MOVF009, and returns to the reactor via the RHR loop C injection line. This configuration can only be in operation when the reactor is in operating Mode 4 or 5, and reactor water temperature is less than
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200°F. Reactor water is cooled by the SPC heat exchanger, and can also be processed by the SPC filter demineralizer skid as a supplement or alternative to the water processing capability of the Reactor Water Cleanup system, if required. Reactor water can also be rejected to Liquid Radwaste in this configuration.

ADHR Configuration 2 takes suction from the reactor via the RHR shutdown cooling valves, E12-MOVF008 and E12-MOVF009, and returns to the reactor cavity pool via SFC-V3014. This configuration can only be operated with reactor in Mode 5, reactor water temperature less than 200°F, reactor head removed, and the reactor cavity pool filled. Water is cooled by the SPC filter-demineralizer skid or rejected to Liquid Radwaste, as needed.

ADHR Configuration 3 takes suction from the reactor cavity pool via SFC-V3014, and returns to the reactor via the RHR loop C injection line. This configuration can only be operated with the reactor in Mode 5, reactor water temperature less than 200°F, reactor head removed, and the reactor cavity pool filled. Water is cooled by the SPC heat exchanger and can also be processed via the SPC filter-demineralizer skid or rejected to Liquid Radwaste, as needed.

9.3.8.3 Safety Evaluation

The SPC system has no safety-related function as defined in Section 3.2. Failure of the system will not compromise any safety-related system or component and will not prevent safe reactor shutdown.

However, the system incorporates features that will ensure reliable operation over the full range of normal plant operations and during plant shutdowns when the system is operated in decay heat removal configurations. These features consist primarily of instrumentation that will monitor and/or control its respective processes.

The SPC system interface with the RHR suction piping is provided with automatically closing, safety-related isolation valves. These isolation valves are provided with automatic closure signals as described in Section 6.2.4.3.7 to isolate the SPC system whenever RHR loop C operation or containment isolation is required. Additional isolation signals are provided to augment procedural controls to ensure suppression pool, upper containment pools, or reactor water levels are maintained during applicable system operating configurations. The SPC system interface with

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Fuel Pool Cooling and Cleanup is provided with a manual safety-related isolation valve. Electrical separation is maintained in accordance with Reg. Guide 1.75 and IEEE 384-1974 where required.

9.3.8.4 Inspection and Testing Requirements

The SPC system is an operational system which is expected to be in daily use and as such does not require periodic testing to ensure operability. Demonstration or verification of SPC decay heat removal capability will be performed, as required, when the system is utilized for alternate decay heat removal.

9.3.8.5 Instrumentation Requirements

The SPC system is primarily remote-manually and manually controlled. The communication between the SPC components and the main and auxiliary control rooms is accomplished via OPTO 22 multiplexer/microprocessor system. The filter demineralizer skid controls and indications are also transmitted via a programmable logic controller (PLC) that directly interfaces with OPTO 22 system. Component controls and indications are also provided locally at SPC-PNL100 in the E-Tunnel and SPC-PNL200 in the Radwaste Building.

The SPC pumps and major system valves are controlled via remote-manual handswitches in the control room. Equipment status, position indication, and annunciators are also located in the control room. Indicated parameters include system total flow, system inlet temperature, and heat exchanger outlet conductivity. Control and indication for the SPC backwash tank drain valve and a common filter demineralizer skid trouble alarm is located in the auxiliary control room.

Various interlocks are provided to prevent equipment damage or preclude inadvertent draining of upper containment pool water to the suppression pool. The SPC pump start is inhibited if system high point water sensors indicate no liquid present to prevent water hammer. The operating SPC pump will trip on high or low system flow or low pump suction pressure. The SPC-SFC suction valve, SPC-AOV14, and RHS-AOV63 are interlocked so that only one valve can be opened at any one time to preclude possible draining of the upper containment pools to the suppression pool. Interlocks and signals from the non safety-related SPC system and the safety-related suction isolation valve, RHS-AOV63, is accomplished by equipping RHS-AOV63 with two solenoid valves. One of the two solenoid valves is non-safety related and interfaces with the SPC system controls.
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References - 9.3

1. Generic Letter 85-03, Clarification of Equivalent Control Capacity for Standby Liquid Control Systems, Janaury 28, 1985.

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9.4 AIR-CONDITIONING, HEATING, COOLING, AND VENTILATION SYSTEMS

9.4.1 Control Building Ventilation System

The functions of the control building ventilation system are to provide cooling, heating, ventilation, pressurization, and smoke removal for the several areas within the control building.

The areas within the control building are:

1. Main control room
2. Standby switchgear rooms
3. Battery rooms
4. HVAC equipment rooms
5. Cable vault
6. General areas

The control building ventilation system is shown in Fig. 9.4-1a through 9.4-1c.

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Environmental and system design parameters are listed in Table 9.4-1. The nominal capacity and performance data of the principle system components supplied by the equipment manufacturer are listed in Table 9.4-2. Heat removal requirements are accomplished by maintaining ambient temperature and relative humidity.

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9.4.1.1 Design Bases

The control building ventilation system is completely independent of all other plant heating, ventilating, and air-conditioning systems, and consists of the following subsystems.

9.4.1.1.1 Main Control Room Air-Conditioning Subsystem

The main control room air-conditioning subsystem is designed in accordance with the following criteria:

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1. Maintain ambient condition within the design limits as listed in Table 9.4-1 and control the air circulation for optimum personnel comfort and equipment performance requirements. The heat removal requirements from the main control room are accomplished by maintaining ambient temperature and relative humidity in the main control room.

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2. Maintain a positive pressure above atmospheric pressure to prevent outside air and air from other

control building areas from leaking into the main control room.

3. Reduce the airborne radioactivity in the outside air to the main control room by diverting the intake air flow through a special filter train containing charcoal filters during an accident.

4. Perform its design function during normal, shutdown, loss of offsite power, and DBA conditions without loss of function.

5. Operate under emergency conditions assuming the single failure of any one active component.

6. Detect and limit the introduction of smoke into the main control room.

7. Capability to remove smoke from the main control room.

8. Seismic Category I and Safety Class III.

9.4.1.1.2 Standby Switchgear Rooms Air-Conditioning Subsystem

The standby switchgear rooms air-conditioning subsystem provides heating, cooling, and ventilation to the standby switchgear rooms and associated battery rooms, cable vault, and general areas.

The standby switchgear rooms air-conditioning subsystem is designed in accordance with the following criteria:

1. Maintain ambient condition within the design limits as listed in Table 9.4-1 and control the air circulation for equipment performance requirements.

2. Operate during normal, shutdown, loss of offsite power, and DBA conditions without loss of function.

3. Perform its design function under emergency conditions assuming a single failure of any one active component.

4. Capability to remove smoke from areas served by the subsystem.

5. Seismic Category I and Safety Class III.

9.4.1.1.3 Chiller Equipment Room Air-Conditioning Subsystem

The chiller equipment room air-conditioning subsystem is designed in accordance with the following criteria:

1. Maintain ambient condition within the design limits as listed in Table 9.4-1.

2. Provide air-conditioning to operate during normal, shutdown, loss of offsite power, and DBA conditions without loss of function.

3. Provide a ventilation air supply to and exhaust from the equipment room during normal and shutdown conditions. The ventilation equipment is seismically supported. Ventilation equipment is not connected to the emergency bus and is not designed to operate after loss of offsite power.

4. Provide exhaust air for smoke removal.

5. Seismic Category I and Safety Class III.

9.4.1.2 System Description

The control building ventilation system is located in a Seismic Category I structure that is tornado, missile, and flood protected.

9.4.1.2.1 Main Control Room Air-Conditioning Subsystem

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The main control room air-conditioning subsystem includes redundant full capacity air handling units. Air for the toilet and kitchen is also provided by this system. Each unit consists of a filter assembly, cooling coil, fan, and dampers. Both units discharge air into a common duct, and hence to the distribution ductwork and supply registers in the rooms. An electric heating coil is located in the supply duct of each air-conditioning unit. Main control room area ventilation outside air intakes and exhausts are missile protected. The supply air is cooled as it passes through each unit's cooling coil which is served by the chilled water system. Redundant chilled water supply systems, each composed of two 100-percent capacity water chillers and related pumps, are provided as described in Section 9.2.10. The kitchen and toilet are exhausted to atmosphere by separate fans and exhaust duct systems. Redundant isolation dampers are provided which are designed to isolate kitchen and toilet exhaust on LOCA manual initiation, LOCA, or high outdoor radioactivity.

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Note: The electric heating coils (duct heaters - 1HVC*CH1A, B) are described as part of the Main Control Room Air Conditioning Subsystem.
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Two outside air charcoal filter trains are provided to filter the main control room outside air supply during and after a LOCA. One serves as a full capacity spare. A detailed description of the emergency air filtration system and its components is provided in Section 6.4.2.

During normal and plant shutdown conditions, a mixture of outside air and recirculation air is filtered for dust before delivery to the main control room. The supply air to exhaust air ratio is sufficient to maintain a positive pressure above atmospheric pressure which prevents outside air and air from other control building areas from leaking into the main control room. A maximum outside air quantity of 4,000 cfm can be provided for pressurization of the main control room. The following factors were taken into consideration to determine the volume of air for pressurization:

1. Net volume of the main control room and the associated pressure boundary areas is 240,700 cu ft.

2. An adequate maximum outside air supply of approximately one air change/hr is provided for comfort of personnel in the main control room.

No noxious gases are stored near the main control room outside air intakes. For further description see Section 2.2.3.

The main control room pressure envelope is maintained at a positive pressure relative to the adjoining areas, as described in Section 6.4. Two separate outside air intakes are furnished to provide alternate sources of outdoor air for the main control room. The local air intake is located on the roof of the control building, and the remote air in-take is located inside the standby cooling tower, a Seismic Category I structure. The control building intake locations are shown in Fig. 6.4-1. The remote air intake controls are located in the main control room.

The air intakes are located so that under a variety of wind conditions one of the air intakes continually ensures air free of objectionable contamination for main control room pressurization, thus minimizing the potential for exposure to airborne radioactivity to persons in the main control room (Section 15.7).

Following a DBA or high outdoor radioactivity, the main control room outside air supply is automatically diverted through one of the emergency charcoal filtration units. The

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redundant outside air diverting valves and dampers are located within the main control room pressure boundary and are accessible during an accident. Low air flow through the operating filter train automatically starts the redundant filter train booster fan.

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Electric heating coils in the ductwork are included to provide heating.

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Smoke removal is provided by a separate subsystem. The smoke removal subsystem consists of an exhaust fan, dedicated ductwork, and a part of the air-conditioning return air ductwork. The subsystem is seismically supported but is not designed to operate during DBA conditions. A description of the operation of the main control room smoke removal subsystem is given in Section 6.4.2 and meets the BTP ASB 9.5-1 requirements for smoke detection and removal in the main control room area.

The main control room is isolated from other areas in the building by fire doors, fire dampers, and fire rated walls. All fire dampers are thermally operated by means of a fusible link.

9.4.1.2.2 Standby Switchgear Rooms Air-Conditioning Subsystem

The standby switchgear equipment is housed in three separate rooms. Each standby switchgear room includes an associated walled-off battery room.

The standby switchgear room air-conditioning is located on el 71 ft 0 in of the control building and consists of an air-conditioning subsystem for the three switchgear rooms with associated individual battery room air exhaust systems.

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The standby switchgear rooms air-conditioning subsystem provides heating, cooling, and ventilation to the standby switchgear rooms, the associated battery rooms, the cable vault, and the general areas. The air-conditioning sub-system maintains a maximum air temperature of 104°F for the switchgear rooms, general areas and cable vault and 90°F for the battery rooms. The subsystem is designed to operate during normal, shutdown, loss of offsite power, and DBA conditions without a loss of function.

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Air is supplied to the standby switchgear rooms from redundant 100-percent capacity air-conditioning units. Each unit consists of a fan, filter, chilled water coil, and electric heating coil. Redundant full capacity fans return approximately 25,330 cfm to the operating air-conditioning unit. An electric heating coil is located in the air handling unit to maintain a minimum supply air temperature. Smoke removal is provided by a separate subsystem consisting of an exhaust fan and dedicated ductwork. The smoke removal subsystem is seismically supported, but is not designed for DBA conditions. A description of the operation of the standby switchgear room and cable vault smoke removal is given in Section 6.4.2.

Each battery room is provided with an exhaust subsystem which includes redundant full capacity exhaust fans. The ventilation supply air for each battery room is provided by the standby switchgear rooms air-conditioning units. There is no air recirculation from the battery rooms. Smoke removal is provided for each battery room using redundant exhaust fans and exhaust ductwork.

The standby switchgear rooms and associated battery rooms are isolated from other areas in the building by fire doors, fire dampers, and fire rated walls. All fire dampers are thermally operated by means of a fusible link.

9.4.1.2.3 Chiller Equipment Room Air-Conditioning Subsystem

The chiller equipment room air-conditioning subsystem consists of an outside air supply, room exhaust, and redundant full capacity unit coolers. The outside air supply provides 1,100 cfm ventilation air supply to the chiller equipment room. An electric heating coil is located in the supply ductwork to maintain minimum supply air temperature. An exhaust of 1,100 cfm is provided. Redundant full capacity unit coolers maintain chiller equipment room ambient conditions within the maximum design limits as listed in Table 9.4-1 by recirculating 3,500 cfm of the room air. Smoke removal is provided for the chiller equipment room using the room exhaust fan and ductwork.

The chiller equipment room is isolated from other areas in the building by fire doors, fire dampers, and fire rated walls. All fire dampers are thermally operated by means of a fusible link.

9.4.1.3 Safety Evaluation

The essential air-conditioning equipment within the control building, with the exception of the smoke removal subsystems, includes the main control room, standby switchgear rooms and associated battery rooms exhaust, and the chiller equipment room subsystems. This equipment must maintain functional integrity during a DBA. Therefore, the essential ventilation and air-conditioning equipment and the associated ductwork, piping, instrumentation, and valves for these rooms are designed as Seismic Category I systems. All equipment is located within the control building, a protected Seismic Category I structure. Since no high or moderate energy piping passes through the control building, protection against high and moderate energy pipe breaks is not necessary. Standby electrical power is available for operation of the safety class equipment, motors, and controls (Chapter 8). Class 1E equipment within the main control room is qualified as described in Section 3.11.

The single-failure criterion for active equipment except smoke removal equipment is met by the redundant design of equipment and controls. The controls automatically switch from the failed piece of equipment to the redundant equipment. Redundant and independent chilled water systems are provided.

Standby service water is available to the air handling unit cooling coils to provide cooling sufficient to maintain main control room habitability in the event all chillers and/or all circulation pumps fail. Conformance of the chilled water system to the single-failure criterion is described in Section 9.2.10. Active equipment consists of air handling units and exhaust fans. Passive system components, such as supply and return ductwork, are shared by redundant active equipment.

The local outside air intake located on the control building roof for the ventilation and air-conditioning system is protected by a missile barrier. Neither control dampers nor instrumentation are installed within this barrier. The barrier is designed to prevent direct impingement on the system ductwork from any type of precipitation. The opening is designed to maintain a low air velocity to minimize water droplet carryover. A protective screen used at the intake is of 1/2-in-sq, No. 16 gauge mesh which is large enough to prevent the accumulation and subsequent blockage by either snow or ice. The remote outside air intake, located at the SSW cooling tower, is protected in a similar manner.

Abnormal air-conditioning subsystem conditions are alarmed in the main control room. Radiation monitors are located in the main control room outside air stream. Area radiation monitors are also provided in the main control room. In the event of increasing radioactivity levels, the outdoor supply air is automatically diverted through the main control room emergency charcoal filter train. The consequences of control building ventilation system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) Report submitted under separate cover. A more detailed description of the safety evaluation is provided in Section 6.4.

9.4.1.4 Inspection and Testing Requirements

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All systems are tested and inspected as separate components and as an integrated system. All system ductwork is subjected to leak tests during erection and is balanced in accordance with the procedures of the Associated Air Balance Control Council (AABC)[8]. Inservice testing of the main control room charcoal filters is conducted in accordance with the surveillance requirements in the Technical Specifications/Requirements (Chapter 16) and conforms to the guidelines of Regulatory Guide 1.52 except as noted in Table 6.5-1. The tests ensure casing tightness, carbon adsorber efficiency, and particulate filter efficiency. Capacities and performance of the fans comply with Air Moving and Conditioning Association (AMCA) test codes and certified rating programs. All coils are hydrostatically tested. A more detailed description of equipment testing is provided in Section 6.4.

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9.4.1.5 Instrumentation Requirements

The control building ventilation system control logic is shown on Figure 7.3-12.

9.4.1.5.1 Main Control Room

Control switches are provided in the main control room for manual control of the main control room air handling units.

Control logic prevents automatic operation of an air handling unit unless an associated chilled water pump is running. During loss of offsite power, the main control room air handling units restart after a predetermined time from energization of the standby 4.16 kV buses by the standby diesel generators. The air handling units are interlocked with their discharge and inlet dampers so the dampers are open when the unit is running and closed when the unit is not running. High differential pressure across an air handling unit filter and high air handling unit discharge temperature activates alarms in the main control room.

Main control room temperature is controlled and humidity is limited by modulating the main control room air handling

• →12 • →6 • →3
unit chilled water valve. Pushbutton controls are provided in the main control room for manual operation of the heater breakers. The heaters are modulated automatically when the HVC-CH1A(B) pushbutton is in START and adequate system flow exists.
3←• 6←• 12←•
Control switches are provided in the main control room for manual operation of the isolation valves (MOV 1A,B) for the main control room air handling units. A LOCA signal or a high radiation condition in the control building local air intake closes the isolation valve.

Local and remote outside air intake radioactivity levels are monitored, and a high radiation level condition activates an alarm in the main control room. The control building ventilation system and area radiation monitors are described in Section 12.3.4.

Control switches are provided in the main control room for either manual or automatic operation of the main control room charcoal filter train local outside air intake dampers (AOD 19C,D,E,F) and booster fans (FN1A,B). In the automatic mode the dampers open and the fans start on a LOCA signal or a high radiation condition in the local outside air intake. The operator has the option of drawing outside air from the remote air intake. Control switches are provided in the main control room for manual operation of the motor-operated remote outside air intake dampers (MOD 7A,B) and air-operated control room charcoal filter remote outside air intake dampers (AOD 19A,B).

Charcoal filter trouble alarms are provided in the main control room. Abnormal conditions are monitored by the plant computer. Charcoal filter bed inlet temperature is monitored, and a high temperature condition activates an alarm in the main control room.

Control logic is provided for automatic startup of the spare booster fan when an operating fan fails and a high radiation condition in local outside air intake or LOCA condition exists. A booster fan failure condition is re-presented by a low air flow signal. The booster fans (FN1A,B) are interlocked with their air-operated discharge and inlet dampers (AOD 3A,B and AOD 43A,B), so that the fan start signal will open the dampers and the fan will start after the inlet damper is fully open. This prevents potential damage to the upstream ductwork caused by operating the booster fan with the inlet damper closed.

The main control room charcoal filter train air heater is automatically energized when neither the high filter air temperature cutout nor the low filter air flow cutout has been activated.

Control switches are provided in the main control room for manual control of the main control room recirculation dampers (AOD 106, AOD 148).

Control switches are provided in the main control room for either automatic or manual operation of the main control room charcoal filter train decay heat removal fans (FN8A,B). Interlocks prevent operation of a decay heat removal fan unless the filter inlet damper is fully closed. When operating in the automatic mode, the decay heat removal fan starts up automatically after the filter system shuts down. A short time delay is included so that testing of the filter system can be accomplished without unnecessarily initiating the decay heat removal system. The fans are interlocked with their inlet and outlet dampers so the dampers are open when the fan is running and closed when the fan is not running.

A LOCA signal or a high radiation condition in the control building local air intake prevents the main control room smoke removal damper (AOD 107 or AOD 108) from opening. A control switch in the main control room enables the operator to start and stop the main control room smoke removal fan (FN9). Interlocks prevent the smoke removal fan from starting unless the main control room smoke removal dampers are open.

Alarms are provided in the main control room for misalignment of the charcoal filter train and air-conditioning system dampers for each division.

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Local controls are provided for either automatic or manual operation of the local outside air intake roll filter. An extreme high filter pressure differential condition activates an alarm in the main control room.

Control building ventilation system inoperative alarms are provided in the main control room for each division.

9.4.1.5.2 Standby Switchgear Room

Control switches are provided in the main control room for manual control of the standby switchgear air-conditioning units. Control logic prevents operation of an air handling unit unless an associated chilled water pump is running. During loss of offsite power, the standby switchgear air-conditioning units restart after a predetermined time from energization of the standby 4.16 kV buses by the standby diesel generators. The air handling units are interlocked with their discharge and inlet dampers so that the dampers are open when the unit is running and closed when the unit is not running. High differential pressure across an air handling unit filter and high air handling unit discharge temperature activate alarms in the main control room.

Switchgear room air handling unit heaters are controlled and operated in two stages to maintain room temperature within design limits. For cooling purposes, the standby switchgear room return air temperature is controlled within acceptable limits by positioning within acceptable limits by positioning the air handling unit chilled water valve.

Control switches are provided in the main control room for either manual or automatic control of the standby switchgear room return fans (FN2A,B). Control logic is provided to prevent startup of a standby switchgear room return fan unless a chilled water pump is running while operating in the automatic mode. The fans are interlocked with their suction dampers (AOD 5A,B) so the dampers are open when the fan is running and closed when the fan is not running. A low air flow condition activates an alarm in the main control room.

Control switches are provided in the main control room for either automatic or manual operation of the battery room exhaust fans. During automatic mode of operation, the exhaust fans start when the battery room exhaust flow reaches a low point. A low air flow condition activates an alarm in the main control room.

Battery room air heaters are operated as needed to maintain room temperature within design limits. High battery room temperature alarms are provided in the main control room.

9.4.1.5.3 Chiller Equipment Room

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Control switches are provided in the main control room for either manual or automatic control of the chiller equipment room air handling units. Control logic is provided to prevent startup of a unit unless a chilled water pump is running while operating in the automatic mode. High differential pressure across the air handling unit filter activates an alarm in the main control room.

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9.4.2 Fuel Building Ventilation System

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The function of the fuel building ventilation system is to control the building air temperature and the movement of potential airborne radioactivity contaminants within the building. The system is to maintain a negative pressure within the building during the movement of recently irradiated fuel. The system provides an environment which ensures the operability of the equipment and safety of plant personnel during all modes of plant operation, including the design basis accident (DBA). The portions of fuel building ventilation system required to function following a DBA are designed to Seismic Category I, Safety Class 3 criterion.

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9.4.2.1 Design Bases

The fuel building ventilation system is designed in accordance with the following criteria:

1. Maintain ambient conditions in the fuel building, as listed in Table 9.4-1, to ensure a suitable operating environment for all equipment, processes, and personnel.

2. Maintain air flow from areas of low potential radioactivity to areas of progressively higher potential radioactivity prior to filtration and exhaust to atmosphere.

3. Provide the building with a continuous source of fresh air to continuously purge the inside atmosphere and limit the concentration of airborne radioactivity well within the maximum permissible concentration listed in 10CFR20, Appendix B, Table I.

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4. Maintain air pressure within building equal or less than 0.00 in W.G. during movement of recently irradiated fuel (i.e., fuel that has occupied part of a critical reactor core within 24 hours and during accident

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conditions (refer to 15.7.4, Fuel Handling Accident) to prevent any leakage of contaminated air from the building to the outside.

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5. Mitigate the consequences of fuel-handling accidents by limiting the plant site boundary dose within the guidelines of 10CFR50.67 by routing exhaust air from the spent fuel pool and fuel cask areas through charcoal filter units (containing high efficiency particulate air (HEPA) filters and iodine removal charcoal filters) during fuel handling operation and upon detection of high airborne radioactivity in the exhaust air. Amendment 132 revised the design basis accident offsite dose limit requirements from 10CFR100 to 10CFR50.67.

6. The design of the charcoal filtration unit assemblies and appurtenances conforms to the requirements of Reg. Guide 1.52 with the exceptions listed in Table 6.5-1. The building exhaust is automatically routed through charcoal filter units if high radiation is detected in the exhaust duct or receipt of a LOCA signal.

7. Provide heating to maintain a minimum ambient temperature and to protect the piping and equipment from freezing.

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8. The ventilation system equipment and components which operate during a DBA are designed to Seismic Category I, Safety Class 3 criteria and housed within a Seismic Category I structure capable of protecting the system from outside missiles and dynamic effects of tornado and wind pressure. Equipment motors and controls in the safety class portions of the system are supplied power from their respective independent standby emergency power sources and have sufficient redundancy to satisfy the single failure criterion (Section 9.4.2.3).

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9.4.2.2 System Description

The fuel building ventilation system consists of the following subsystems:

1. Supply air system

2. Unit coolers system

3. Exhaust air system

4. Charcoal filtration system.

The fuel building ventilation system is shown in Fig. 9.4-2a and 9.4-2b and design data of principal system components are listed in Table 9.4-3. The system components are housed within the Seismic Category I fuel building to withstand the effects of tornadoes, earthquakes, hurricanes, and floods (Section 3.8.4). The fresh air intake louvres are located within the fuel building, and are protected from tornado-generated missiles by a labyrinth wall (Fig. 1.2-22) which is capable of withstanding tornado missile impact.

9.4.2.2.1 Supply Air System

The supply air system provides the building with a filtered source of 9,000 cfm outside air at required design temperature. The supply air system consists of a builtup air handling unit with an outside air intake louver, wire mesh screen, tornado damper, inlet air filer, electric heating coil, chilled water cooling coil, two 100-percent capacity vaneaxial supply fans (one operating at one time with the second on standby), supply air ductwork, and discharge air openings. Air is supplied to the operating floor, fuel cask area, spent fuel pool area, and to various cubicles within the building before being exhausted by the exhaust air system. The fuel building ventilation system serves the following areas within the fuel building in addition to the spent fuel pool and general areas:

1. Fuel pool cooling pump cubicle

2. Fuel pool purification pump cubicle

3. Heat exchanger cubicles

4. Filter rooms, pipe chases, etc.

The supply air system is not designed to meet safety class or Seismic Category I requirements since it is not required to operate following a postulated DBA. However, the outside air intake plenum, tornado dampers, isolation dampers, and ductwork to filter plenum are designed as Safety Class 3, Seismic Category I, to maintain operational integrity during all modes of plant operation. A common supply air duct (maximum capacity of 9,800 cfm) with redundant isolation dampers is provided in the outside air intake duct to ventilate the fuel building in the event of failure of the sup- ply air system.

During accident and emergency conditions, the fuel building emergency outside air intake isolation dampers can be opened to provide an outside air supply into the fuel building.

The outside air is drawn into the fuel pool cooling pump room and charcoal filter rooms through the fuel building exhaust ductwork and exhausted to the environment through the charcoal filter exhaust fans, in order to maintain these areas within their acceptable environmental design limits.

Ventilation of the spent fuel pool area is affected by a push-pull system in which supply air is supplied to the fuel pool area from one end at lower elevation and the air is exhausted through registers located at the other end at higher elevation. The average air velocity over the surface of water in the pool is approximately 300 fpm and air currents skim the surface of water approximately 6 in above the water surface. The ventilation air quantity is maintained approximately 4 cfm per sq ft of pool water surface area to minimize water carryover. The conditioned air is continuously discharged over the water surface of the spent fuel, fuel cask, and general areas of the building for normal ventilation through the sheet metal duct distribution system. The chilled water for cooling coils of the supply air system is supplied by the radwaste building chilled water system (Section 9.2.9). An electric heating coil is provided to temper the outside air to maintain a required discharge air temperature.

9.4.2.2.2 Unit Coolers System

Individual unit coolers are provided for removal of heat dissipated from equipment for the following areas:

1. Electrical equipment area
2. Charcoal filter rooms
3. Fuel receiving area
4. CRD pump areas
5. New fuel receiving area
6. General area.

Each unit cooler consists of a housing, throwaway-type filters, cooling coils, vaneaxial fan, and ductwork. The unit coolers are designed for adequate air recirculation to remove heat dissipated from electrical equipment, piping, and motors and to maintain design temperature. The unit coolers are not designed to meet safety class or Seismic Category I requirements since these are not required to operate following a postulated DBA.

Two unit coolers are provided with electric heating coils through their ductwork distribution system to maintain the minimum design temperature.

The chilled water for cooling coils of unit coolers is sup-plied by the radwaste building chilled water system (Section 9.2.9).

9.4.2.2.3 Exhaust Air System

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The exhaust air system is designed to exhaust the ventilation air supplied in the building to the atmosphere through exhaust ventilation ducts located near the spent fuel pool, in general areas and various cubicles. During normal operation the building air is exhausted by one of two 100-percent capacity exhaust fans. The exhaust air system capacity (10,000 cfm) is in excess of the supply air system to maintain the building air pressure equal to or less than 0.00 inches W.G. during normal operating condition.

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Normally, ventilation air is exhausted directly to atmosphere. Upon detection of high airborne radioactivity concentration exceeding set point and during fuel handling operation, the exhaust air is routed through the charcoal filtration units.

The exhaust fans are not designed to meet safety class or Seismic Category I requirements and are not required to operate following a postulated DBA or fuel handling accident. The exhaust fans are used for smoke removal in the event of fire in the fuel building during normal plant operation.

9.4.2.2.4 Charcoal Filtration System

The ventilation air from the fuel building is exhausted by two separate routes. During normal operation, exhaust air from all areas is exhausted directly to atmosphere by vaneaxial exhaust fans (Section 9.4.2.2.3). In the event of presence of high airborne radioactivity concentration in the building, and during fuel handling operation, exhaust air is routed through charcoal filtration units.

The charcoal filtration system consists of two 10,000 cfm (100-percent capacity) filtration units with their individual centrifugal exhaust fans, ductwork, dampers, and control devices. Each filter unit includes (in order) a moisture separator, electric heating coil, prefilters, HEPA filters, charcoal filter, and HEPA filters. The decay heat produced by radioactive materials in the inactive charcoal filter unit is removed by a 100 cfm capacity centrifugal fan, taking air from the equipment room and exhausting to the main exhaust duct. The design, testing, and maintenance criteria for charcoal filtration system conforms to Regulatory Guide 1.52 with the exceptions listed in Table 6.5-1. For detailed description and performance of various components of charcoal filter units see Section 6.5. Each filter unit is sized to provide adequate filtration and reduce radioactive releases to the atmosphere. Electric heating coils in the filter unit raise the temperature of air to limit the relative humidity to a maximum of 70 percent.

Tornado dampers are provided at outside air intake and exhaust openings to maintain system operability during all modes of plant operation. Tornado dampers are located within the structures designed against tornado-generated missiles. The tornado dampers are designed against the effect of a 3 psig positive and negative pressure (minimum) differential between building envelope and outdoors without pressure relief devices. Tornado protection dampers are provided to allow an inlet of design airflow and to close automatically, to isolate and protect the system from reverse flow caused by a design basis tornado.

Redundant radiation monitoring systems are provided in the building exhaust duct to detect the release of radioactivity to the environment. Upon detection of high airborne radio- activity in the building exhaust duct, the air is automatically diverted to charcoal filter units.

Both redundant 100-percent capacity charcoal filtration units are automatically actuated in the event of any of the following three isolation signals:

1. High radiation in the fuel building exhaust duct
2. High pressure in the drywell
3. Reactor vessel low low water level.

The plant operator can stop one of the units from the main control room after the startup is complete.

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The charcoal filtration system, an engineered safety feature (ESF), is designed to function following a DBA or fuel handling accident and is designed to meet Safety Class 3 and Seismic Category I requirements. The detailed component system description and materials for various components is

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similar to the standby gas treatments units discussed in Sections 6.5.1.2 and 6.5.1.5, respectively.

Charcoal filter component sizing is governed by the following flow parameters:

1. Moisture separator is designed to remove at least 99 percent by weight of the entrained moisture in an air stream containing 0.005 lb of entrained moisture per cu ft and at least 99 percent by count of the 1 to 10 micron diameter droplets without visible carryover when operating at rated (10,000 cfm) capacity to twice rated capacity.

2. Prefilters are designed so that airflow through any standard 24 x 24 x 11 1/2 in cell does not exceed approximately 1,000 cfm.

3. High Efficiency Particulate Air Filters - both HEPA filter banks are designed so that air flow through any standard 24 x 24 x 11 1/2 in cell does not exceed approximately 1,000 cfm.

4. Charcoal Filter Bank - the effective face area of charcoal filter is designed so that the average air velocity through the charcoal bed does not exceed 40 ft/min when the charcoal filter unit is operating at 10,000 cfm. Gas residence time in the charcoal bed is a minimum of 0.25 sec per 2 in of bed depth. Activated carbon material (4,250 lbs) similar in type to Barnaby Cheney 727 is provided for each charcoal filter train to meet the gas flow and minimum residence time established herein.

9.4.2.3 Safety Evaluation

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Continued operation of the fuel building ventilation system's essential components during the required modes of plant operation is assured by the following features for which the system is designed:

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1. The safety-related components are designed to Safety Class 3 and Seismic Category I requirements and located so that failure of portions of other nonessential systems does not prevent operation of any safety-related systems.

2. All system components are protected against internally and externally generated missiles by the following:

a. Location within a Seismic Category I tornado proof structure designed to withstand the effects of tornadoes and wind pressure, and

b. Physical separations that are provided between redundant equipment.

3. During loss of offsite power, all active components such as motors, damper operators, controls, and instrumentation (except supply and exhaust fans) receive power from their respective independent standby emergency power supplies.

4. Redundant radiation monitoring systems are provided in the exhaust duct at the release point. The exhaust air is continuously monitored for high radioactivity (Section 11.5). Redundant radiation monitor sample points are located in the building exhaust duct. At a predetermined level, exhaust air is automatically diverted through charcoal filtration units.

5. To meet the single active failure criterion, the following redundant components are provided:

a. Two 100-percent capacity charcoal filtration units.

b. Two 100-percent capacity centrifugal exhaust fans for charcoal filtration system.

c. Redundant isolation dampers in the supply air system.

6. The design features (Section 9.4.2.2) incorporated in the fuel building ventilation system minimizes moisture (and, thus, airborne radioactivity) propagation in the fuel building environment.

7. The consequences of fuel building ventilation system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) Report submitted under separate cover.

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8. The fuel building is maintained at equal or less than 0.00 inches W.G. relative to outside during normal operating, and equal or less than -0.25 inches W.G. during movement of recently irradiated fuel (i.e., fuel that has occupied part of a critical reactor core within the previous 24 hours) and during accident conditions (refer to 15.7.4, Fuel Handling Accident), thereby

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minimizing any possibility of leakage of unfiltered contaminated air to the environment.

9. The physical layout of nonessential portions of the fuel building ventilation system and of other systems in the fuel building not designed to Seismic Category I requirements is such that failure of any nonessential component does not affect operation of the essential safety-related portions of the system.

10. Two 100-percent capacity supply and exhaust fans are provided for reliable continuous normal operation.

A detailed description of compliance with positions C.2.a through C.2.f and C.2.k of Regulatory Guide 1.52 is provided as follows:

C.2.a

The ESF atmosphere cleanup system for the fuel building is redundant and consists of the following components: (1) demister, (2) electric heater, (3) prefilters, (4) HEPA filters, (5) iodine adsorber (impregnated activated carbon), (6) HEPA filters.

C.2.b

The redundant ESF atmosphere cleanup system filtration units in the fuel building are located in different cubicles separated by a 1 1/2 ft thick reinforced concrete wall.

C.2.c

All components of the fuel building ESF atmosphere cleanup system are designated as Seismic Category I.

C.2.d

The fuel building ESF atmosphere cleanup system is not subjected to pressure surges.

C.2.e

The effects of radiation are considered for all organic-containing materials that are necessary for operation during a postulated DBA.

C.2.f

The volumetric air flow rate through a single cleanup unit for the fuel building is 10,000 ft^3/min. The filter layout for a fuel building cleanup train is three HEPA filters high and three wide.

C.2.k

Outdoor air intake opening is missile/tornado protected and equipped with security grating and bird screens.

9.4.2.4 Inspection and Testing Requirements

To ensure and demonstrate the capability of the fuel building ventilation system, the system components and equipment are subjected to preoperational testing in accordance with the procedures described in Chapter 14.

Local display and/or indicating devices are provided for surveillance of vital parameters such as room temperature and buildup differential pressure. All charcoal filter system ductwork is subjected to leak tests in accordance with Regulatory Guide 1.52. All system ductwork is balanced in accordance with the procedures of the Associated Air Balance Control Council (AABC)[(8)].

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The inservice inspection and testing is done in accordance with the procedures described in the Technical Specifications/ Requirements (Chapter 16).

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9.4.2.5 Instrumentation Requirements

Control switches are provided in the main control room for manual operation of the fuel building ventilation air supply fans (FN 1A, 1B). Interlocks are provided to ensure full open position of the redundant supply air inlet dampers (AOD 101, AOD 122) prior to starting a fan.

Control switches are provided in the main control room for manual operation of the air supply inlet isolation dampers. A LOCA signal, manual containment isolation signal, or fuel building high radiation automatically closes the normal air supply inlet isolation dampers (AOD 101 and AOD 122) and opens the free discharge air supply inlet dampers (AOD 37A and AOD 37B).

Control switches are provided in the main control room for manual operation of the fuel building normal air exhaust fans (FN 8A and 8B) and inlet (AOD 102 and AOD 112) and outlet (AOD 104 and AOD 137) isolation dampers. A LOCA signal, manual containment isolation signal, or fuel building high radiation automatically closes the isolation dampers. Interlocks are provided to ensure full open position of the exhaust fan inlet and outlet isolation dampers prior to starting a fan.

Fuel building normal supply and exhaust fan trouble alarms are provided in the main control room.

Control logic is provided so that a low exhaust air flow condition automatically starts the standby normal air exhaust fan.

Fuel building ventilation system inoperative alarms are provided in the main control room.

The fuel building charcoal filtration units are monitored by the plant computer for abnormal conditions such as high filter differential pressure or high charcoal filter outlet temperature. Filter trouble alarms are provided in the main control room.

Control switches are provided in the main control room for manual operation of the fuel building exhaust filter train air exhaust fans (FN 3A and 3B) and the decay heat removal fans (FN 7A and 7B). A LOCA signal, manual containment isolation signal, or fuel building high radiation automatically starts the charcoal filter train exhaust fans. Control logic is provided so that a low air flow in the filter train that is in operation automatically starts the standby exhaust filter train.

The fuel building exhaust filter charcoal bed temperature differential is maintained at the design value by controlling the filter heater. The heater is stopped automatically if the filter exhaust fan stops, or low air flow or high air temperature occurs.

The level of radiation of the fuel building exhaust is monitored, and a high radiation level alarm is provided in the main control room. Control logic is provided so that a high radiation signal automatically diverts the exhaust air through the charcoal filter unit. Sections 7.3.1 and 12.3.4 describe the fuel building ventilation exhaust radiation monitors.

Misalignment of the fuel building ventilation system dampers is alarmed in the main control room.

Temperature controls are provided for the fuel building areas to maintain the area temperature at a nominal 80°F. A high temperature area condition in any one of the fuel building areas opens the fuel building air handling unit chilled water outlet control valve (AOV 177). Interlocks prevent this valve from opening when the supply fan is not running.

Local control switches are provided for manual operation of the area unit coolers. Temperature switches provide on-off control of the chilled water control valve for each unit cooler.

A trouble alarm is provided in the main control room for the fuel building ventilation system.

Control switches are provided in the main control room for manual operation of the fuel building air handling unit air heaters.

The fuel building pressure relative to atmosphere is measured and a high pressure activates an alarm in the main control room.

9.4.3 Auxiliary and Radwaste Area Ventilation System

The function of the auxiliary building ventilation system is to control the building air temperature and the movement of potential airborne radioactivity contaminants, and to maintain a negative pressure within the building. The system provides an environment which ensures the operability of the equipment and the safety of plant personnel during all modes of plant operation, including the design basis accident (DBA).

The function of the radwaste building ventilation system is to control the maximum building air temperature and circulation of potential airborne radioactive contaminants. This provides an environment which ensures the operability of the equipment, the safety of plant personnel, and the accessibility of the building.

9.4.3.1 Design Bases

9.4.3.1.1 Auxiliary Building Ventilation System

The auxiliary building ventilation system is designed in accordance with the following criteria:

1. Provide an environment with controlled temperature to ensure the comfort and safety of personnel and operability of auxiliary building equipment necessary for power generation.

2. Provide air movement from areas of low potential radioactive contamination to progressively higher potential radioactivity prior to filtration and exhaust to atmosphere.

3. Provide the capability to redirect the exhaust air from shielded compartments to the standby gas treatment unit (Section 6.5) when airborne radioactivity levels for direct exhaust are exceeded and also during accident conditions.

4. Provide filtration of outside air to limit dust particles.

5. Provide the building with a continuous source of fresh air during normal plant operation to purge the inside atmosphere and limit the concentration of airborne radioactivity below the maximum permissible concentration listed in 10CRF20, Appendix B, Table I.

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6. Maintain the auxiliary building at atmospheric pressure during normal operation and at a negative pressure of at least -0.25 in W.G. with respect to atmosphere during a LOCA and high radiation accident to prevent any exfiltration of contaminated air (Section 6.5).

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7. Maintain design ambient temperatures and limit the maximum humidity as listed in Table 9.4-1.

8. Design ventilation system equipment and components which operate during LOCA to Seismic Category I, Safety Class 3 criteria and house within a Seismic Category I structure capable of protecting the system from outside missiles and dynamic effects of tornadoes and wind pressure.

9. Supply equipment motors and controls in the safety class portions of the system with power from Class 1E power source, and with sufficient redundancy to satisfy the single-failure criterion.

9.4.3.1.2 Radwaste Building Ventilation System

The radwaste building ventilation system is designed in accordance with the following criteria:

1. All components of the radwaste building ventilation system are nonnuclear safety-related, nonseismic, and are not required to operate following a DBA.

2. Maintain ambient conditions in the various building areas within the design limits as listed in Table 9.4-1 to provide a suitable environment for personnel and to ensure the operability of equipment and controls.

3. Distribute air within the building, providing for controlled air movement from areas of lower radioactivity to areas of progressively higher potential radioactivity.

4. Provide the building with a continuous source of fresh air to continuously purge the inside atmosphere and limit the concentration of airborne radioactivity much lower than the maximum permissible concentration listed in 10CFR20, Appendix B, Table I.

5. Provide filtration of outside intake air to limit airborne dust particles.

6. Provide high-efficiency filtration of all exhaust air before discharge to the atmosphere.

7. Provide air conditioning (cooled air) to the laundry room and sample room.

8. Provide exhaust from radioactive tanks and centrifuge area through charcoal filtration units.

9. Design charcoal filtration units in accordance with Regulatory Guide 1.140 (see Table 9.4-6 for exceptions).

9.4.3.2 System Description

9.4.3.2.1 Auxiliary Building Ventilation System

The auxiliary building ventilation system is shown in Fig. 9.4-7d and 9.4-7e. The principal system components and their performance data are listed in Table 9.4-4. The auxiliary building contains equipment for normal plant operation and safety-related equipment valves, switchgear, safety-related instrumentation, cables, and control wiring required for safe shutdown of the plant.

The auxiliary building ventilation system consists of the following systems:

1. Supply air system

2. Exhaust air system

3. Unit coolers system.

9.4.3.2.1.1 Supply Air System

The supply air system consists of two 100-percent capacity, 10,000 cfm vaneaxial fans; a prefilter; high-efficiency filters; one 100-percent capacity, 80 kW electric duct heater; dampers; and ductwork. The prefilters are of a renewable roll type, automatically progressed to maintain a uniform pressure drop. The high-efficiency filters are of an extended surface type. The electric duct heater is a duct-mounted, staged-type heating coil. The supply air sys- tem serves the following areas within the auxiliary building through the distribution ductwork:

1. Normal switchgear and terminal box areas

2. Control rod drive (CRD) transfer and work area

3. RPCCW pump and heat exchanger area

4. RHR heat exchangers and pump rooms

5. Work area and miscellaneous areas.

The supply air from these areas flows to areas of progressively higher potential contamination and is exhausted by the exhaust air system. During normal operation the supply air system operates continuously, providing ventilation air. The supply air system is not in operation during a DBA or when a high radiation level exists within the building. All components of the supply air system are nonnuclear safety class and nonseismic, with the exception of outside air intake and isolation dampers which are designed to Seismic Category I and Safety Class 3 requirements. Ventilation air for the auxiliary building is drawn through a common missile protected and tornado-proof opening serving both the containment and auxiliary buildings and is designed to meet Seismic Category I requirements (Fig. 1.2-13). Redundant isolation dampers are provided in the outside air intake to prevent any outleakage of radioactivity during a postulated seismic event.

The one 100-percent capacity outside air heating coil tempers the supply air during conditions of low outside ambient temperature to maintain the auxiliary building minimum design temperature.

9.4.3.2.1.2 Exhaust Air System

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The exhaust system consists of two 100-percent capacity, 10,000 cfm exhaust fans, dampers, ductwork, and necessary controls. The ventilation air is induced into cubicles from the general building areas, thus keeping the cubicle at a slightly negative pressure and ensuring flow of air from areas of less to progressively greater potential radioactive contamination. The exhaust air is continuously monitored for radioactivity in the main control room by a radiation monitoring system located in the exhaust duct (Section 12.3.4). In the event that radioactivity approaches a predetermined level, specified in the Technical Specifications/Requirements, main control room operators can manually shut down the supply fans and reroute the exhaust air through the SGTS (Section 6.5). Each fan is connected with a flow control modulating damper which operates in conjunction with the fan and exhaust airflow controller.

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During the DBA, the auxiliary building ventilation system in conjunction with the SGTS maintains at least -0.25 in W.G. negative pressure within the building. At this time, the supply and exhaust air systems are shut down, and the exhaust air is diverted to the SGTS.

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The exhaust fans are used for smoke removal in the event of fire in the auxiliary building during normal plant operation.

9.4.3.2.1.3 Unit Coolers System

Unit coolers are provided for removal of heat dissipated from equipment for the following areas:

1. Switchgear areas
2. East and west general areas, annulus mixing system, and charcoal filter room
3. Charcoal filter rooms

4. HPCS pump cubicle

5. RHR pump room and heat exchanger cubicle

6. RPCCW pumps and heat exchanger cubicles

7. RWCU pump cubicle

8. RCIC pumps and turbine cubicle

9. General areas

10. LPCS pump cubicle

•→1

11. Main steam pipe tunnel, north end.

1←•

Each unit cooler consists of a housing, throw-away type filters, cooling coils, vaneaxial fan, and ductwork. The unit coolers are designed for adequate air recirculation to remove heat dissipated from electrical equipment, piping, motors and to maintain design ambient temperature. Warm building air is cooled by recirculating the air through cooling coils by the unit cooler fans. Cooling water for the cooling coils is provided by the normal service water system (Section 9.2.1). During loss of offsite power and DBA conditions, the cooling water is supplied by the standby service water system as described in Section 9.2.7. During loss of offsite power or during DBA conditions coincident with loss of offsite power, power for the unit coolers is provided by the independent standby buses. The unit cooler protecting an ECCS component is connected to the same bus supplying power to the ECCS component.

There are three unit coolers serving the safety-related pump rooms as follows:

1. Group 1 - The HPCS pump room which contains the high pressure core spray pump and discharge line fill pump is served by unit cooler 1HVR*UC5.

2. Group 2 - The RHR heat exchangers A and C and pump room A which contain the residual heat removal pump and heat exchangers, the LPCS pump room which contains the low pressure core spray pump and discharge line fill pump, and the RCIC pump room which contains the reactor core isolation cooling pump, turbine, and discharge line fill pump are served by unit cooler 1HVR*UC6.

3. Group 3 - The RHR heat exchangers B and D and pump room B which contains the residual heat removal pump and heat exchangers, and the RHR pump room C

which contains the residual heat removal pump and discharge line fill pump are served by unit cooler 1HVR*UC9.

Failure of any one unit cooler affects no more than one group of safety-related pump rooms. Each cooler is supplied by its associated independent standby service water supply and served by an independent standby bus.

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With the exception of unit cooler 1HVR-UC14, the unit coolers are classified as Safety Class 3 and Seismic Category I.

1←•

The safety-related unit coolers' cooling coil construction conforms to the requirements of ASME[7] Section III, Class 3 and bears the N stamp. The cooling coils' framing and sup- ports conform to the requirements of subsection NF of ASME Section III, Division I.

Unit cooler 1HVR-UC14 is not designed to meet safety class or Seismic Category I requirements since it is not required to operate following a postulated DBA or loss of offsite power.

9.4.3.2.2 Radwaste Building Ventilation System

The radwaste building ventilation system is shown in Fig. 9.4-3a and 9.4-3b. The principal system components and their performance data are listed in Table 9.4-5. The radwaste building ventilation system is a 100-percent outside air supply and exhaust system, providing once-through air flow with no recirculation.

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The system consists of a common air intake built-up filter unit, unit coolers, and distribution ductwork. The filter unit consists of an insulated steel cabinet housing prefilters, high-efficiency filters, intake dampers, and plenum. The prefilters are of renewable roll type, automatically progressed to maintain uniform pressure drop. The high-efficiency filters are of extended surface type.

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Each unit cooler consists of a housing, cooling coil, electric heating coil, vaneaxial fan, and ductwork. Prefilters and high-efficiency filters function to remove dust particulates from the outside air before it is delivered to the system. Electric coils are provided for temperature and humidity control.

All unit coolers draw outside air from the intake plenum through ductwork. The cooling coils are provided with chilled water from the radwaste building chilled water system (Section 9.2.9). Distribution duct from the unit coolers supplies air to the clean areas. Air is exhausted from potentially contaminated areas only, thus maintaining air flow from clean to contaminated areas.

•→15

During normal plant operation, the supply system operates continuously. During the heating season the unit cooler's electric heating coil tempers the outside air to maintain space design temperature. The tempered air is distributed via the ductwork distribution system. Supplementary electric duct heaters are provided in certain areas to reheat the air to maintain space design temperature. The radwaste building supply system has no safety functions and is inoperative in the event of a loss of offsite power.

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The exhaust air system is divided into two sections:

1. The exhaust air from waste collector tanks, centrifuge, and potentially contaminated equipment is discharged to the exhaust duct through a char-coal filter train which uses a 100-percent capacity, 4,000 cfm centrifugal exhaust fan. The second charcoal filter train and exhaust fan is operated on rotational basis with the first fan. The design, testing, and maintenance criteria for each charcoal filtration system conforms to Regulatory Guide 1.140[1] (with exceptions listed in Table 9.4-6). Each charcoal filter train consists of the following components:

    a. A demister (moisture separator) to remove at least 99 percent by weight of the entrained moisture in an airstream containing 0.005 lb of entrained moisture per cu ft and at least 99 percent by count of the 1 to 10 micron diameter droplets without visible carryover when operating at rated (4,000 cfm) capacity to twice rated capacity.

    b. An electric heating coil to limit the relative humidity of the incoming air to 70 percent at design flow.

    c. Prefilters upstream of the first bank of HEPA filters to remove coarse particles from the air stream. The prefilters are designed for 78 percent average efficiency based on the ASHRAE 52-68 dust spot test.

d. A bank of HEPA filters for essentially complete removal of fine airborne particulates. The filters are of water- repellent and fire-resistant construction and are designed for a minimum efficiency of 99.97 percent on a 0.3 micron DOP (dioctylphthalate) test. The HEPA filters are fabricated in accordance with MIL-F-51068[6] and MIL-STD-282[5] and carry a UL label.

e. A minimum of 4-in deep bank of charcoal adsorber filters. Filters are of an all-welded, gasketless design and are sized for a maximum air velocity of 40 fpm through the charcoal bed at rated airflow. The adsorber media is activated coconut shell charcoal impregnated with potassium iodine (KI).

f. A second bank of HEPA filters, identical to item d. The function of this second HEPA filter bank is to capture charcoal particles which may escape from charcoal filters.

All the preceding components are mounted in an all-welded steel housing. Each charcoal filter train is provided with an integrally mounted water spray, fire extinguishing system. A thermistor detection system is installed in the charcoal beds. The vendor-supplied detection panels are integrated into the main control room panel to annunciate an alarm in the event of fire. Housing floor drains are provided for the demister, the occasional wash- down required for decontamination, and the water sprays, in the event of fire, in accordance with the recommendation of ERDA76-21[3]4[2].

A centrifugal-type fan, with 4,000 cfm capacity, is provided downstream of each filter unit. The fan is a direct-drive type with a single-speed motor. The decay heat produced by radioactive materials in the inactive charcoal filtration unit is removed by 100 cfm capacity centrifugal fans, taking air from the equipment room and exhausting to the main plant exhaust duct.

2. The exhaust air from general areas and the equipment area is discharged to the exhaust duct through an exhaust filter plenum by two 50-percent capacity exhaust fans. During normal plant operation, two exhaust fans operate, with a third fan in standby

drawing air from a common exhaust plenum and discharging the air above the radwaste building roof. The exhaust duct system is arranged in such a manner that all exhaust is drawn from areas with potential radioactive contamination, thus inducing air flow from clean areas into potentially contaminated areas. The exhaust air system is balanced to maintain the main areas of the building under a slight negative pressure relative to outside atmosphere in order to minimize any unmonitored leakage of potentially contaminated air to the environment. Dampers are provided throughout the distribution and exhaust system for balancing and to ensure isolation of areas of high potential radioactivity from areas of low potential radioactivity.

The radwaste building sample room, laundry room, and formaldehyde area are provided with redundant air conditioning systems to maintain suitable conditions for personnel comfort. A separate branch duct equipped with an electric reheat coil is provided for the sample room.

A redundant radiation monitoring system is provided in the building exhaust duct to alarm in the main control room in the event of high radioactivity levels.

Effluent from the radwaste building ventilation system is discharged through the roof at a minimum velocity of 2,000 fpm to be dispersed into the atmosphere at higher elevation and continuously monitored for gaseous activity and continuously sampled for laboratory analysis of particulate radioactivity. The sampling and monitoring system is described in Section 11.5.

The exhaust fans are used for smoke removal in the event of fire in the radwaste building during normal plant operation.

9.4.3.3 Safety Evaluation

9.4.3.3.1 Auxiliary Building Ventilation System

Continued operation of the auxiliary building system components during all modes of operation is assured by the following features:

1. All system components are protected against internally and externally generated missiles a) by virtue of their location within the building which is a Seismic Category I tornado-proof structure,

designed to withstand the dynamic effects of tornadoes and wind pressure, and b) physical separations provided between redundant equipment.

2. During loss of offsite power, all active components such as motors, damper operators, controls, and instrumentation (except supply and exhaust fans) receive power from their respective independent standby emergency power supplies.

3. Redundant unit coolers are provided for essential areas to ensure that this part of the system satisfies the single-failure criteria.

4. The fresh air intake for the ventilation system is protected by a missile barrier (Fig. 1.2-13). The air intake is designed so as to prevent direct impingement on the system ductwork from any type of precipitation. The air intake louver is designed to minimize water droplet carryover. A protective bird screen is provided to prevent accumulation and subsequent blockage by either snow or ice.

The system capacity is based on maximum summer ambient design air temperature and the heat generated by equipment, motors, electrical components, piping and pipe hangers, valves and lighting. Heat dissipation within the areas where safety-related equipment is located, are analyzed individually to establish air quantities for effective cooling.

A radiation monitor is provided in the exhaust duct. High radiation exceeding set point in the auxiliary building exhaust duct sounds an alarm in the main control room, and air is manually diverted to the SGTS.

The auxiliary building normal exhaust path is provided with redundant, air operated, fail-closed isolation dampers to preclude the possibility of airborne radioactivity bypassing the boundary regions of the SGTS. In the event of failure of the nonsafety-related portion of the auxiliary building ventilation system due to a seismic event or malfunction of equipment, the safety-related portion is isolated by the redundant isolation dampers without jeopardizing the ventilation system.

Failure of the nonsafety-related portion of the system does not compromise any safety-related system or component and does not prevent safe reactor shutdown.

The SGTS performs the operations required for control of radioactivity following an accident. Refer to Section 6.5 for a description of this system.

The auxiliary building system ductwork conveying exhaust air to the SGTS in the event of a high exhaust radiation signal complies with the guidelines of applicable portions of Position C.2 of Regulatory Guide 1.52 as follows:

C.2.a

The auxiliary building ventilation system ductwork and dam-per arrangement is designed with sufficient redundancy to meet single-failure criterion (see Figures 9.4-7d and 9.4-7e).

C.2.d

Pressure surges resulting from a postulated accident on the auxiliary building ductwork will be analyzed and the system will be revised, if necessary, to support the findings of the analysis.

C.2.e

The effects of radiation on the ESF system components such as controls, joining compounds, dampers, gaskets, and other organic-compounds materials that are necessary for operation during a postulated DBA have been considered.

9.4.3.3.2 Radwaste Building Ventilation System

The radwaste building heating and ventilation system is not required for a safe shutdown of the plant; however, the following features are incorporated in its design to ensure system reliability and to minimize the uncontrolled release of airborne radioactive contaminants during normal plant operation:

1. Fifty percent standby capacity of the main exhaust fans ensures full system capacity with any unit inoperative due to equipment failure or maintenance outage.

2. The radwaste building exhaust air is monitored by radiation detectors prior to discharge, to ensure

against release of radioactive contaminants. The radwaste building ventilation system is shut down manually upon detection of high radiation levels in the common air exhaust duct.

3. Redundant unit coolers for sample room, laundry room, and solid waste treatment area ensure supply system operation in the event of single fan failure.

4. All exhaust air from waste tanks and other equipment handling radioactive materials is passed through the charcoal filter unit prior to discharge, thus minimizing the release of radioactive contaminants.

5. A manually actuated water spray fire protection system is provided for each filter unit to protect against possible fire in the filters.

6. The redundant 100-percent capacity of the charcoal filtration system for processing contaminated tanks and shielded compartment exhaust ensures continued operation of the system at all times.

The radiation monitors continuously sense the radiation level and automatically send an alarm signal to the main control room (Section 12.3.4).

A detailed description of compliance of the radwaste building ventilation system (RBVS) charcoal filtration system with positions C.1.a through C.1.d and C.2.a through C.2.e of Regulatory Guide 1.140 is provided as follows:

C.1.a The design of the charcoal filtration system is based upon the maximum operating parameters of temperature (105°F), pressure (atmospheric), relative humidity (20-100 percent), and radiation levels (70 rads).

C.1.b The charcoal filtration unit is not located in areas of high radiation during normal plant operation, so no special shielding of the components from the radiation source needs to be provided.

C.1.c No engineered-safety-feature system that must operate after a design basis accident will be adversely affected by the charcoal filtration system's operation in the radwaste building.

C.1.d Contaminants that could damage the filter units were evaluated. No contaminants were identified that could damage the units.

C.2.a In accordance with Regulatory Guide 1.140, the RBVS charcoal filtration system consists of fans, dampers, ductwork, and filter units. Each filter unit consists of a moisture separator, an electric heating coil, a prefilter, a HEPA filter, a charcoal iodine adsorber bank, and another HEPA filter.

C.2.b The volumetric air flow through the RBVS unit is 4000 cfm.

C.2.c The charcoal filtration system's instrumentation is designated to monitor and alarm pertinent pressure drops and flow rates in accordance with the recommendations of Section 5.6 of ERDA 76-21 (see Figure 9.4-3). Each filter bank, moisture separator, and charcoal adsorber has its own pressure differential monitors. Flow indicators are provided to ensure that the flow is in the desired range. High Delta P and low flow conditions are alarmed on a local panel.

C.2.e The outdoor air intake openings for the RBVS consist of a louvered intake plenum with filter banks to ensure that contaminants do not enter the system (see Figure 9.4-3).

9.4.3.4 Inspection and Testing Requirements

9.4.3.4.1 Auxiliary Building Ventilation System

The auxiliary building ventilation system is subjected to preoperational testing in accordance with procedures (Chapter 14) to verify wiring and control hookup, system in- place integrity, and proper function of system components and control devices, and to establish system design air flow. Local display and/or indicating devices are provided for surveillance of vital parameters, such as room temperature. All standby gas treatment filter system duct- work is subjected to leak tests in accordance with Regulatory Guide 1.52. All system ductwork is balanced in accordance with the procedure of the Associated Air Balance Council (AABC)[8].

The ventilation system components are periodically inspected to assure that all normally operating equipment is functioning properly. Maintenance is provided on a regularly scheduled basis to check and replace filters, provide lubrication, etc, in accordance with manufacturer's recommendations.

9.4.3.4.2 Radwaste Building Ventilation System

The radwaste building ventilation system is subjected to preoperational testing in accordance with procedures of Chapter 14. The charcoal filter system ductwork is subjected to leak test in accordance with Regulatory Guide 1.140. All system ductwork is balanced in accordance with the procedures of Associated Air Balance Council (AABC)[8].

The system is designed to permit periodic inspection of major components such as fans, motors, belts, coils, filters, ductwork, piping, and valves to assure the integrity and capability of the system. Local display and/or indicating devices are provided for surveillance of vital parameters such as room temperature. Test connections are provided in charcoal filter units and chilled water piping for periodic checking of air and water flows for conformance to design requirements.

The HEPA filters in the charcoal filter units are subjected to both shop and field efficiency tests. Upon installation, and periodically thereafter, HEPA filters are given an in-place DOP test in accordance with ANSI N510[3]. Filters are field tested at rated flow with an acceptance limit of less than 0.05 percent penetration.

9.4.3.5 Instrumentation Requirements

9.4.3.5.1 Auxiliary Building Ventilation System

Control switches are provided in the main control room for either automatic or manual operation of the auxiliary building supply and exhaust air fans. Interlocks are provided to prevent a fan from starting unless its containment isolation dampers are fully open.

Control logic is provided to stage the electric duct heater to maintain the supply air temperature within a predetermined range and to deenergize the heater at a high air temperature condition.

Local controls are provided for either manual or automatic operation of the auxiliary building supply air filter motor. Control logic is provided to start the filter motor when the filter differential pressure reaches a high set point and to stop the motor when the differential pressure is at normal set point. When operating in the automatic mode, failure of an operating fan (low air flow signal) starts the standby fan.

A LOCA signal or manual containment isolation signal automatically closes the respective auxiliary building isolation dampers and diverts the exhaust to the SGTS (Section 6.5.1.5.1). Pushbutton controls are provided in the main control room for manually diverting the auxiliary building exhaust to the SGTS. Control switches are provided in the main control room for manual operation of the air- operated auxiliary building isolation dampers.

An auxiliary building isolation damper or unit cooler inoperative condition activates a reactor plant ventilation system inoperative alarm in the main control room on loss of control power to the damper or unit cooler.

The radiation level of the auxiliary building exhaust is monitored, and high radiation level alarms are provided in the main control room. The auxiliary building ventilation exhaust radiation monitor is described in Section 12.3.4.2. Manual controls are provided to shut down the supply fans and divert the auxiliary building exhaust through the SGTS in the event of high radiation.

Control switches are provided in the main control room for manual operation of the auxiliary building unit coolers (with the exception of unit cooler UC14 which has local controls). For Appendix R requirements, local control switches and indicating lights are included with remote shutdown panel transfer switches which isolate the main control room for the Appendix R equipment (UC6, UC7, and UC11A).

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A low discharge flow alarm is provided in the main control room for SBGT area unit coolers UC11A and B.

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9.4.3.5.2 Radwaste Building Ventilation System

Control switches are provided in the auxiliary control room for manual operation of the radwaste building unit cooler fans and waste tank pump room booster fan.

Control switches are provided in the auxiliary control room for manual operation of the radwaste building main exhaust fans (FN1A, B, C) and charcoal filter exhaust fans (FN4A, B).

Interlocks are provided to prevent startup of an exhaust fan unless the radwaste building exhaust damper (AOD101) is fully open.

The radwaste building fans and their dampers are interlocked so that the damper is open when the fan is running and closed when the fan is not running. Charcoal filter exhaust fan trouble alarms are provided in the auxiliary control room if the fan continues to run with low discharge flow.

A control switch is provided in the auxiliary control room for either automatic or manual operation of the decay heat removal system. When operating in the automatic mode, the decay heat removal fan starts up automatically after the filter system shuts down. A short time delay is included so that testing of the filter system can be accomplished without unnecessarily initiating the decay heat removal system. Interlocks prevent decay heat removal fan startup unless the filter inlet damper is fully closed.

The radwaste building charcoal filter decay heat removal fans and their dampers are interlocked so that the dampers are open when the fan is running and closed when the fan is not running.

Control switches are provided in the auxiliary control room to manually open and close the radwaste building intake and exhaust isolation dampers (AOD101 and AOD103).

Controls are provided for controlling the temperature of the electrical and mechanical equipment areas in the radwaste building by opening and closing radwaste building unit cooler chilled water supply valves. Extreme high temperatures are alarmed in the auxiliary control room.

Alarms are provided in the auxiliary control room for any abnormal filter differential pressure or temperature.

The radiation level of the radwaste building exhaust is monitored. Alert and high radiation alarms are provided in the main and auxiliary control rooms. The radwaste building ventilation exhaust radiation monitors are described in Section 12.3.4.2.

Local controls are provided for either automatic or manual operation of the radwaste building intake air roll filters (FLT4A and FLT4B). Control logic is provided to start the filter motor when the filter differential pressure reaches a high set point and to stop the motor when the differential pressure is at normal set point when operating in the automatic mode.

Control logic is provided for operation of the charcoal filter train air heaters and radwaste building unit cooler heaters. The radwaste building charcoal filter train air heater is energized when the charcoal filter exhaust fan is running, and neither the high-temperature cutout nor the low air flow cutout has been activated.

9.4.4 Turbine Building Ventilation System

The function of the turbine building ventilation system is to control the maximum building air temperature and circulation of potential airborne radioactive contaminants. This provides an environment which ensures the operability of the equipment, the safety of plant personnel, and the accessibility of the building and shielded compartments.

9.4.4.1 Design Bases

The ventilation and air-conditioning system for the turbine building is designed in accordance with the following criteria:

1. All components of the turbine building ventilation system are nonnuclear safety-related, nonseismic, and are not required to operate following a design basis accident (DBA).

2. Provide an environment with controlled temperature and humidity to ensure the comfort and safety of personnel and integrity of nonsafety-related building equipment necessary for power generation.

3. Maintain design ambient temperature and humidity as listed in Table 9.4-1.

4. Provide filtered outside air to reduce dust and airborne particles within the turbine building.

5. Provide means for air movement from clean to progressively greater potential contamination areas prior to final exhaust. This distribution serves

to limit airborne contaminants from migrating from potentially contaminated areas into clean areas.

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6. Monitor all exhaust air from the building for radioactive contaminants, prior to discharge to atmosphere, to ensure that the release of contaminants does not exceed the limits as defined in 10CFR20 and the Technical Specifications/Requirements.

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7. Provide the capability to direct the exhaust air from the mechanical vacuum pump through charcoal filtration units prior to discharge to the environment.

8. Provide the sample room with heated and cooled ventilation air for personnel comfort and sample room exhaust hood requirements.

9. Provide a reliable method of maintaining the off gas charcoal adsorber vault at subzero temperatures during plant operation, by the recirculation of vault air through refrigeration units. This sub-zero atmospheric condition is required to ensure proper operation of the off-gas system gas coolers and charcoal adsorber beds (Section 11.3). The system is designed with sufficient flexibility to maintain the vault temperature at any set point between -40°F and 0°F.

   The refrigeration system is designed with 100-percent redundancy to ensure uninterrupted service during normal plant operation.

9.4.4.2 System Description

The turbine building ventilation system consists of the following subsystems:

1. Main supply system

2. Unit coolers system

3. Off-gas area/condensate demineralizer area ventilation system

4. Exhaust air system

5. Charcoal filtration system

6. Sample room air conditioning system

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7. Heating system

8. Steam tunnel air conditioning.

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The configuration of these systems is shown in Fig. 9.4-4a through 9.4-4d and design data of principal system components are listed in Table 9.4-7.

9.4.4.2.1 Main Supply System

During normal plant operation, ventilation of the turbine building is accomplished by supplying 100-percent filtered, tempered, and conditioned air to the various areas. The main supply system consists of an air-conditioning unit with two 50-percent capacity vaneaxial fans connected to a common air intake, common filters, common heating coil, and common chilled water cooling coil. The two fan assemblies are connected to a common supply air duct distribution system. The supply air ducts deliver fresh filtered and conditioned air to the radioactively clean areas of the turbine building.

The prefilters are of renewable roll type, automatically progressed to maintain uniform pressure drop. Electric heating coils are provided to temper the outside air and to maintain a required discharge air temperature. The chilled water cooling coils are multirow, arranged for counterflow of tubeside liquid against the airside, with the hot liquid outlet at the hot air face inlet. The main supply fans are vaneaxial type with heavy duty manually adjustable pitch blades. Chilled water to the cooling coils is supplied from the ventilation chilled water system described in Section 9.2.9.

During normal plant operation, the main supply system operates continuously, providing heated or cooled air to radioactively clean areas of the turbine building. An exhaust air duct system is connected to each of the potentially contaminated cubicles. The cubicle supply and exhaust air is balanced in such a manner that the exhaust air volume is slightly greater than supply to ensure a proper flow. All air is exhausted through these cubicles. Thus, an air flow pattern is established from the clean areas to areas of potentially greater levels of radioactivity. Cubicle design is such that the air passing through the entrance to the cubicles is designed for a minimum velocity of 100 fpm to ensure that airborne radiation does not escape from the cubicle to the general areas.

9.4.4.2.2 Unit Coolers System

Independent unit coolers are provided for ventilation and removal of heat dissipated from equipment, piping, and lighting for various areas in the turbine building.

Each unit cooler consists of a housing, throw-away type filters, cooling coil, vaneaxial fan, and ductwork. Each unit cooler is framed with structural steel welded to the fan casing. The filters are of disposable, nonrenewable, minimum 2-in thick glass fiber, adhesive-coated viscous impingement type with reinforced backing. The chilled water cooling coils are multirow, arranged for counterflow of tubeside liquid against the airside, with the hot liquid outlet at the hot air face inlet. The supply fans are vaneaxial type with heavy duty, manually adjustable pitch blades.

The unit coolers are designed for adequate air recirculation to remove heat dissipated from equipment, piping, and lighting, and to maintain design ambient temperature. Warm air is cooled by recirculating through the cooling coils of the unit cooler. The chilled water for cooling coils of unit coolers is supplied from the ventilation chilled water system (Section 9.2.9).

9.4.4.2.3 Off-Gas/Condensate Demineralizer Area Ventilation System

Ventilation air supply for the condensate demineralizer/ion exchanger and regeneration areas is provided by transferring air from the turbine building. Chilled water fan coil recirculation units are provided in various cubicles to supplement the ventilation in the same manner as described in Section 9.4.4.2.2. The off-gas area is maintained at a negative pressure with respect to the surrounding areas of the turbine building. This is accomplished by inducing the air into the off-gas area from the turbine building and exhausting to the plant exhaust duct through redundant exhaust fans.

The vault containing off-gas charcoal adsorber tanks for holding radioactive noble gases is cooled (refrigerated) by a low temperature recirculating refrigeration system. The vault refrigeration system consists of redundant units, each with a compressor, refrigerant condenser, cooler, air handling equipment, liquid receiver, regeneration equipment, piping, ductwork, and necessary controls.

During normal operation, one refrigeration system operates while the other is in a standby mode. During initial startup, both refrigeration units run for a period of up to 24 hr with no process gas flow to lower the temperature of the vault and contents from 150°F to 0°F. Each unit is designed to maintain the vault at a set temperature in the range -40°F to 0°F. Each refrigeration unit is capable of supplying 6,500 cfm refrigerated air to the off-gas vault. Electric heating coils are provided to maintain minimum design conditions during the heating season.

9.4.4.2.4 Exhaust Air System

The turbine building exhaust air system consists of three 22,000 cfm, 50-percent capacity (two operating with the third on standby) exhaust fans for the turbine building and condensate demineralizer area, and two 8,300 cfm, 100-percent capacity (one operating with the second on standby) exhaust fans for off gas and regeneration area with their associated isolation dampers, ductwork, and controls. The main exhaust fans exhaust air from steam tunnel, condenser demineralizer tank area, moisture separator area, heater cubicle area, pressure reducing valve area, and various cubicles. The off-gas exhaust fans exhaust air from the off-gas condenser and recombiner cubicle, desiccant dryer and regenerator area, hydrogen analyzer cubicle, and other areas.

The exhaust ductwork is arranged so that all exhaust air is drawn from areas with greater radioactive contamination potential thus inducing air flow from clean areas into potentially contaminated areas. The exhaust air system is balanced to maintain the main areas of the building under a slight negative pressure relative to outside atmosphere in order to minimize any unmonitored leakage of potentially contaminated air to the environment. Dampers are provided throughout the exhaust air system for balancing and to en-sure isolation of areas of high potential radioactivity from areas of low potential radioactivity.

Exhaust air is discharged above the reactor building roof through the main plant exhaust duct. Exhaust air is not filtered prior to main exhaust. An independent radiation monitoring system (Section 12.3.4) is provided in the turbine area and off-gas area exhaust ducts. High radiation alarms are provided in the main control room. The exhaust fans can be manually started for smoke removal in the event of fire in the turbine building during normal plant operation.

9.4.4.2.5 Charcoal Filtration System

The exhaust air from the mechanical vacuum pump is discharged to the main plant exhaust duct through a charcoal filtration unit by a centrifugal exhaust fan. The design, testing, and maintenance criteria for the charcoal filtration system conforms to Regulatory Guide 1.140 (with exceptions as listed in Table 9.4-6). The design of the charcoal filtration system and its components is similar to that described in Section 9.4.3.2.2.

An exhaust fan having a capacity of 5,000 cfm is provided downstream of the filter unit. The fan is a centrifugal type with a direct-drive single speed motor. The decay heat produced by radioactive materials during the inactive period of the filter unit is removed by a 100-cfm capacity centrifugal fan taking air from the equipment room and exhausting it to the main exhaust duct. The discharge from the air removal hogging pump is connected to an outside air intake duct with modulating dampers. A constant volume of 5,000 cfm is passed through the charcoal filter unit at all times when the vacuum pump is running. As the vacuum is produced in the steam condenser and the flow to its filters is reduced, makeup air is provided by modulating the outside air damper. A radiation monitoring system is provided in the exhaust duct and the air is continuously monitored in the main control room for radioactivity.

9.4.4.2.6 Sample Room Air-Conditioning System

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The turbine building sample room, located on the lower elevation of the turbine building, is provided with a sample exhaust hood and a self-contained air-conditioning system. The air-conditioning unit consisting of throw-away filters, direct expansion cooling coil, heating coil, fan and distribution ductwork, supplies outside air for ventilation of the sample room. The outside air is exhausted through sample room hoods and discharged to the turbine building main exhaust duct. Room air is recirculated through the air-conditioning unit to maintain a required room temperature. The water-cooled condensing unit is supplied with cooling water from the normal service water system.

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9.4.4.2.7 Heating System

During the heating season, the main supply system air-conditioning unit's electric heating coil preheats the outside air supply. Electric duct and unit heaters are provided to reheat this air to maintain the turbine building at minimum design conditions.

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9.4.4.2.8 Steam Tunnel Air Conditioning System

An air conditioning unit provides additional cooling to the south end of the main steam tunnel. This unit consists of three fans and direct expansion cooling coils located in the steam tunnel and two refrigerant air cooled condensing units located outside. Room air is recirculated through the fan-coil unit and this additional cooling allows limited maintenance and surveillance activities by personnel.

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9.4.4.3 Safety Evaluation

The turbine building ventilation system has no safety-related function and is not required for safe shutdown of the plant. The following features are incorporated in the design of the system to ensure system reliability and to minimize the release of airborne radioactivity:

1. Standby main exhaust fan capacity is provided (two of three fans operating and the third on standby) to ensure full system capacity in the event of a single fan failure.

2. Two 100-percent capacity exhaust fans are provided (one operating and the second on standby) for the off gas building to maintain the area under negative pressure with respect to the main turbine building area.

3. Two 100-percent capacity off-gas vault refrigeration units are provided (one operating and one on standby) to maintain the charcoal adsorber vault at subzero temperature for continuous reliable operation.

4. Redundant supply fans of 100-percent capacity are provided for the unit coolers of the steam tunnel and turbine well to ensure a continuous operation of the unit coolers.

5. Exhaust air is drawn from within the shielded areas of the turbine building thus inducing air flow from clean areas to potentially contaminated areas.

6. The exhaust air from the mechanical vacuum pump is passed through the charcoal filter unit prior to discharge to the plant exhaust duct thus minimizing radioactive release.

A detailed description of compliance of the turbine building ventilation system (TBVS) charcoal filtration system with positions C.1.a through C.1.d and C.2.a through C.2.e of Regulatory Guide 1.140 is provided as follows:

C.1.a The design of the charcoal filtration system is based upon the maximum operating parameters of temperature (96°F), pressure (atmospheric), relative humidity (20-100 percent), and radiation levels (10 rads).

C.1.b The charcoal filtration unit is not located in areas of high radiation during normal plant operation; therefore no special shielding of the components from the radiation source needs to be provided.

C.1.c No engineered-safety-feature system that must operate after a design basis accident will be adversely affected by the charcoal filtration system's operation in the turbine building.

C.1.d Contaminants that could damage the filter units were evaluated. No contaminants were identified that could damage the units.

C.2.a In accordance with Regulatory Guide 1.140, the TBVS charcoal filtration system consists of fans, dampers, ductwork, and filter units. Each filter unit consists of a moisture separator, an electric heating coil, a prefilter, a HEPA filter, a charcoal iodine adsorber bank, and another HEPA filter.

C.2.b The volumetric air flow through the TBVS unit is 5000 CFM.

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C.2.c The charcoal filtration system's instrumentation is designed to monitor and alarm pertinent pressure drops and flow rates in accordance with the recommendations of Section 5.6 of ERDA 76-21 (see Figure 9.4-4b). Each filter bank, moisture separator, and charcoal adsorber has its own pressure differential monitors. Flow indicators are provided to ensure that the flow is in the desired range. High Delta P and low flow conditions are alarmed in the main control room and on the local turbine ventilation panel.

C.2.e The outdoor air intake openings for the TBVS consist of a louvered intake plenum with filter banks to ensure that contaminants do not enter the system (see Figure 9.4-4a).

14←•

9.4.4.4 Inspection and Testing Requirements

The turbine building ventilation system is designed to permit periodic inspection of major components such as fans, motors, coils, filters, ductwork, piping, and valves, to assure the integrity and capability of the system. Local display and indicating devices are provided for periodic inspection of parameters such as filter pressure drops. Test connections are provided in the charcoal filter unit and chilled water piping for periodic checking of air and water flows for conformance to design requirements.

The HEPA filters in the charcoal filter units are subjected to both shop and field efficiency tests. Upon installation, and periodically thereafter, HEPA filters are given an in place DOP test in accordance with ANSI N510[3].

All charcoal filter system ductwork is subjected to leak tests during erection in accordance with Regulatory Guide 1.140. All system ductwork is balanced in accordance with the procedures of the Associated Air Balance Council (AABC)[8].

9.4.4.5 Instrumentation Requirements

Local panels located at different elevations of the turbine building provide instrumentation and controls for operation of the turbine building area ventilation system. Abnormal temperatures, pressures, and flows in the system are alarmed on the local panel. Any one of these alarms in the turbine building ventilation system or the charcoal filtration unit also alarms in the main control room.

A three position mode switch is provided for selecting two of three turbine building exhaust fans for operation in conjunction with two turbine building supply fans. Interlocks prevent a supply fan from starting until its associated exhaust fan is running, thereby assuring that the turbine building atmosphere is at a slightly negative pressure.

Pushbutton controls are provided on local panels for manual operation of the turbine building ventilation supply air heater. Control logic is provided for heater cutout on low air flow or high temperature.

The turbine building exhaust fans are interlocked with their respective outlet damper positions so that the damper is open when the fan is running and closed when the fan is not running.

A flow controller is provided for maintaining a constant flow through the charcoal filtration unit by modulating the unit inlet damper. Interlocks are provided to allow modulation of the damper only when the unit exhaust fan is running.

Controls are provided on local panels for proper operation of the coolers. A control valve in the chilled water line leaving the cooler is modulated by the return air temperature in the cooler. Interlocks are provided to allow modulation of the valve only when the unit fan is running.

The turbine building air-conditioning unit outlet temperature is controlled by modulating a control valve in the chilled water line leaving the unit cooler or a stage heater. Interlocks are provided to allow modulation of the valve or the stage heater only when the unit fan is running.

For certain areas, the unit cooler air outlet temperature is monitored by a scanner in the main control room. In other areas, the ambient air temperature is monitored by the scanner. Abnormal high temperature alarms are provided in the main control room for both types of areas.

•→16

Radiation monitors are provided for the turbine building exhaust, and off-gas building exhaust. High radiation alarms are provided in the main control room. The radiation monitors are described in Section 12.3.4.

16←•

Local controls are provided for proper operation of the off-gas refrigeration unit and the off-gas/condensate demineralizer area ventilation system.

9.4.5 Engineered Safety Features (ESF) Ventilation Systems

The ESF ventilation systems are as follows:

1. Control building ventilation system (standby switchgear and battery rooms)

2. Diesel generator building ventilation system

3. Standby service water pump house ventilation system

4. Auxiliary building ventilation system (safety-related pump rooms and standby gas treatment)

5. Annulus mixing system (Disabled)

6. Containment ventilation system

7. Fuel building ventilation system (charcoal filter).

9.4.5.1 Design Bases

The ESF ventilation systems are designed in accordance with the following criteria:

1. The systems are designed to provide a reliable source of fresh air and an environment with controlled temperature to ensure the comfort and safety of personnel and the integrity of plant equipment.

2. The systems are designed to maintain space temperatures within the design limits as listed in Table 9.4-1.

3. The ESF ventilation systems are designed to Safety Class III and Seismic Category I criteria in accordance with Regulatory Guides 1.26 and 1.29.

4. The ESF ventilation systems are designed with redundancy to meet the single-failure criterion.

5. The power supplies to the ESF ventilation systems allow operation in the event of loss of normal off-site power.

•→9

6. Supply air at a minimum rate of 5 air changes per hr for battery rooms is provided to prevent accumulation of hydrogen (H2) in the area.

9←•

7. The system and components are located in Seismic Category I structures that are tornado, missile, and flood protected in accordance with GDC 2.

8. The Seismic Category I ESF ventilation systems have been analyzed for the postulated effects of pipe failures and initiation of internally generated missiles as described in Sections 3.5 and 3.6A.

9. The ESF atmosphere cleanup systems are designed in accordance with Regulatory Guide 1.52, with exceptions as noted in Section 1.8 and Table 6.5-1.

10. Fire protection has been evaluated and is described in Section 9.5.1 and Appendix 9A.

9.4.5.2 System Description

9.4.5.2.1 Control Building Ventilation System (Standby Switchgear and Battery Rooms)

For a description of the switchgear and battery rooms ventilation subsystem, see Section 9.4.1.

9.4.5.2.2 Diesel Generator Building Ventilation System

The diesel generator building ventilation system serves the diesel generator rooms, associated controls rooms, and excitation control cabinets.

The system is shown in Fig. 9.4-5. The major system components and performance data are listed in Table 9.4-8.

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Three independent subsystems, one per diesel generator room, are provided for the emergency diesel generator rooms to maintain an indoor design temperature as listed in Table 9.4-1. Intake and exhaust openings through the outside wall of the building are missile and tornado protected. (Note that the tornado dampers 1HVP*DMP10A/B & *DMP11 on the exhaust opening through the outside wall of the building are locked in an open position. However, these dampers are not required to close during a design basis tornado as the diesel generators and their supporting equipment would withstand the affects of design basis tornado which results in a decrease in atmospheric pressure of 3 PSI at a rate of 2 PSI per second.) Each diesel generator room is provided with one exhaust fan connected to the normal offsite power or to the respective diesel emergency bus. The exhaust fans start manually or automatically. In the automatic mode, the fans are activated with the start of their respective diesel generators or on high temperature of their associated area. Diesel generators 1A and 1B control rooms and excitation control cabinets are ventilated by their respective dedicated supply fans. These fans start on high ambient diesel generator control room temperature. Diesel generator 1C control room is ventilated by its dedicated supply fan controlled to start on high ambient diesel generator control room temperature. Power to each fan is supplied from normal off-site power or its respective diesel emergency bus. Ventilation air from the diesel generator control room is exhausted through fire protected openings to the diesel generator room. Ventilation air from excitation control cabinets is exhausted in the diesel generator room.

7←• 14←•

Each diesel generator room is provided with a nonsafety-related and nonseismic ventilation fan to prevent stagnation of room air.

Unit heaters are provided in each diesel generator room to maintain the minimum design temperature for the areas during conditions of low outside ambient temperature.

9.4.5.2.3 Standby Service Water (SSW) Pump House Ventilation System

The SSW pump house ventilation system serves the SSW cooling tower pump house pump rooms and switchgear rooms.

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The pump house ventilation system is shown in Fig. 9.4-6a. The major system components and performance data are listed in Table 9.4-8.

9.4.5.2.3.1 SSW Cooling Tower Pump House Pump Rooms

The SSW cooling tower pump house pump rooms ventilation subsystem is shown in Fig. 9.4-6a. The major system components and performance data are listed in Table 9.4-8.

The SSW cooling tower pump house pump rooms ventilation subsystem consists of two 100-percent capacity supply fans for each pump room utilizing separate ducting, dampers, and controls to maintain the space design temperature of 109 °F maximum as listed in Table 9.4-1. Only one 100-percent capacity supply fan is required to maintain design ambient temperature of ≤109 °F with a second fan as standby. Both supply fans start automatically when their ambient set point temperature of 98 °F is reached in the pump room. There is no impact on the standby cooling tower ventilation system/equipment with the operation of both fans in pump room. One fan can be secured if desired, and ventilation system operability is assured. In the event of failure of both fans in one train, the standby cooling tower pump room ventilation system has redundant train to meet the single failure criterion.

Each pump room ventilation system is connected to the emergency bus which serves the pumps that are being cooled. In this manner the associated fan is operational when its respective pump is operating, and operation is assured in the event of loss of offsite power and LOCA.

The ventilation air is supplied and exhausted through missile and tornado protected openings. Each room is supplied with an electric unit heater in order to maintain the minimum design temperature of 40 °F.

16←•

9.4.5.2.3.2 SSW Cooling Tower Pump House Switchgear Rooms

The SSW cooling tower pump house switchgear rooms ventilation subsystem is shown in Fig. 9.4-6. The major system components and performance data are listed in Table 9.4-8.

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The SSW cooling tower pump house switchgear rooms ventilation subsystem consists of two 100-percent capacity supply fans for each switchgear room utilizing separate ducting, dampers, and controls to maintain the space design temperature of 109°F maximum as listed in Table 9.4-1. Only one 100-percent capacity supply fan is required to maintain design ambient temperature of ≤109 °F with a second fan as standby. One supply fan will start automatically when the ambient setpoint temperature of 98°F is reached in the switchgear room. The standby fan will start automatically if the ambient setpoint temperature of 103°F is reached in the switchgear room. There is no impact on the standby cooling tower ventilation system/equipment with the operation of both fans in switchgear room. One fan can be secured if desired, and ventilation system operability is assured. In the event of failure of both fans in one train, the standby cooling tower switchgear room ventilation system has redundant train to meet the single failure criterion.

Each switchgear room ventilation system is connected to the emergency bus which serves the switchgear that is being cooled. In this manner the associated fan is operational when its respective switchgear is operating, and operation is assured in the event of loss of offsite power and LOCA.

The ventilation air is supplied and exhausted through missile and tornado protected openings. Each room is supplied with an electric unit heater in order to maintain the minimum design temperature of 40 °F.

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9.4.5.2.3.3 SSW Cooling Tower Remote Air Intake Room

The SSW cooling tower remote air intake room ventilation system consists of two 100-percent redundant divisional air supply fans and duct heaters. A controlled environment of temperature and humidity is maintained in the room for the two divisions of radiation monitoring equipment located there.

9.4.5.2.4 Auxiliary Building Ventilation System (Safety-Related Pump Rooms and Standby Gas Treatment)

For a description of the safety-related pump rooms ventilation subsystems see Section 9.4.3. For a description of the standby gas treatment subsystem see Section 6.5.

9.4.5.2.5 Annulus Mixing System (Disabled)

For a description of the annulus mixing system see Section 9.4.6.

9.4.5.2.6 Containment Ventilation System

For a description of the containment ventilation system see Section 9.4.6.

9.4.5.2.7 Fuel Building Ventilation System (Charcoal Filtration Subsystem)

For a description of the charcoal filter subsystem see Section 9.4.2.

9.4.5.3 Safety Evaluation

The equipment which forms part of the ESF ventilation systems must maintain functional integrity during a DBA. Therefore, the ventilation and air conditioning equipment and all associated ductwork and piping for these areas is designed to Seismic Category I requirements.

All equipment is located within Seismic Category I structures. Redundant components are provided to ensure that a single failure does not impair or preclude systems operation. The systems are connected to the emergency power bus and are operable during loss of offsite power.

The safety evaluations of the control building, fuel building, auxiliary building, and containment ventilation systems and of the annulus mixing system are further discussed in the respective sections referenced in Section 9.4.5.2 for these systems.

• →16

Each SSW cooling tower pump house pump room and SSW cooling tower pump room switchgear room is equipped with two 100-percent outdoor supply fans. Only one 100-percent capacity supply fan is required to maintain design ambient temperature of ≤109 °F. Both supply fans start automatically when their ambient set point temperature of 98°F is reached in their respective pump rooms. One supply fan will start automatically when the ambient setpoint temperature of 98°F is reached in the switchgear room. The standby fan will start automatically if the ambient temperature of 103°F is reached in the switchgear room. One fan can be secured manually if

16←•

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desired (can be used as a standby), and ventilation system operability is assured. Manual initiation of the secured (standby) fan is required in the event of failure of the operating fan. In the event of failure of both fans in one train the standby cooling tower pump and switchgear rooms' ventilation system has redundant train to meet the single failure criterion.
16←•

The diesel generator rooms 'A' 'B' & 'C' (Division I, II, & III) are provided with one exhaust fan each connected to normal offsite power and respective diesel emergency bus. The fans start automatically with start of their respective diesel generators or on high ambient temperature in their associated rooms. The failure of the diesel generator room exhaust fan with associated diesel generator running requires evaluation and appropriate action by Operations to continue diesel generator operation, or switch to other Division diesel generator and associated exhaust fan.

The diesel generator control rooms 'A' & 'B' (Division I & II) and excitation control cabinets EGE-CAB01A & EGE-CAB01B are equipped with outdoor supply fans HVP-FN6A/B. Diesel generator control room 'C' (Division III) is equipped with an outdoor air supply fan HVP-FN6C. The failure of the diesel generator control room outdoor air supply fan with associated diesel generator running requires evaluation and appropriate action by Operations to continue diesel generator operation, or switch to the other Division diesel generator and associated outdoor air supply fan.

9.4.5.4 Inspection and Testing Requirements

The ventilating and cooling systems are periodically inspected to assure that all equipment required during normal operation is functioning properly. Standby components are periodically tested to ensure system operability.

9.4.5.5 Instrumentation Requirements

9.4.5.5.1 Control Building Ventilation System

The instrumentation requirements for the main control room area ventilation system are described in Section 9.4.1.5. The instrumentation requirements for the electrical switch-gear rooms and battery rooms ventilation systems are also described in this section.

9.4.5.5.2 Diesel Generator Building Ventilation System

•→4
Local control switches are provided for manual and automatic operation of the normal ventilation system fans, FN1A, B, and manual operation only for FN1C.
4←•

Control switches are provided in the diesel generator control room for the operation of standby ventilation systems (FN2A, B, FN3A, FN6A, B, C and AOD11A, B, C). Alarms are provided in the main control room for standby ventilation exhaust fan trouble, ambient temperature/supply fan filter differential pressure high, and standby ventilation system inoperative conditions. Standby ventilation exhaust fan trouble also is alarmed in the diesel generator control room.

The exhaust fans (FN2A, B and FN3A) start manually or automatically. In the automatic mode, the fans are activated with the start of the respective diesel generator or on high temperature of their associated area. The supply fans (FN6A, B) start manually or automatically on the availability of diesel generator field voltage or on high temperature of their associated area. Supply fan (FN6C) for diesel generator 1C starts manually or automatically on high temperature of its associated area.

Sequencing of these loads on a loss of offsite power and LOCA is noted in Table 8.3 2.

9.4.5.5.3 Standby Service Water Pump House Ventilation System

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Control switches are provided in the main control room for either automatic or manual operation of the SSW pump house pump room fans (FN1A, B, C, D) and switchgear room fans (FN2A, B, C, D). For the pump room fans only, control logic is provided to stop a fan which has been running for a preset time when the fan discharge air flow is below a preset limit. For both the pump room and switchgear room fans, a low discharge air flow condition activates an SSW pump house fan trouble alarm in the main control room. In the automatic mode, SSW pump house pump room or switch gear room high temperature automatically starts the respective SSW pump house fan(s). When the room temperature returns to normal, the fan(s) which is running stops. A SSW pump house ventilation system inoperative alarm is provided in the main control room for each division. Local control switches and indicating lights are included with remote shutdown panel transfer switches, which isolate the controls of SSW pumphouse pump room fans (FN1A, C) and switchgear room fans (FN2A, C).

6←• 16←•

Control switches are provided in the main control room for manual, automatic, or backup operation of remote intake air room ventilation fans (FN32A, B) in the SSW pump area. The ventilation fan starts and stops automatically to control the room temperature and humidity within preset limits. Upon loss of power, these fans may start on restoration of power to the motor control center, depending upon the mode of operation and the presence of control signals. Duct heaters (CH6A, B) provide heating to control humidity and low room temperature when the ventilation fan is required to run to control these parameters. A running fan trips on low flow after a preset time and starts the redundant fan and duct heater as required, and an SSW pumphouse fan trouble alarm is activated in the control room.

Local control switches and indicating lights are included with remote shutdown panel transfer switches, which isolate the controls of SSW pumphouse pump room fans (FN1A, 1C) and switchgear room fans (FN2A, 2C) from the main control room for 10CFR50 Appendix R requirements.

9.4.5.5.4 Auxiliary Building Ventilation System

The instrument requirements for the unit coolers and associated air operated dampers located in the auxiliary building are described in Section 9.4.3.5.1.

9.4.5.5.5 Annulus Mixing System (Disabled)

The instrumentation requirements for the annulus mixing system are described in Section 9.4.6.5.5.

9.4.5.5.6 Containment Ventilation System

The instrumentation requirements for the containment air recirculation cooling units are described in Section 9.4.6.5.1.

9.4.5.5.7 Fuel Building Ventilation System

The instrumentation requirements for the fuel building area ventilation system are described in Section 9.4.2.5.

9.4.6 Reactor Plant Ventilation System

The function of the reactor plant ventilation system is to control building air temperature, humidity, and movement of potential airborne radioactivity, and to maintain a negative pressure in the annulus during all modes of plant operation. The ventilation system provides an environment which ensures the operability of the equipment and safety of plant personnel during all modes of plant operation.

9.4.6.1 Design Bases

The reactor plant ventilation system is designed in accordance with the following criteria.

1. Safety Design Basis

    a. Reduce the pressure within the containment and minimize the adverse environmental effects of LOCA by cooling and dehumidifying the containment atmosphere.

    b. Prevent the maximum long-term bulk air temperature from exceeding 165°F during accident conditions.

    c. Minimize hydrogen pocketing within the containment by providing a homogeneous containment atmosphere mixture during post-DBA operation.

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    d. Maintain a negative pressure relative to the auxiliary building of at least -3.0 in W.G. during normal operation and at least -0.25 in W.G. during accident in the annular space between the shield building and the primary containment to minimize the release of airborne radioactivity to the environment.

14←•

    e. The safety-related portion of the reactor building ventilation system is designed to withstand tornado effects and is protected against internal and external missiles without loss of function.

2. Power Generation Design Basis

    a. Control the drywell and containment thermal environments within the design limits as listed in Table 9.4-1 based on equipment design limits, and safety of personnel.

    b. Maintain the containment atmosphere pressure within the design limits, as listed in Table 9.4-1.

    c. Reduce airborne radioactivity in the drywell/containment atmosphere for personnel access during normal plant operation and after shutdown, and to reduce airborne radioactivity levels below the limits specified in 10CFR20, Appendix B, Table I.

    d. Minimize the airborne radioactivity exposure to polar crane operators and to personnel on the operating floor and other accessible areas.

•→14

e. Maintain a design negative pressure of at least -3 in W.G. in the annulus space between the freestanding steel containment and the shield building to minimize the release of airborne radioactive material to the environment.

14←•

f. Purge the drywell/containment atmosphere in the event of buildup of radiation levels within the drywell and containment volumes above the acceptable level for working personnel.

g. Provide means to monitor all effluent from the reactor building prior to release for radioactive contamination and to isolate all ventilation openings in the reactor building in the event that radiation levels exceed a predetermined value.

h. Provide a continuous purge of the containment atmosphere in order to maintain the radio- nuclide concentrations at less than 25 percent of maximum permissible concentration as given in 10CFR20 paragraph 20.203.d(1)(ii) and Appendix B, Table I, Column 1.

The reactor plant ventilation system equipment and components which operate following LOCA are designed to Seismic Category I, Safety Class 2 and 3 criteria (Section 9.4.6.2). Equipment motors and controls in the safety related portion of the system are supplied power from their respective in- dependent standby emergency power sources and have sufficient redundancy to satisfy the single-failure criterion (Section 9.4.6.3).

The safety-related portion of the system is designed to accommodate the operating basis earthquake (OBE) within stress limits of applicable codes, and to withstand the safe shut- down earthquake (SSE) without loss of function. The sup- ports for the nonsafety-related portion of the system (where required) are designed to Seismic Category I requirements to maintain their structural integrity to prevent adverse effects on the safety-related components. All ducts and piping of the reactor plant ventilation system penetrating containment are provided with redundant isolation valves. The containment isolation valves are designed, manufactured, and "N" stamped Class 2 in accordance with Section III of the ASME code. The primary containment purge isolation valves are "N" stamped Class 2 in accordance with Section III of ASME code.

9.4.6.2 System Description

The reactor plant ventilation system consists of the following systems:

1. Containment ventilation system
2. Drywell ventilation system
3. Annulus pressure control system (APCS)
4. Annulus mixing system (Disabled)
5. Containment and drywell purge system
6. Containment heating system.

9.4.6.2.1 Containment Ventilation System

The containment ventilation system is shown on Fig. 9.4-7a through 9.4-7c and design data of principal components are listed in Table 9.4-9. The containment air recirculation cooling system consists of three 50,000 cfm capacity unit coolers, ductwork, dampers, and controls. During normal plant operation and loss of offsite power, two 50 percent capacity coolers operate (with third on standby) to maintain design ambient conditions and to remove heat generated within the containment. Following LOCA, only one 50 percent unit cooler is required to operate (with second on standby) to assist the containment heat removal system. Each unit cooler is designed to remove the heat generated within the containment by recirculating the air over the cooling coils.

Each unit cooler is sized for 50 percent capacity, and utilizes chilled water in its cooling coils during normal plant operation and refueling operation. Section 9.2.9 describes the ventilation chilled water system. During loss of offsite power and accident conditions, the cooling water is supplied by the standby service water (SSW) system (Section 9.2.7). Each containment unit cooler consists of the following components:

1. Fan/Motor Assembly

   Each unit cooler has a statically and dynamically balanced non-overloading vaneaxial type fan. Each fan is directly driven by a totally enclosed, singlespeed, air-cooled motor. The motor is seismically and environmentally qualified as discussed in Section 3.11.

2. Cooling Coils

   Finned tube cooling coils remove heat from the containment air. During normal operation, the main mode of heat transfer is sensible cooling whereas during post-LOCA operation, condensation is dominant. The cooling coils are designed for optimum tube and fin spacing and proper drainage to avoid water clogging during post-LOCA operation. Drain pans are provided to collect and remove the condensate. Cooling coil construction conforms to the requirements of ASME code, Section III, Class 3, and bears the "N" stamp. Cooling coil framing and supports conform to the requirements of subsection NF of ASME code, Section III.

The unit coolers directly discharge air to the shielded compartments within the containment. Due to the limited vent areas into the compartments, lower compartments pressurize more rapidly than the upper volume. Pressure relief dampers are provided in the discharge ductwork to protect the unit cooler fans and motors against possible positive pressure transients following a LOCA. Only positive pressure transients occur following a LOCA.

The gravity dampers in the discharge duct of each cooler are normally closed when the fan is not running. Dampers open under the fan discharge pressure but close on reverse flow to prevent backflow through the fan.

Each unit cooler assembly has provision for installing a dust filter which is in place during construction or, if desired, during periods of containment maintenance.

The containment ventilation system is designed to limit the air temperature in the closed containment building to the maximum design temperature of 90°F during normal plant operation. During post-LOCA operation, one containment unit cooler is in operation to assist the containment heat removal system. The capacity of each unit cooler is designed to assist in preventing the maximum long-term bulk air temperature from rising above 165°F (Section 6.2.2).

The three unit coolers are supplied from two separate standby electrical buses and standby service water piping systems. Each unit cooler discharges air into a common duct, from which a distribution ductwork system distributes the air throughout the reactor containment. The supply air is directly ducted to the shielded compartments within the containment. The air is exfiltrated through grills in the walls of these compartments.

The air side of the containment unit coolers is designed to Safety Class 2 and Seismic Category I requirements. The cooling water side of the coolers is designed to Safety Class 3 and Seismic Category I requirements.

Four recirculation fans, each with a capacity of 7,400 cfm, are located above the polar crane. These fans are not ducted. Their function is to dissipate gases and heat which collect in the volume above the polar crane by providing continued movement of this air.

9.4.6.2.2 Drywell Ventilation System

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The drywell ventilation system is shown in Fig. 9.4-8 and is designed to maintain average drywell conditions of 145°F and 50 percent relative humidity during normal plant operation. The drywell ventilation system is nonsafety-related and is not required to operate following LOCA.

1←• •→15

The drywell ventilation system consists of six fan coil units, each with 28,000 cfm capacity, which remove the heat generated within the drywell by recirculating the air over cooling coils receive water from the normal service water system (Section 9.2.1). Drywell unit coolers are not required to operate following LOCA but operate following loss of offsite power receiving power from their respective standby emergency electrical power sources and cooling water from the SSW system.

15←• •→7 •→1

Each unit is sized to 25 percent of the total cooling load. One of the six units acts as standby. If an operational unit cooler should fail, a spare unit cooler is manually started from the main control room. Each unit consists of an air intake, cooling coils, fan, and dampers. Each fan is connected with an automatic open/close damper which operates in conjunction with the fan. Each unit cooler assembly has

1←• 7←•

provisions for installing disposable filters which are in place during construction or, if desired, during periods of drywell maintenance.

Each unit discharges into a common duct and into distribution ductwork which distributes the air throughout the drywell. Cool air is also recirculated through the annulus between the reactor vessel head and the drywell head.

The construction of drywell unit cooler components is similar to those of containment unit coolers (Section 9.4.6.2), with the exception that the drywell coolers are nonnuclear safety, nonseismic, and are not designed to ASME code Section III requirements.

9.4.6.2.3 Annulus Pressure Control System

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The annulus pressure control system (APCS) consists of two 100-percent capacity, 2,000 cfm centrifugal exhaust fans with associated ductwork, dampers, and controls (Fig. 9.4-7c). The exhaust fans, one operating and one on standby, exhaust air from the annulus to the plant exhaust duct. The APCS is designed to maintain a negative pressure of at least -3 in W.G. in the annulus during normal plant operation by means of a differential pressure controller. The controller can be operated in automatic or manual. When operated in automatic, the controller modulates a damper to maintain a constant negative pressure in the annulus. When operated in manual, the negative pressure in the annulus will be proportional to shield building inleakage (i.e., less inleakage yields higher negative pressure).

13←• 14←• •→10 •→8

The suction of the two exhaust fans is connected to a common duct which penetrates the shield building to draw the annulus atmosphere. Inside the annulus this duct is connected to a sheet metal ring duct which is provided with return air openings. Upon receipt of a LOCA or high radiation signal from a radiation monitor, or loss of air flow in the suction of APCS fans, the annulus pressure control system is isolated, and the SGTS (Section 6.5.1) is started to maintain negative pressure in the annulus.

10←• 8←•

Redundant radiation monitors are provided in the common duct which penetrates the shield building, and the air is continuously monitored for radioactivity prior to discharge to atmosphere. Upon detection of high airborne radioactivity concentration, the annulus exhaust is diverted to the SGTS automatically.

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A pressure differential switch is provided to alarm the operator in the control room when the pressure exceeds -3 in W.G. Following a LOCA the annulus space is maintained at a negative pressure of at least -0.25 in W.G. with respect to the auxiliary building and at least -0.50 in W.G. with respect to atmosphere. The annulus pressure control system does not operate during loss of offsite power.

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The exhaust fans for the annulus pressure control system are nonsafety class but the ductwork in the annulus space with isolation dampers is designed to Seismic Category I requirements.

9.4.6.2.4 Annulus Mixing System (Disabled)

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The annulus mixing system fans HVR-FN11A/B and associated alarm functions are secured to disable the annulus mixing system.

9.4.6.2.5 Containment and Drywell Purge System

The containment and drywell purge system is designed either to continuously purge the containment or to recirculate air during periods of testing. The system has the capability of being operated at two different capacities. The normal system operating capacity is 7,000 cfm. During normal operation, only the containment is purged in order to maintain the radionuclide concentrations at less than 25 percent of maximum permissible concentration as given in 10CFR20, paragraph 20.203.d(1)(ii) and Appendix B, Table I, Column 1. The use of recirculation only is not adequate to maintain containment levels below those designated for an airborne radioactivity area. The drywell purge system is provided to reduce drywell airborne levels during shutdown and refueling outages, not during normal operations. A second manually actuated system with a capacity of 12,500 cfm is provided to operate in the event of a mechanical failure of the normal operating system. This system discharges filtered outside air into the containment and/or drywell and exhausts it through the SGTS (Section 6.5.1) to the atmosphere.

The containment/drywell purge system consists of an intake structure, air filter, purge supply fans, supply and exhaust distribution ductwork, charcoal filtration unit, exhaust fans, isolation valves, associated controls, and radiation monitoring systems. The fresh air is drawn through an intake structure located on the roof of the auxiliary building. The auxiliary building is a tornado-proof structure, and the air intake is covered by a tornado-proof enclosure.

Qualification of the 36-in purge valves is outlined in Section 6.2.4.3.7.2 and Table 6.2-52.

Seismic Category I debris screens are located a minimum of one pipe diameter away from the inner side of each inboard containment purge isolation valve. The screens are constructed from 3/16-in-thick stainless steel bar, with a nominal opening of 2 in x 1 3/16 in. The debris screens are designed to withstand the LOCA differential pressure. The piping between the screens and the isolation valves is also Seismic Category I.

Outdoor filtered air is distributed to the general areas of the containment and drywell. The purge air is exhausted through the containment continuous purge system or SGTS. Following a LOCA the containment/drywell purge system is not in operation and all containment isolation valves are closed. The system may be manually actuated to purge the containment or drywell volumes if desired.

The supply fans are centrifugal type with direct-drive single speed motors. The design, testing, and maintenance criteria for the containment/drywell purge system charcoal filter unit conforms to Regulatory Guide 1.140 (with the exceptions listed in Table 9.4-6). The design of the charcoal filtration system and its components is similar to that described in Section 9.4.3.2. Each charcoal filter unit is provided with an integrally mounted water extinguishing sys- tem consisting of discharge nozzles and distribution piping. An exhaust fan having a capacity of 7,000 cfm is provided downstream of the filter unit. The fan is a centrifugal direct-drive type with a single speed motor. The decay heat produced by radioactive materials during the inactive period of the filter unit is removed by a 100-cfm capacity centrifugal fan, taking air from the equipment room and exhausting it to the main exhaust duct.

The containment/drywell purge system is classified as non-nuclear safety with the exception of the containment and drywell isolation valves. The containment/drywell purge system exhaust fan can be manually started for smoke removal in the event of fire in the containment building.

9.4.6.2.6 Containment Heating System

An electric heating coil is provided in the containment drywell purge supply line to heat the containment/drywell area during a shutdown condition to maintain these areas at their minimum design conditions.

9.4.6.3 Safety Evaluation

Continued operation of reactor plant ventilation system is assured by the following safety features incorporated in the system:

1. All safety-related components are designed to pertinent safety class and Seismic Category I requirements. Safety-related components are located so that failure of a portion of other nonessential systems does not prevent operation of any safety-related system.

2. Adequate redundancy is provided for safety-related components to meet the single active failure criteria. The consequences of reactor building ventilation system active component failures are presented in the Failure Modes and Effects Analysis (FMEA) report submitted under separate cover.

3. All system components are protected against internally and externally generated missiles (a. by virtue of location within the building which is a Seismic Category I structure and b. physical separations are provided between redundant equipment) and are designed to withstand the dy-

namic effects of tornado and wind pressure. Nuclear safety-related system components are protected from the effects of high and moderate-energy line breaks (Section 3.6).

4. All containment penetrations associated with the reactor building ventilation system are provided with redundant isolation valves. The valves are designed, manufactured, and "N" stamped Class 2 in accordance with Section III of the ASME Code and are designed to operate in the event of a postulated SSE (Seismic Category I).

5. The air recirculation and cooling equipment are located in areas that are accessible for maintenance and repair.

6. The following safety-related equipment is supplied with standby electrical power following the loss of all normal power:

   a. Three containment unit coolers are supplied with standby electrical power. One cooler 1HVR*UC1A is connected to standby bus 1EJS*LDC2A, and coolers 1HVR*UC1B and 1HVR-UC1C to standby bus 1EJS*LDC2B, with cooler 1HVR-UC1C being tripped off the bus following LOCA. During loss of offsite power two coolers operate with the third on standby.

•→7

   b. The electrical arrangement of the six unit coolers ensures that, with loss of normal power and one emergency bus, there will be three available units for Drywell cooling.

7←•

   c. All active components of annulus mixing system such as motors, damper operators, controls, and instrumentation receive power from their respective independent standby emergency power supplies.

7. The SGTS (Section 6.5.1) prevents unfiltered leakage of airborne radioactivity through the shield building ensuring that post-accident offsite doses do not exceed guidelines of 10CFR50.67. Amendment 132 revised the design basis accident offsite dose limit requirements from 10CFR100 to 10CFR50.67.

•→14

8. The annulus is maintained at a negative pressure of at least -0.25 in W.G. with respect to the auxiliary building and at least -0.50 in W.G. with respect to atmosphere by the SGTS (Section 6.5.1) to prevent any outleakage of airborne radioactivity to the environment.

14←•

9. Radiation monitors located in the exhaust air ducts monitor exhaust air discharged from the reactor building and transmit an isolation signal in the event that the radiation level exceeds a preset level. See Section 12.3.4 for a discussion of the airborne radiation monitoring system.

10. During normal operation, the annulus is exhausted through the APCS. However, the annulus exhaust is automatically lined up to the SGTS in the following contingencies:

•→13

a. Occurrence of high radiation in the annulus exhaust air (non-ESF).

13←•

b. Receipt of a high drywell pressure or low reactor water level signal, or both (ESF).

•→10 •→8

c. Loss of annulus pressure control flow (non-ESF).

8←• 10←• •→14

In that event, 2500 cfm is exhausted through the SGTS, thus maintaining a negative pressure of at least -0.25 in W.G. in the annulus with respect to the auxiliary building and at least -0.50 in W.G. with respect to the atmosphere.

14←•

9.4.6.4 Inspection and Testing Requirements

To ensure and demonstrate the capability of the reactor plant ventilation system, the system components and equipment are subjected to pre-operational testing in accordance with procedures (Chapter 14) to verify wiring and control hookup, system inplace integrity, proper function of system components and control devices, and to establish system design airflow. All ductwork associated with the standby gas treatment filter system and all containment/drywell purge charcoal filter system ductwork are leak tested in accordance with Regulatory Guides 1.52 and 1.140, respectively. All system ductwork is balanced in accordance with the procedures of the Associated Air Balance Council (AABC)[8].

Test connections are provided in charcoal filter unit and chilled water piping for periodic checking of air and water flows for conformance to design requirements.

The HEPA filters in the charcoal filter unit are subjected to shop and field efficiency tests. Upon installation, and periodically thereafter, HEPA filters are given an inplace DOP test in accordance with ANSI N510[3]. Filters are field tested at rated flow with an acceptance limit of less than 0.05-percent penetration. To ensure a continued state of readiness of the reactor plant ventilation system after completion of the preoperational tests, the Technical Specifications (Chapter 16) are followed in the performance of periodic inspection, maintenance, and testing.

9.4.6.5 Instrumentation Requirements

9.4.6.5.1 Containment Ventilation System

The containment bulk air temperature is controlled by temperature controllers which sense the air inlet temperature of the containment air recirculation cooling units (UC1A, B, C) and modulate control valves (TV5A, B, and TV122) in the chilled water supply to the unit coolers. Pushbutton controls are provided in the main control room for manual operation of the unit coolers (Section 7.3.1.1.6).

Control switches are provided in the main control room for either automatic or manual operation of the air-operated temperature control valves (TV5A, B) located in the ventilation chilled water line to the safety-related containment unit coolers (UC1A, B). A LOCA signal or manual initiation signal automatically closes these valves and allows the standby service water system to provide cooling water to the coolers (Section 9.2.7.5). Interlocks are provided to ensure proper valve positions with respect to operation of the fans.

Control switches are provided in the main control room for manual operation of the containment unit cooler discharge valves (MOV22A, B). A LOCA signal or manual initiation signal automatically closes the discharge valve.

The temperatures of the chilled water to and from the containment unit coolers are monitored by the plant computer.

Control switches are provided in the main control room for manual operation of the containment unit cooler (UC1A, B) chilled water containment isolation valves. A LOCA signal or manual containment isolation signal automatically closes these valves. An abnormal containment to annulus differential pressure condition also closes the chilled water containment isolation valves. When the containment pressure drops below the annulus pressure by a preset amount, an alarm is activated in the main control room. An inoperative alarm is provided in the main control room for the ventilation chilled water system isolation valves for each division.

The safety related containment unit cooler fans (UC1A, B) start on an automatic or manual containment isolation signal and stop when the containment to annulus differential pressure is not normal. During loss of offsite power, with LOCA signal, the unit cooler fans start after a preset time of sustained bus voltage.

The discharge air temperature of the unit coolers is monitored in the main control room. A low discharge air flow alarm is provided in the main control room.

Controls are provided in the main control room for manual operation of the containment dome recirculation fans (FN1A, B, C, D).

An inoperative condition of either containment unit cooler fan activates an alarm in the main control room.

9.4.6.5.2 Drywell Ventilation System

Control switches are provided in the main control room for manual operation of the drywell unit cooler fans (UC1A through UC1F). An automatic or manual isolation signal automatically trips the fans that are running.

•→3 •→2

The discharge air temperature from each unit cooler is controlled at its setpoint by modulating the temperature control valve in the service water line from the unit cooler (Sections 9.2.1.5 and 9.2.2.5). When the unit cooler fan stops running the temperature control valve can be manually controlled by placing the manual/auto station in the manual position. Low unit cooler discharge air temperature (fan running) activates a trouble alarm in the main control room. The drywell unit cooler discharge air temperature is monitored by the plant computer.

2←• 3←•

Low unit cooler discharge air flow (fan running) activates an alarm in the main control room.

•→8 •→14

Vibration is monitored on three drywell unit cooler fan motors, and a high vibration alarm is provided in the main control room.

8←• 14←•

9.4.6.5.3 Containment and Drywell Purge System

Control switches are provided in the main control room for manual operation of the containment and drywell purge air supply fans (FN8 and FN13). Interlocks prevent startup of a fan if the auxiliary building inlet dampers (AOD 164 and AOD 143) are not fully open. Each fan and associated fan discharge damper (AOD 244 and AOD 236) are interlocked so that the damper is open when the fan is running and closed when the fan is not running.

Control switches are provided in the main control room for manual operation of the containment and drywell purge air supply and exhaust isolation valves (AOV's 123, 125, 126, 128, 147, 148, 165, and 166). Control logic is provided to close the containment and drywell purge isolation valves on an automatic or manual containment isolation signal, and to prevent opening the containment purge air supply isolation valve (AOV 123) for a period of 10 hr at which time the isolation valve can be opened manually only. Containment and drywell purge inoperative alarms are provided in the main control room for each division.

Containment purge air supply and exhaust dampers (AOD 124 and AOD 127) are manually controlled from the main control room. A low purge supply air flow condition, while the containment and drywell purge air supply fan is running, activates a fan trouble alarm in the main control room.

•→16

The containment continuous purge charcoal filter (FLT 6) is monitored by the plant computer for any abnormal conditions. Charcoal filter bed outlet temperature is monitored and a high temperature condition activates an alarm in the main control room.

16←•

Local controls are provided for either automatic or manual operation of the containment and drywell purge supply air roll filter (FLT 5). An extreme high filter pressure differential condition activates an alarm in the main control room.

•→15

Manual control switches are provided in the main control room for operation of the containment continuous purge filter fan (FN 14) and containment purge exhaust isolation valves (AOV 128 and AOV 166). An abnormal containment to annulus differential pressure condition automatically closes the containment purge exhaust isolation valves. The fan (FN 14) is interlocked with its inlet damper (AOD 240) and the containment continuous purge filter inlet damper (AOD 238) so that the dampers are open when the fan is running and closed when the fan is not

15←•

running. An extreme high containment purge radiation level automatically closes the containment supply and exhaust isolation valves (AOV 123, AOV 165, AOV 128, AOV 166). Alert and high containment purge radiation levels activate alarms in the main control room. A low containment continuous purge air flow condition while the containment continuous purge air supply fan (FN 13) is running, activates a trouble alarm in the main control room.

Control switches are provided in the main control room for either manual or automatic operation of the containment continuous purge filter decay heat removal fan (FN 15). In the automatic mode, the decay heat removal fan starts automatically after the filter system shuts down. A short time delay is included so that testing of the filter system can be accomplished without unnecessarily initiating the decay heat removal system.

Interlocks prevent decay heat removal startup unless the filter inlet damper is fully closed.

The fan is interlocked with the decay heat removal inlet purge damper (AOD 239) and its respective discharge damper (AOD 241) so that the dampers are open when the fan is running and closed when the fan is not running.

Control switches are provided in the main control room for manual operation of the containment continuous purge system exhaust damper (AOD 225).

Control switches are provided in the main control room for manual operation of the containment and drywell purge exhaust to SGTS isolation dampers (AOD 245 and AOD 162). An automatic or manual containment isolation signal automatically closes the isolation damper.

An alarm is provided in the main control room for any misalignment of the containment and drywell purge system dampers and valves.

Radiation monitors are provided for the drywell and containment atmospheres. Alert and high radiation level alarms are provided in the main control room. The drywell and containment atmosphere radiation monitors are described in Section 12.3.4.

9.4.6.5.4 Annulus Pressure Control System (APCS)

• →6

Control switches are provided in the main control room for operation of the APCS isolation dampers (AOD 23A, B, and AODs 142, 162, and 261) and exhaust fans (FN 16A, B). Interlocks are provided to ensure proper damper position prior to starting a fan. If the running fan trips the standby fan will start automatically if the standby fan is in the automatic mode. A fan trouble alarm is provided in the main control room. A high annulus pressure alarm is provided in the main control room.

6←• • →10 • →8

An automatic or manual containment isolation signal, a high radiation level in the annulus exhaust signal, or a loss of air flow in the suction of APCS fans signal, automatically closes the APCS isolation dampers and diverts the annulus exhaust to the SGTS.

8←• 10←• • →14 • →13

Pushbutton controls are provided in the main control room for manually closing the APCS isolation dampers and diverting the annulus exhaust to the SGTS (i.e., manual initiation of APCS to SGTS) (Section 6.5.1.5). Gaseous radiation levels in the reactor building annulus exhaust are monitored and alert and high radiation alarms are provided in the main control room. The annulus exhaust radiation monitoring system is described in Section 12.3.4. The gaseous and particulate radiation levels in the plant exhaust duct are monitored and alert and high radiation alarms are provided in the main control room. The main plant exhaust radiation monitoring system is described in Section 12.3.4.

13←•

9.4.6.5.5 Annulus Mixing System (Disabled)

14←• • →10 • →8 8←• 10←•

The annulus mixing system fans HVR-FN11A/B and associated alarm functions are secured to disable the annulus mixing system.

•→10 •→8 8←• 10←•

9.4.7 Miscellaneous Buildings Heating, Ventilation, and Air-Conditioning Systems

The various heating, ventilation, and air-conditioning (HVAC) systems serving the miscellaneous buildings of the plant are designed to provide suitable environmental conditions for efficient equipment operation and/or personnel comfort. The HVAC systems for the miscellaneous buildings are designed to provide accessibility for adjustment, periodic inspections, and testing of the principal system components to ensure continuous functional reliability. These systems are designed to nonsafety and nonseismic requirements (with the exception of electrical and piping tunnel ventilation systems which are provided with Seismic Category I supports to maintain the structural integrity of these systems) and are not required for safe shutdown of the plant. The miscellaneous building HVAC system consists of the following systems:

1. Fire Pump House Heating and Ventilation System.
2. Normal Switchgear Building HVAC System.
3. Auxiliary Boiler Building HVAC System.
4. Water Treatment Heating and Ventilation System.

5. Makeup Water Intake Structure and Switchgear House Heating and Ventilation System.

6. Electrical and Piping Tunnels Ventilation System.

7. Motor Generator Building Heating and Ventilation System.

8. Demineralized Water Pump House Heating and Ventilation System.

9. Circulating Water Pump House and Switchgear Room Heating and Ventilation System.

10. Cooling Tower Switchgear House Heating and Ventilation System.

11. Clarifier Area Switchgear House Heating and Ventilation System.

12. Hypochlorite Area Switchgear House Heating and Ventilation System.

13. Blowdown Pit Heating and Ventilation System.

14. Auxiliary Control Building Heating and Ventilation System.

9.4.7.1 Design Bases

The heating, ventilation, and air-conditioning systems serving the various buildings are designed to satisfy the following criteria:

1. Limit the maximum temperature for various buildings and provide a suitable environment for personnel and equipment operation.

2. Provide filtered outside air for all air-conditioned areas and electrical equipment areas.

3. Provide exhaust hoods to remove noxious fumes generated in the battery room and water treatment area and to provide tempered air for ventilation and personnel comfort.

4. Control the thermal environment within the design limits listed in Table 9.4-1.

5. Provide accessibility for maintenance and periodic inspection of principal system components.

6. Seismic supports are provided for ductwork and equipment of tunnel ventilation system to maintain their structural integrity. All other miscellaneous buildings' HVAC systems are designed to nonsafety and nonseismic requirements.

9.4.7.2 System Description

The miscellaneous buildings' HVAC systems are described in the following sections and the principal system components and associated performance data are given in Table 9.4-10.

9.4.7.2.1 Fire Pump House Heating and Ventilating System

•→15

The fire pump house (Fig. 9.4-6a) is divided into four compartments separated by fire walls. The compartments have independent ventilation systems, consisting of air intake louvers and power roof ventilators. Each air intake motor-operated louver is interlocked with the roof ventilator. A space thermostat is provided to start the fan and open the louver if the temperature exceeds the set point. Outside air is induced and exhausted by the roof ventilator to maintain the space temperature.

15←•

The combustion air required for the diesel engine is supplied from the space. Each compartment has an electric unit heater with built-in thermostat to maintain a minimum ambient temperature and to protect the piping from freezing in the winter.

9.4.7.2.2 Normal Switchgear Building HVAC System

The normal switchgear building HVAC system (Fig. 9.4-6) consists of three split system air-conditioning units with distribution ductwork and associated controls. The normal switchgear rooms, basement cable tray room, load center area, mechanical equipment room, and security switchgear room are served by two redundant 100-percent capacity air-conditioning units. Two 100-percent redundant vaneaxial fans discharge exhaust air from all areas, except from battery rooms, to the outside.

A separate split system air-conditioning unit, with ducted air distribution, serves the battery rooms and computer room. Air in the computer room is 100 percent recirculated. The system is designed to maintain the maximum and minimum indoor temperatures listed in Table 9.4-1.

A centrifugal exhaust fan removes ducted air from the battery rooms, discharging to the outside, and maintains the battery rooms at a negative pressure to prevent hydrogen contamination of adjacent areas.

Each air-conditioning system consists of an air handling unit, roof-mounted air cooled condensing unit, refrigerant piping, controls, and associated distribution ductwork. Each air handling unit has a mixing section, filter, direct expansion cooling coil and supply fan. Electric duct heaters are provided to maintain the required space temperature.

9.4.7.2.3 Auxiliary Boiler Building HVAC System

•→11

The auxiliary boiler building heating, ventilating, and air-conditioning system is designed to remove the heat generated by operation of the auxiliary boiler and switchgears and to limit the temperature to 104°F. The auxiliary boiler is no longer used and has been abandoned in place. Two independent systems are provided, one serving the boiler room and other for switch- gear room. The boiler room ventilation system consists of air operated intake louvers and roof exhaust fans. The air is introduced into the boiler room through three operable louvers each with a capacity of 3,070 cfm and the warm air is exhausted through two roof exhaust fans each with a capacity of 4,600 cfm.

11←•

An independent split system air-conditioning unit, with ducted air distribution, serves the switchgear room. The air is recirculated or exhausted by an exhaust fan depending upon the space temperature. The air-conditioning system consists of an air handling unit, roof-mounted, air-cooled condensing unit, refrigerant piping, controls, and associated distribution ductwork. The air handling unit has a mixing section, throw-away filter, direct expansion cooling coil, and supply fan.

Two electric unit heaters are provided to maintain the auxiliary boiler room minimum design temperature.

9.4.7.2.4 Water Treatment Heating and Ventilation System

The heating and ventilating system serving the water treatment area is designed to remove noxious fumes generated in the area and to limit the temperature to 104°F. The system is basically a once-through system, with the facility for the partial recirculation of air to reduce heating requirements during the winter.

●→14
The air is supplied to water treatment area and vacuum deaerator room by an air handling unit with a capacity of 22,850 cfm and distribution ductwork. The air handling unit consists of a prefilter, an electric heating coil, and a supply fan, all in an insulated steel housing. A return/exhaust fan is provided for recirculation or exhaust through the roof exhaust hood. The supply air handling unit and exhaust fan operate continuously. When the outdoor temperature rises to 65°F, the air handling unit draws 100-percent outdoor air and distributes it to the water treatment area. At this same temperature, the roof exhaust relief damper is full open to relieve the exhaust air.

●→16 14←●
A minimum of 4,000 cfm outside air is continuously supplied in the water treatment area and exhausted through the roof exhaust hood to remove any noxious fumes which may be generated in the area. A built-in electric heater in the air handling unit is provided to temper the outside air and maintain a minimum design ambient temperature.

16←●

9.4.7.2.5 Makeup Water Intake Structure and Switchgear House Heating, Ventilation, and Air-Conditioning System

●→8
The makeup water pump house heating and ventilating system (Fig. 9.4-6) consists of two 100-percent capacity 42,350 cfm redundant supply fans, replaceable roughing filter, two 100-percent capacity exhaust fans, ductwork and associated controls. An independent heating and ventilation unit, with ducted air distribution, serves the battery room.

8←●
The supply fans draw air from the outside atmosphere through intake louvers. The air is discharged, via ductwork, into the switchgear area, transformer area, makeup pump area, and intake piping area. The air from all the areas is exhausted through relief louvers by 100-percent capacity redundant exhaust fans. The operation of supply and exhaust fans is controlled by a temperature switch which senses indoor temperature. One of the two supply and exhaust fans is used to maintain design temperature (Table 9.4-1). The second supply and exhaust fan is in standby and starts in the event that the operating fans fail.

●→8
The battery room heating and ventilation system consists of an air handling unit, controls, and associated distribution ductwork. The air handling unit has a prefilter, heating coil, and supply fan.

8←●

The air from the battery room is exhausted by an exhaust fan to remove the combustible gases. The capacity of the exhaust fan (650 cfm) is in excess of the supply air handling unit (550 cfm) to maintain a negative pressure in the battery room and to avoid exfiltration of combustible gases in the surrounding areas.

No heating is provided in the makeup water pump house except in the battery room.

9.4.7.2.6 Electrical and Piping Tunnels Ventilation System

•→8

The electrical and piping tunnels ventilation system (Fig. 9.4-6a) consists of louvered air intakes, inlet filters, ductwork, and vaneaxial supply and exhaust fans. Outside air is supplied to various electrical and piping tunnels to ventilate and to remove the heat dissipated by cables and piping.

8←•

The exhaust air from the electrical tunnels is discharged to the atmosphere and the exhaust air from the piping tunnels is discharged to the plant exhaust duct.

All supply air system ductwork is provided with electric heating coils to temper the incoming outside air to maintain the tunnels at their minimum design condition.

9.4.7.2.7 Motor Generator Building Ventilation System

The ventilation system for the motor generator building (Fig. 9.4-6c) consists of a roof inlet hood, prefilter, exhaust hood, and supply fan with associated ductwork and dampers for each of two areas.

The supply fans draw air from the outside atmosphere through the inlet hood. The air is discharged, via ductwork, to the motor generator room and exhausted through an exhaust hood.

The motor generator building is located as shown on Fig. 1.2-4.

9.4.7.2.8 Demineralized Water Pump House Heating and Ventilation System

The ventilation system for the demineralized water pump house (Fig. 9.4-6d) consists of three roof-mounted exhaust fans and three wall-mounted motor-operated louvers.

The exhaust fan draws outside air into the room through the wall louver and exhausts the air through the roof.

Four electric unit heaters are provided to maintain the demineralized water pump house minimum design temperature.

The demineralized water pump house is located as shown on Fig. 1.2-2.

9.4.7.2.9 Circulating Water Pump House and Switchgear Room Heating and Ventilation System

The ventilation system for the circulating water pump house and switchgear room (Fig. 9.4-6c) consists of a prefilter, supply fan with associated ductwork, dampers, louvers, and a wall exhaust fan.

The supply fan draws outside air through the inlet louver and the prefilter. The air is discharged, via ductwork, to the circulating water pump house and switchgear room and exhausted through the exhaust louver. A wall-mounted exhaust fan constantly exhausts air from the battery area. The operation of the supply fan is controlled by a temperature switch that senses room temperature.

Two electric unit heaters are provided to maintain the circulating water pump house minimum design temperature.

The circulating water pump structure is shown on Fig. 1.2-41 and 1.2-42.

9.4.7.2.10 Cooling Tower Switchgear Houses Heating and Ventilation System

The heating and ventilation system for the cooling tower switchgear houses (Fig. 9.4-6c) consists of a filter, electric duct heater, and supply fan with associated ductwork, dampers, and louvers for each switchgear house in each of the four cooling towers.

The supply fan draws air from the outside atmosphere through the inlet louver. The air is discharged, via ductwork, to the cooling tower switchgear house. The operation of the supply fan is controlled manually by the operator or automatically by a temperature and humidity switch. An electric duct heater is provided to reduce the relative humidity of the entering air. The operation of the duct heater is controlled by a moisture switch that monitors the relative humidity.

The cooling tower area is shown on Fig. 1.2-1 and 1.2-43.

9.4.7.2.11 Clarifier Area Switchgear House Heating and Ventilation System

The clarifier area consists of two ventilation zones, a switchgear area, and a tank room. The ventilation system for the clarifier switchgear area (Fig. 9.4-6d) consists of a filter and a supply fan with associated ductwork, dampers, and louvers. The ventilation system for the clarifier area tank room consists of an exhaust wall fan and a supply louver.

The supply fan in the switchgear area draws air from the outside atmosphere through the supply louver. The air is discharged, via ductwork, to the switchgear area and is exhausted through a wall louver. The exhaust fan, in the tank area, draws air from the outside atmosphere through a wall louver and exhausts the air to the outdoors.

Two electric unit heaters are provided to maintain the clarifier area switchgear house minimum design temperature.

The location of the clarifier area is shown on Fig. 1.2-1.

9.4.7.2.12 Hypochlorite Area Switchgear House Ventilation System

The hypochlorite area switchgear house ventilation system (Fig. 9.4-6d) consists of a rooftop supply fan, wall louvers for exhaust, and a unit heater. The supply fan provides ventilation to the hypochlorite area to maintain the maximum design temperature. The ventilation air is exhausted via the wall louvers. The unit heater is provided to maintain the hypochlorite area switchgear house minimum design temperature.

The location of the hypochlorite electrical equipment is shown on Fig. 1.2-2.

9.4.7.2.13 Blowdown Pit Heating System

The blowdown pit heating system (Fig. 9.4-6d) consists of an electric duct heater. The purpose of this heater is to reduce the relative humidity of the blowdown pit.

The blowdown pit houses piping and valves associated with the control of blowdown from the circulating water system and is located in the vicinity of the hypochlorite area shown on Fig. 1.2-2.

9.4.7.2.14 Auxiliary Control Building Heating, Ventilation, and Air-Conditioning System

The auxiliary control building ventilation, heating, and air-conditioning system (Fig. 9.4-9) consists of four self-contained rooftop air-conditioning units, duct heaters, return fans, and distribution ductwork. Two 100-percent redundant air-conditioning units serve the auxiliary control room, mechanical equipment room, MCC panel room, and the personnel passageways.

A separate rooftop air-conditioning unit with ducted air distribution serves the hot machine shop, clothing storage area, tool area, and the decontamination room.

Another rooftop air-conditioning unit with ducted air distribution supplies the I&C and electrical hot shop.

Two 100-percent capacity redundant exhaust fans remove the air that is not returned to the air-conditioning units and exhausts it to the plant exhaust stack.

Electric duct heaters and electric unit heaters are supplied to maintain the minimum design temperature.

The location and arrangement of the auxiliary control building is shown on Fig. 1.2-4 and 1.2-5.

9.4.7.3 Safety Evaluation

The miscellaneous buildings' HVAC systems have no safety-related function. Malfunction or failure of the systems does not compromise any safety-related system or component and cannot prevent safe reactor shutdown. All miscellaneous buildings' HVAC systems and components are designed to non- safety and nonseismic requirements except for the electrical and piping tunnel ventilation systems which are provided with Seismic Category I supports to maintain the structural integrity of these systems.

9.4.7.4 Testing and Inspection Requirements

The miscellaneous buildings' HVAC systems are designed to permit periodic inspection of important components, such as fans, motors, belts, coils, filters, ductwork, and dampers to assure the integrity and capability of the system. Local display or indicating devices are provided for periodic inspection of vital parameters such as space temperatures.

All system ductwork is subjected to leak tests during erection and is balanced in accordance with the procedures of the Associated Air Balance Council[8]. Portable test and monitoring equipment are used to balance the systems when required. Electric heaters are approved by Underwriters' Laboratories.

9.4.7.5 Instrumentation Requirements

9.4.7.5.1 Fire Pump House Heating and Ventilating System

Local controls are provided for either automatic or manual operation of each fire pump house roof ventilator fan (FN 3 through FN 7). In the automatic mode, fan startup occurs if the fire pump house compartment temperature exceeds a preset limit. The fire pump house air intake louvers (MOL 101 through MOL 105) are interlocked with their respective ventilator fans so that the louver is open when the fan is running and closed when the fan stops.

Local controls are provided for either automatic or manual operation of each fire pump house unit heater (UH 1 through UH 5). In the automatic mode, the heater is energized when the fire pump house compartment temperature reaches a low level and is deenergized when the temperature returns to normal.

9.4.7.5.2 Normal Switchgear Building HVAC System

Control switches are provided in the auxiliary control room for either automatic or manual operation of the normal switchgear building battery room exhaust fan (FN 21) and the normal switchgear room exhaust fans (FN 19A, B).

In the automatic mode, the battery room exhaust fan (FN 21) operates when the normal switchgear building air-conditioning unit (ACU 2) is running.

In the automatic mode, the normal switchgear room exhaust fan (FN 19A, B) operates when either one of the normal switchgear building air-conditioning units (ACU 3A, B) is running. A low airflow condition at the discharge of an air-operating fan activates an exhaust fan trouble alarm in the auxiliary control room. The exhaust fan and air-conditioning units are interlocked so that the fan stops if both units are not running.

Normal switchgear building room inlet air heaters (CH 2, CH 9, CH 3, and CH 4) and air-conditioning system condensing units (CUR 2 and CUR 3A, B) are turned on and off to maintain the respective room temperature within design limits.

Control switches are provided in the auxiliary control room for starting and stopping the normal switchgear building air-conditioning units (ACU 2 and ACU 3A, B).

9.4.7.5.3 Makeup Water Intake Structure and Switchgear House HVAC System

Control switches are provided locally for either automatic or manual operation of the following makeup water intake structure and switchgear house equipment:

1. Battery room exhaust fan (FN 24)

2. Equipment room exhaust fans (FN 22A, B)

3. Equipment room supply fans (FN 23A, B)

In the automatic mode, the battery room exhaust fan (FN 24) operates when the air-conditioning unit (ACU 1) is running.

In the automatic mode, if an operating equipment room exhaust fan (FN 22A, B) fails, the standby fan starts up. A low airflow condition at the discharge of an operating fan activates an exhaust fan trouble alarm in the auxiliary control room and trips the respective fan. The control logic for the equipment room supply fans (FN 23A, B) is similar.

•→8

The makeup water intake structure and switchgear house inlet air heater (CH 1) is turned on and off to maintain the indoor temperature within design limits.

Control switches are provided in the auxiliary control room for starting and stopping the makeup water intake structure and switchgear house heating and ventilation unit (ACU 1).

8←•

9.4.7.5.4 Electrical and Piping Tunnels Ventilation System

Control switches are provided in the auxiliary control room for either automatic or manual operation of the following equipment, located in the electrical and piping tunnels:

1. Electrical tunnel supply fans (FN 8 through FN 12, FN 14, FN 17, and FN 18)

2. Electrical tunnel exhaust fans (FN 15A, B)

3. Pipe tunnel exhaust fans (FN 16A, B).

In the automatic mode, the electrical tunnel supply fans (FN 11, FN 12, FN 14 and FN 18) operate when either one of the electrical tunnel exhaust fans (FN 15A, B) is running. In the automatic mode, the electrical tunnel supply fans (FN 8, FN 9, FN 10, and FN 17) operate when either one of the electrical tunnel exhaust fans (FN 16A, B) is running.

In the automatic mode, if an operating electrical tunnel exhaust fan (FN 15A, B) fails, the standby fan starts up. A low airflow condition at the discharge of an operating fan, a motor-winding, temperature high, or fan motor overload activates an exhaust fan trouble alarm in the auxiliary control room. The control logic for the pipe tunnel exhaust fans (FN 16A, B) is similar.

References - 9.4

1. Regulatory Guide 1.140, Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants, October 1979.

2. ANSI/ASME N509-1980, Nuclear Power Plant Air Cleaning Units and Components.

•→8

3. ANSI/ASME N510-1989, Testing of Nuclear Air Cleaning Systems.

8←•

4. ERDA 76-21, Nuclear Air Cleaning Handbook, Oak Ridge National Laboratory.

5. MIL-STD-282, Filter Units, Protective Clothing, Gas-Mask Components and Related Products: Performance -Test Methods, Military Standard, 28 May 1956.

6. MIL-F-51068, Filter, Particulate, High Efficiency, Fire Resistant, Military Specification.

•→3

7. ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components, July 1, 1971 Edition with Addenda through Winter 1973. Replacement cooling coils are manufactured to ASME Boiler and Pressure Vessel Code, Section III, Nuclear Power Plant Components 1980 Edition with addenda through summer 1982.

3←•

8. Associated Air Balance Council, Vol. 2, No. 71679, National Standards for Field Measurement and Instrumentation, Total System Balance, 1979.

9. ASTM D3809-79, Standard Method for Radioiodine Testing of Nuclear-Grade Gas-Phase Adsorbents.

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 Fire Protection System

9.5.1.1 Design Bases

The overall RBS fire protection program is based upon an evaluation of potential fire hazards throughout the plant and the effect of fires relative to maintaining the ability to perform safety shutdown functions and to minimize radioactive releases to the environment. The RBS fire protection program conforms with the requirement of General Design Criteria 3 of Appendix A to 10CFR50. In addition, requirements stated in the following documents were considered in the design and evaluation of the fire protection systems:

1. Appendix A to NRC Branch Technical Position APCSB 9.5-1 dated August 23, 1976

2. Basic Fire Protection for Nuclear Power Plants, April 1976, American Nuclear Insurers

3. National Fire Codes, National Fire Protection Association.

The intent of the fire protection program is to provide the concept of the "defense-in-depth" principle by achieving an adequate balance in:

1. Preventing fires from starting

2. Detecting fires quickly, suppressing those fires that occur, putting them out quickly, and limiting their damage

3. Designing plant safety systems so that a fire that starts in spite of the fire prevention program and burns for a considerable time in spite of fire protection activities does not prevent essential plant safety functions from being performed.

•→3

Fire protection system components which, as a result of their collapse due to an earthquake, may damage safety-related systems or components are designed with seismic supports to prevent such an occurrence. Valve trim piping at each riser in the fire protection system however, is exempt from seismic support requirements, as failure of this piping will not affect safety related systems or components.

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The Fire Hazards Analysis which includes review of safety-related components, the fire detection and suppression systems for each building, safe shutdown analysis, and radioactive release analysis, are described in Sections 9A.2.1 through 9A.2.19 of Appendix 9A, "Fire Protection Program Evaluation Report."

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In order to develop data meaningful to the fire hazard analysis, the plant has been divided into numerous fire areas, which have been further subdivided into fire zones. Fire hazard analysis for each fire area/zone detailing location, combustible quality and quantity, fire load, estimated duration of possible fire, safety-related and nonsafety-related equipment, electrical cable description, detection, suppression, and radioactive analysis, is described in Appendix 9A.

15←•

Point-by-point comparison of the fire protection program of the River Bend Station with the position of Appendix A to NRC Branch Technical Position APCSB 9.5-1, dated August 23, 1976, Guidelines for Fire Protection for Nuclear Power Plants docketed prior to July 1, 1976, is shown in Section 9A.3 of Appendix 9A.

The fire protection program consists of use of noncombustible materials; fire barriers; fire characteristics; fire-resistive materials; fire loads; fire exits; smoke removal and venting; drainage; fire water storage tank, fire pumps, hydrants, standpipe, and hose system; sprinkler and spray systems; carbon dioxide and Halon systems; portable extinguishers; fire and smoke detection and control system; fire seals; self-contained breathing apparatus, emergency lights, plant fire brigade; fire drills; testing; etc. Appropriate backup fire suppression capability is provided throughout the plant to limit the extent of fire damage.

•→7

Storage and usage of flammable liquids is in accordance with existing RBS safety practices.

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A quality assurance program is described in Section 9A.3.4 of Appendix 9A.

9.5.1.2 System Description

The fire protection system consists of two water-supply tanks, one electrically driven 1,500 gpm at 165 psig fire pump, two diesel-driven 1,500 gpm at 165 psig fire pumps, one 50 gpm at 110 psig jockey fire pump, fire water yard mains, hydrants, standpipe hose stations and suppression systems (Fig. 9.5-1), high-pressure carbon dioxide (Fig. 9.5-12), Halon 1301 systems (Fig. 9.5-13), portable extinguishers, self-contained breathing apparatus, fire and smoke detection and control system, fire barriers, egress facilities, etc.

9.5.1.2.1 Water Supply Tanks

Fire water supply is from two ground level steel suction tanks. Each tank has a maximum working capacity of 265,000 gallons. These tanks are filled automatically by the shallow well makeup water pump at a rate of 800 gpm when the water level in the tanks falls 2'-0" below the overflow level. At this level the usable volume is at its minimum of 241,000 gal. The makeup water pump shuts off automatically when the water level in the tanks reaches the overflow level. Additional makeup water is available from two 150-gpm, manually operated deep well pumps. The two storage tanks have their discharge piping cross-connected with normally open valves, so that the fire pumps can take suction from either tank.

9.5.1.2.2 Fire Pumps

The fire protection water flow and pressure requirements are met by one electrically driven and two diesel-driven fire pumps. Each pump is rated at 1,500 gpm at 165 psig and is separated by a 3 hr-rated fire wall in the fire pump house. Outside screw and yoke (OS&Y) valves are installed in the suction lines to the fire pumps utilizing the guidance of NFPA 20. Tanks, pumps, and discharge lines to the underground loop are provided with sectionalizing shutoff valves, so no single impairment incapacitates more than one tank or pump. Each pump is equipped with a main relief valve to limit system pressure to 160 psig.

•→1

The system pressure is maintained continuously between 130 and 140 psig by a jockey pump. The fire pumps are started by actuation of pressure switches located on the discharge side of the pumps and stopped manually at the fire pump house. The motor-driven pump starts when system discharge pressure drops to 120 psig. The two diesel-driven pumps start when pressure drops to 110 psig and 100 psig, respectively. In addition, to prevent pump runout, if a fire pump is running and pressure drops, indicating a flow increase, the second and third fire pumps are started automatically when pressure decreases to 140 psig. If electric motor-driven pump P2 is running and pressure drops to 140 psig, diesel-driven pump P1A starts after a time delay of 10 sec, and diesel-driven pump P1B starts after a time delay of 15 sec. If the electric motor-driven fire pump is out of service and diesel-driven pump P1A is running, diesel-driven pump P1B starts automatically after a time delay of 15 sec when pressure drops to 140 psig. Fire pumps are designed utilizing guidance from NFPA Code 20.

1←•

9.5.1.2.3 Yard Piping

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The plant underground fire protection system piping is cement-lined, cast-iron and ductile iron pipe with mechanical joints except for the lateral, which is constructed with PVC pipe, that extends from the yard loop to the hydrants at the new low level radwaste storage building. Looped mains with post indicator sectional valves are provided to isolate portions of the system for maintenance or repair, without shutting off the supply of primary and backup fire suppression systems serving other areas that contain or expose safety-related equipment. Yard piping is designed utilizing guidance from NFPA Code 24. Hydrants are provided on the yard main at approximately 250-ft intervals. Hydrant hose houses are equipped with hose, spray nozzles, wrenches, and other accessories and are located at alternate hydrants. Yard piping and hydrant locations are included in Appendix 9A.

•←8

9.5.1.2.4 Hose Stations

Standpipe and hose systems are designed utilizing guidance from NFPA Code 14. Individual standpipes are 4 inches in diameter for multiple hose connections and 2 1/2 inches in diameter for single hose connections. Manual hose stations equipped with a minimum of 75 ft and a maximum of 150 ft of 1 1/2-in synthetic or cotton-jacketed lined hose are provided in major buildings. Hose station piping, serving equipment required for safe shutdown of the plant in case of an SSE is designed and supported for SSE loading and is provided with standby service water supply and pipe supports to assure system pressure integrity. Additional details and locations of hose stations with in excess of 75 ft of hose are included in Appendix 9A, Section 9A.3.6.3.5.

9.5.1.2.5 Wet-Pipe Sprinkler Systems

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Wet-pipe sprinkler systems are designed utilizing the guidance of NFPA Code 13. Wet-pipe sprinkler systems with fusible heads are provided in the turbine building below the operating floor, mezzanine floor, and condensate pit; radwaste building bailing area; pit and drum storage area; fuel building new fuel receiving area and general area; control building cable chases, HVAC rooms and the General Area on elevation 98’ below Division I and Division II cable trays; over exposed combustibles in the concealed airspace located above the suspended airspace in the CRD rebuild room; and auxiliary building cable trays, arranged in stacks of seven or more horizontal trays and vertical tray risers. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating, or ductwork. Operation of the sprinkler system is signaled locally and in the main control room. System schedule and additional details are included in Appendix 9A.

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9.5.1.2.6 Manual Dry-Pipe Sprinkler System

The manual dry-pipe sprinkler system protects the outdoor spent fuel shipping area north of the fuel building. This manual system was initially a dry-pipe sprinkler system, designed utilizing the guidance of NFPA Code 13, that has been converted from automatic operation to a manually operated system. The system is provided with closed-head, fusible link sprinklers. Operation of the manual dry-pipe system is signaled locally and in the main control room.

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9.5.1.2.7 Preaction Sprinkler Systems

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Preaction sprinkler systems are designed utilizing the guidance of NFPA Code 13. Preaction systems with fusible links and deluge valves are provided in the RCIC pump room in the auxiliary building, on the turbine bearings and oil piping, and also in the diesel generator building. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating, or ductwork. Operation of preaction systems is signaled locally and in the main control room. Additional details are included in Appendix 9A.

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9.5.1.2.8 Water Spray Deluge Systems

Water spray deluge systems are designed utilizing the guidance of NFPA Code 15. Deluge water spray systems are hydraulically designed, utilizing open head directional solid cone spray nozzles or open sprinkler heads. These systems are provided to protect the:

1. Hydrogen seal oil unit, oil storage, and lube oil system in the turbine building

2. Cable vaults in the control building

3. Cable trays in cable and pipe tunnels

4. Yard transformers.

5. Charcoal filters

6. Auxiliary building (water curtains at el 70 ft 0 in and 141 ft 0 in).

•→2

7. Motor operated valves in the auxiliary building and pipe tunnels.

2←• •→15

Operation of each deluge water spray system is signaled locally and in the main control room. System schedule and additional details are included in Appendix 9A.

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9.5.1.2.9 Carbon Dioxide Systems

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Carbon dioxide systems are designed utilizing the guidance of NFPA Code 12. The high-pressure carbon dioxide (850 psig) systems are provided to protect turbine generator bearings and exciter. 75-lb capacity containers are installed in the storage area in the basement floor of the turbine building. Fixed-temperature detectors automatically actuate the discharge of carbon dioxide. Predischarge warning is provided. Operation of each carbon dioxide system is signaled locally and in the main control room. Additional details are included in Appendix 9A.

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9.5.1.2.10 Halon 1301 Systems

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With the passing of the Clean Air Act in 1990, and the identification of Halon as an ozone depleting agent, Entergy Corporation is actively pursuing the elimination of halogenated fire extinguishing agents in non-critical applications. Halon 1301 remains an effective fire suppression agent, however installed systems are being phased out when suitable replacement agents are available and when it is economical to do so.

Halon 1301 systems are designed utilizing the guidance of NFPA 12A. These systems are provided to minimize damage due to cable fires in the underfloor areas of the PGCC system in the main control room and other non-safety related plant areas where it is economical and justified by the risk of loss.

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Operation of each Halon system is signaled locally and in the main control room. Additional data are included in Appendix 9A and GE Licensing Topical Report NEDO-10466-A.

15←•

9.5.1.2.11 Portable Extinguishers

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The type, size and placement of portable fire extinguishers is determined after evaluation of the combustibles present utilizing guidance provided in NFPA 10. In safety-related areas, special attention is given to locations and mounting so as not to affect safe plant shutdown.

14←•

9.5.1.2.12 Breathing Apparatus

Self-contained breathing apparatus is provided for the use of fire-fighting and main control room personnel. Control room personnel use the same apparatus in the event of main control room evacuation.

9.5.1.2.13 Fire Detection Systems

Fire detection systems are designed utilizing the guidance of NFPA Code 72D. There are two types of fire detection systems.

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One system is dedicated to be used in conjunction with fixed fire suppression systems. These systems function to detect a fire emergency, alarming locally and in the main control room. Where suppression is automatic, the detection system also functions to actuate the suppression system control (e.g., water spray system in tunnels, transformers, etc.). Where suppression is manually actuated, the detection system includes appropriate components for actuation of the suppression system locally and from the main control room with the exception of the locally controlled charcoal filter system.

The second system is dedicated for detection only, alarming locally and within the main control room. This system is provided in general areas where the fire hazard analysis does not justify the need for a fixed suppression system.

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Detailed schedules of detectors are shown in Appendix 9A.

9.5.1.2.14 Fire Barriers

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Fire barriers are provided to contain the fire within the fire area. Structural steel requiring fireproofing shall be fireproofed in accordance with Underwriters' Laboratories, Inc. (UL) approved designs or to designs evaluated to be equivalent to UL approved designs. Fire-rated doors, which are provided in the fire-rated openings, are labeled utilizing the guidance of NFPA 252, except for doors required for pressure tight, water tight, security and missile protection. The doors are a specialty item, varying from 5/8-in. to 3 1/2-in. thick steel doors, not having a listed fire rating. Fire seals are provided at penetrations in the fire-rated barriers or an evaluation is on file providing justification for the adequacy of the fire barrier. Fire-rated walls and doors are shown in details in Appendix 9A.

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Qualification of Doors in Fire Rated Assemblies

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With the exception of special doors such as pressuretight, watertight, security and missile-protected doors, the doors installed in the fire rated assemblies are labeled fire doors. The security, pressure-tight and watertight doors have been evaluated against the fire testing requirements of NFPA-252. Door manufacturers certificates of equivalency or RBS calculations document these evaluations. Missile-protected doors by their nature take precedence to fire ratings. Missile-protected doors are located in exterior building walls for which there are negligible external fire loadings. Therefore, fire rating of these doors is not required.

7←• 13←•

•→13 13←•

Equipment removal plugs are not tested or rated since there is negligible external fire loading and an internal fire would not affect more than one plug as follows:

1. Control building equipment removal plug, el 116 (Section 9.A.2.5, Area C-24)

2. Diesel building equipment removal plug, el 98 (Section 9A.2.6, Areas DG-4, DG-5, and DG-6)

3. Reactor building equipment removal hatch and plug, el 98 (Section 9A.2.6, Area RC-6)

9.5.1.2.15 Egress

Egress is provided from each fire area. Two-hour-rated fire barriers with Class B doors are provided to enclose the stairways and elevator shafts (except in the reactor building) to minimize fire spread potential. Exterior doors at grade and roof levels that are within a 50-ft radius of a fire hazard are fire-rated. All other exterior doors at these levels are not required to be fire-rated. Mark III containment does not have egress enclosures. Two personnel access doors are provided in the reactor building.

9.5.1.2.16 Building Construction

Building construction is rated noncombustible and fire resistive. Noncombustible and fire-resistive materials are used wherever practical throughout the plant, particularly in safety-related areas containing safety-related structures, systems, and components. The flame spread, and smoke and fuel contribution rating for permanent construction materials of major plant structures, are below a rating of 25, except for resilient floor coverings, as defined in ASTM Standard E.84. All metal deck roof construction is FM Class 1 construction or listed by Underwriters Laboratories as classified for fire resistance.

9.5.1.2.17 Drainage

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Floor drains are available for those areas where fixed water fire suppression systems are installed. The drainage system is designed to prevent the spread of fire through drainage piping. Potentially radioactive area drainage is diverted to the radwaste building prior to discharging to the environment. Fire area flooding, resulting from an inadvertent actuation of a sprinkler system and an assumed loss of the floor drainage system, in one fire area, does not cause loss of redundant trains of safety-related equipment.

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9.5.1.2.18 Yard Transformers

Yard transformers are separated by 1-hr-rated fire walls.

Transformers are protected by the automatic water spray deluge system. The necessary drainage facilities are provided.

9.5.1.2.19 Electrical Cable Protection

•→8A

Electrical cables utilized in safety-related circuits meet the requirements of IEEE 383-1974. There are some electrical cables which are not qualified to IEEE 383-1974, but are used only on nonsafety-related circuits. With the exception of light fixture cords, these cables are run entirely inside noncombustible metallic conduits in the plant, or in nonsafety-related duct lines directly buried in earth or are evaluated to have equivalent fire resistant properties of IEEE 383-1974. Optical fiber cables and/or their raceways used at RBS shall be listed as plenum rated as defined in NFPA 70, "National Electric Code" (2002 edition), Section 770.51(A), "Listing Requirements for Optical Fiber Cables and Raceways, Types OFNP and OFCP." Electrical cable concentration exists throughout the plant. For the most part, cables are installed in noncombustible trays. Those not installed in trays are in rigid and/or flexible metallic conduits. For special applications, such as the supply to the Hydrogen Igniters located near the drywell ceiling, stainless steel jacketed-silicon dioxide insulated (completely noncombustible and qualified for the application) cable may be used based on specific evaluations for the application. This cable is designed to be routed external to metallic conduit. Another special application is the instrument wires for the main steam line strain gauges that are attached to the surface of the steam line pipes. The instrument wire is fiberglass insulated, high temperature (900 deg F) cable. It is not IEEE 383-1974 approved, but it is not considered to be a probable source of ignition. The wire is routed externally to conduit where it is spliced to the field cable. The field cable is Rockbestos Firewall III, IEEE 383-1974 rated and qualified for use in the drywell. The cable is routed both inside non-combustible stainless steel flexible conduit and external to conduit in the Drywell. These cables are Augmented Quality and are not Safety Related. Another special application is the 120 VAC power cable connector for the Spent Fuel Pool Instrumentation (SFPI) processor/display module used for SFP level monitoring (installation in compliance with NRC Order EA-12-051 and the guidance provided by NEI 12-02, Revision 1 as endorsed by NRC JLD-ISG-2012-03, Revision 0). This power cable, supplied by the vendor for the SFPI processor/display module, is connected to a 120 VAC power plug as a pigtail. The cable is PVC-jacketed, and it is not IEEE-383 approved. However, the cable is not considered to be a probable source of ignition. The cable is free-air routed, external to any conduit. The cable is routed externally because the SFPI processor/display has exposed plug connectors that are flush with the enclosure, not allowing conduit to be installed to the processor/display enclosure at the connection site. There are two of these cables, one for each SFPI processor/display module on two different channels. The SFPI equipment panels are mounted to the same concrete wall in the Control Building 98 ft. elevation. The power cables to the processor/display for each channel each do not exceed 6 ft. in length, and only routed in the area of the wall in the Control Building. Therefore the cables route maintains the requirements of section 9.5.2.2.1.6 and the RBS position discussed in Appendix 9A.3.5.2.3. These cables are used with equipment that is Augmented Quality. The cables are not Safety-Related. Cable trays are installed in electrical tunnels, piping tunnels, cable spreading rooms, cable chases, and general areas. Some trays have ventilated covers, but most are uncovered. Within the electrical tunnels, east of the fuel, reactor, and auxiliary buildings, 3-hr-rated fire barriers exist between safety divisions. In all other areas, separation is in accordance with Regulatory Guide 1.75. In tunnels, automatic water spray deluge systems are provided. In other areas, water suppression is provided on the basis of fire hazard analysis. Additional data are included in Appendix 9A. Electrical cable tray separation criteria are described in Section 8.3.1.4.

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9.5.1.2.20 Seismic Design Requirements

The fire protection systems in safety-related areas are seismically supported so that failures of the fire suppression system do not incapacitate safety-related systems or components.

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•→3
Valve trim piping at each riser in the fire protection system however, is exempt from seismic support requirements, as failure of this piping will not affect safety related systems or components.
3←•
Seismic Category I water supply is provided from the SSW system to hose stations serving equipment required for safe plant shutdown in the event of an SSE. The standpipe system beyond the connection of the SSW system is seismically designed for the SSE to assure system pressure integrity.

9.5.1.2.21 Ventilation

A dedicated smoke removal system is provided for the main control room and other areas of the control building. Smoke removal for other buildings is accomplished through the normal exhaust systems. All areas having radioactive materials are provided with radiation monitors. Additional details for HVAC and smoke removal systems are included in Section 9.4.

9.5.1.3 Safety Evaluation (Fire Hazards Analysis)

The fire protection program allows the plant to maintain the ability to perform safe shutdown functions and minimize radioactive releases to the environment in the event of a fire. Safe shutdown analysis and radioactive release analysis are described in Section 9A.2 of Appendix 9A.
•→10
Potential fire hazards throughout the plant and the effect of postulated fires on safety-related plant areas are analyzed. The evaluation of analysis includes the consideration of fuel loading, maximum fire intensity, and automatic and manual firefighting activities. Drawings showing detection, and suppression systems are included in Appendix 9A.
10←•
9.5.1.4 Inspection and Testing Requirements
•→14
Periodic operational checks, inspections, and servicing required to maintain fire protection systems that protect equipment that is important to safety, including the alarm and detection systems, conform with the RBS Technical Requirements Manual. In addition, the following documents were used as references in the development of the fire protection systems testing program:

1. Appendix A to Branch Technical Position APCSB 9.5-1, dated August 23, 1976
2. Insurance recommendations
3. Applicable sections of NFPA Standards
4. Vendor recommendations.

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For equipment not important to safety, but important to commercial loss control, details of the test program are governed by Engineering and controlled in accordance with established plant processes for periodic maintenance tasks. Specific instructions for these tests are contained in detailed test procedures and written instructions.

9.5.1.5 Personnel Qualification and Training

Qualifications of the personnel responsible for the preparation of the Fire Hazards Analysis and for the design and selection of equipment are provided in the Fire Protection Program Evaluation Report (Appendix 9A), Section 9A.1.2. Personnel responsible for the development of the RBS fire protection program; maintenance, inspection, and testing of fire protection equipment; and training of firefighting personnel are discussed in Section 9A.3.2.1. A discussion of fire protection training for RBS is provided in Section 13.2.3.

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Section 9A.3.3 (Administrative Procedures, Controls and Fire Brigade) conforms with BTP APCSB 9.5-1 and Section 9B.4.8, 9B.4.9, and 9B.4.11 (Fire Brigade, Fire Brigade Training, and Administrative Controls) conforms with Items III.H., III.I, and III.K, respectively, of Appendix R to 10CFR50. APCSB 9.5-1 and Appendix R sections listed above have the same intent as BTP CMEB 9.5-1 Sections C.2 and C.3.

Procedures are provided (shown in Section 13.5) to maintain the performance of the fire protection systems and to set forth the responsibilities, duties, and controls for the fire protection program in the following general areas:

1. Administrative Procedures

   a. Responsibilities and authorities

   b. Organizational relationships

2. Fire Protection Procedures

   a. Control of ignition sources

   b. Control of transient combustibles

   c. Duties of a fire watch

   d. Fire report

   e. Handling of flammable liquids and gases

   f. Firefighting equipment inventory, inspection, and maintenance

   g. Inspection of maintenance and modification activities for fire protection systems

   h. Surveillance of fire protection activities

   i. Permanent storage of combustibles

3. Fire Emergency Procedures

   a. Duties and responsibilities

   b. Detection and annunciation

   c. Fire fighting

   d. Recovery

4. Fire Protection Training and Drills

    a. Duties and responsibilities

    b. Outline training course requirements

    c. Drill planning guides

    d. Critique of drills

    e. Documentation

•→14
These procedures were initially developed using guidance from Appendix A to BTP APCSB 9.5-1 and applicable sections of 10CFR50 Appendix R. Additional references used included insurance recommendations and available National Fire Protection Association (NFPA) Recommended Practices (NFPA 4, 4A, 6, 7, 8, 27, and 802).
14←•
The Quality Assurance program, as it applies to the fire protection systems, is discussed in Section 9A.3.4 of Appendix 9A.

Fire protection related to emergency planning is discussed under the appropriate areas of Section 13.3.

9.5.2 Communication Systems

9.5.2.1 Design Bases
•→7
Communication systems are provided for reliable intra-plant, intra-site, and plant-to-offsite communication to meet the requirements of operation and maintenance of the units. These systems have redundancy or diversity to ensure communications during all modes of plant operation including emergencies. However, these communication systems are not required to prevent or mitigate the consequences of the design basis events, or a fire or security threat. Communications is required for interface between the Control Room or remote shut down station and operators or the fire brigade during and after the course of a fire. Physical and electrical independence is maintained between the systems. Power sources for each system are listed in Table 9.5-1.
7←•
The maximum sound level that could exist in each of the above areas is 90 dB as specified by OSHA requirements, except for the main control room which has a maximum permissible sound level of 65 dB. Speakers in expected high noise areas are capable of 115 dB at 16 ft and 123 dB at 4 ft.

These communications systems provide reliable, effective communication with the main control room with the sound levels identified above. Tests are based upon manufacturer's instructions at intervals specified by the manufacturers, to assure effective communication.

Diverse types of communication are provided as a protective measure to assure a functionally operable onsite communications system. Each type of communication is independent of the others so that failure of one does not adversely affect any others. Since the page-party, PBX, and portable intercom circuits are installed in separate conduits, the intra-plant communications are not subject to common mode failure. Communication circuit raceways and equipment in seismic Category I areas are seismically supported to ensure their availability during seismic events.

•→1

The portions of the page-party that are in the protected area and the portable intercom are powered from UPS buses and the PBX has battery backup to protect against power failure. The portions of the page-party system that are outside the protected area are not powered from UPS buses but from local non-class 1E power only. As indicated above, functional operability is assured through redundancy. Loss of offsite power does not affect the performance of the page-party or portable intercom communication systems since the batteries furnishing power to the UPS are sized to furnish power for a minimum of 2 hours.

1←• •→7

A Control Room fire could potentially make the Page Party/Public Address Gaitronics System (PP/PA) inoperable, however, the telephone system outside of the Control Room would not be affected. Repeaters used for fire brigade radio communications are located in the Normal Switchgear Building and Services Building. These buildings do not house any safe shutdown equipment. In case of fire in these buildings, the loss of the repeaters would not affect safe shutdown of the plant. The normal power supply for the repeaters located in the Normal Switchgear Building is supplied from the Control Room; however, backup power, isolated from the Control Room is available. Two of the four repeaters located in the Services Building are considered critical and are powered from a dedicated UPS System. The remaining two repeaters in the Services Building are powered locally and will lose power after a loss of power event. Loss of the two locally powered Services Building repeaters will not adversely affect fire brigade radio communications.

7←•

9.5.2.2 System Description

9.5.2.2.1 Intra-Site/Intra-Plant Communications

Intra-site/Intra-plant communications consist of the following systems:

1. A page-party/public address system (PP/PA)
2. A portable intercom system
3. A private branch exchange (PBX) system

•→8

4. A hand-held portable onsite radio and telephone system.

8←•

•→8 •→2

9.5.2.2.1.1 Page-Party/Public Address System (PP/PA)

The page-party/public address system (PP/PA) is a multiple channel system designed to permit simultaneous usage of a page line and five party lines for intraplant use. The system consists of speakers, amplifiers, and handsets located throughout the plant, including safety-related areas. The PP/PA system is also used for sounding evacuation and fire alarm signals, and amplifiers for the PP/PA system will be located and sized so that emergency signals will be audible or visible (flashing red lights) in all plant areas, including those having high ambient noise levels. The PP/PA system is powered from a non-Class 1E uninterruptable power source.

2←•

9.5.2.2.1.2 Portable Intercom System

•→10

The portable intercom system within the plant is used for maintenance and calibration of instrumentation. It consists of jack stations, headsets, and interconnecting wiring. Each major equipment system has its own network of jack stations, and these subsystems can be tied together through operation of manual switches. Jack stations are provided in the main control room (see figure 9.5-8 for the layout of the jack station in the main control room) and at the remote shutdown panel. Power for the portable inter system is from a non-Class 1E noninterruptible power source.

10←•

9.5.2.2.1.3 Private Branch Exchange System (PBX)

The PBX system consists of a switchboard and pushbutton telephones located throughout the plant. The system is designed to allow direct dialing and communication between PBX locations without the involvement of offsite facilities. At River Bend, the PBX system is interconnected with the local commercial telephone system to allow direct access to this system from selected PBX locations. Power for the PBX system is from a non-Class 1E source, with backup provided from a non-Class 1E battery.

8←•

•→8

9.5.2.2.1.4 Hand-Held Portable Radio System

The portable radio system consists of a base station, a fixed repeater, and hand-held portable radios. The system is designed to permit communication between the base station and hand-held portable radios anywhere in the plant. The system operates on ultra-high frequency (UHF) band frequencies, with base station control from the main control room or remote shutdown panels. Power for the base station and repeater is from a non-Class 1E station battery. The hand-held portable radios are battery-powered.

A completely independent radio system is provided for security purposes, as discussed in Section 13.6.

9.5.2.2.1.5 Intra-Site Communications

The PBX, PP/PA, and portable intercom systems are designed to permit communications between the main control room and other locations throughout the station.

9.5.2.2.1.6 Cable and Circuit Routing

All communication cables are either of the coaxial type (as for microwave) or are composed of twisted pairs with short lays. They are isolated by distance, shielding or conduit enclosure from power cables, or any source of line noise which could affect their signal content. They are also isolated from any low signal level cables which they might affect.

•→2

All communication systems wiring in general plant areas is routed in rigid metal conduit, underground duct, or electrical metallic tubing (EMT). The only exceptions are;

1. Coaxial cable in the plant-wide distribution antenna. In order to function as an antenna, the cables cannot be routed in conduit. Sufficient isolation is maintained by distance to prevent interference with the other equipment.

2. Short pieces of communications cable, and 120 volt power cable, will be allowed between the end of a conduit and a piece of equipment when the equipment is not capable of accepting a conduit connection.

3. Temporary communications cables which will remain in the power block for one operating cycle or less.

8←• 2←•

9.5.2.2.2 Plant-to-Offsite Communications

The plant-to-offsite communications consist of the following separate, independent, and diverse systems adaptable to in-plant and offsite locations:

•→12

1. A Bell South system

2. A plant-to-offsite radio system

•→8

3. A microwave system and Fiber-Optic system

8←•

4. A dedicated NRC notification system, (Section 13.3.6.2)

9.5.2.2.2.1 Bell South System

•→8

The Bell South system serves the Baton Rouge area, which includes the River Bend Station. A minimum of one telephone connected directly to the Bell System is installed in the main control room. Six or more Bell telephone lines from the outside are directed to the operator console from which outside calls may be redirected to internal private branch exchange system phones, and from which outgoing calls may be routed.

12←•

9.5.2.2.2.2 Plant-to-Offsite Radio System

A base radio station provides communication with local offsite EOCs and 24-hour points. The base station is controlled by the main control room. The radio system is powered by a separate independent battery and charger. The system is designed to provide reliable radio communications.

9.5.2.2.2.3 Entergy Microwave System

Onsite, near the 230-kV and 500-kV switchyards, there is a microwave terminal tower. This tower and its equipment are supplied by 480-V ac power sources from the plant and switchyards and its own 48-V battery system. The microwave system has the following services carried on its channels:

1. Voice communication

2. Relaying for high-voltage lines

3. Entergy PBX tie lines

4. System dispatcher

5. High-speed data (to the administrative complex), and

6. Miscellaneous functions.

8←•

•→8
Signals received at the microwave terminal tower are routed by communication cable to the proper location for demodulation. The Entergy microwave system is primarily an adjunct of the power transmission system and the power plants. It consists of receivers, transmitters, antennae, and multiplexing equipment. Its terminals are generally at generation and high-voltage switching stations, and its signals are directed to neighboring utilities and to other Entergy facilities. River Bend Station signals are directed into the Entergy microwave system.

9.5.2.2.3 Design Evaluation

All communication systems are physically and electrically independent. The failure of any system does not completely interrupt the flow of information from the plant.

9.5.2.2.3.1 Intra-Site/Intra-Plant Communications
•→1
The page-party system and the associated private branch exchange require local power. Within the protected area, this is supplied by either inverters or battery systems, or both, and has an automatically switched source of local ac power as an optional supply. Outside the protected area, the page-party system is powered from local non-class 1E power without back-up alternate supply. Inverters are powered from batteries not associated with safety-related systems. The hand-held portable onsite radios are battery-powered and independent of plant electric power except for recharging of batteries.
1←•
9.5.2.2.3.2 Plant-to-Offsite Communications

Plant-to-offsite communication systems use a diverse mix of the major types of approaches which are available (South Central Bell, offsite radio, Entergy microwave system) to ensure that, under the most adverse circumstances, communications are maintained.

The battery systems which power the various modes of site communication are designed to operate at least 4 hours in the event of a loss of offsite power (LOOP). The Entergy grid system is conservatively estimated to be able to mitigate a LOOP event 95 percent of the time within 4 hours. Consequently, the communication system provides high reliability for a majority of LOOP events.
•←8
9.5.2.3 Inspection and Testing Requirements
•→12
The design of the communication systems permits routine full functional testing. Power sources are monitored by indicating instruments. Battery cells are checked periodically for voltageand specific gravity, where applicable. Redundant power supplies are isolated for testing to ensure that one does not mask the deficiency of the other. The evacuation alarm signal is tested periodically in accordance with normal station procedures.
•←12

9.5.3 Lighting Systems

Lighting systems described in this section include both normal and emergency lighting systems.

9.5.3.1 Design Bases

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The station lighting systems provide lighting with power supplied from normal and standby ac sources or from an uninterruptible power system and battery pack systems. During normal operation, all lighting is supplied from the normal buses, except for 20 percent of the light fixtures in the main control room and the fixtures in the remote shutdown panel rooms, which are normally connected to a standby bus derived from the standby diesel generators. The loss of offsite power does not affect all of the normal lighting system. The station lighting systems are designed under the following bases:

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1. The station lighting systems provide lighting intensities at levels recommended by the Illuminating Engineering Society and in accordance with current OSHA requirements.

2. Lighting fixtures are selected with due consideration for environmental conditions and ease of maintenance. Fluorescent lamps and light emitting diodes (LEDs) are used for general lighting throughout the plant with the following exceptions. Incandescent lamps are the only type used within the containment, and in certain areas of the auxiliary, radwaste, and fuel buildings, and in the condensate demineralizer area. Some special quartz-incandescent fixtures are used in the fuel pool and the surrounding area. High-pressure sodium (HPS) lamps are used for high-bay, medium-bay, and roadway lighting. The illumination level and type of fixture to be used in vital and hazardous areas where emergency lighting is needed for safe shutdown of the reactor or the evacuation of personnel in the event of an accident are listed in Table 9.5-2.

3. Safety ac lighting, supplied from the normal uninterruptible power system, is provided for 20 percent of the light fixtures in the main control room. Batteries furnishing power to these UPSs are sized for a minimum of 2 hours. Emergency dc lighting, supplied from the battery pack system, is provided in standby generator areas, standby switchgear rooms, standby service water pump house, Class 1E battery rooms, standby motor control centers and load centers, remote shutdown panel rooms, and areas required for egress and exit of buildings. The battery packs are designed to sustain the illumination level for a period of 8 hours.

9.5.3.2 System Description

Outdoor area lighting is controlled by light-sensing devices. High-pressure sodium fixtures are used for general yard and roadway lighting. They are supplied by 240-V or 480-V ac, single-phase power. Fluorescent and incandescent fixtures are supplied by 120-V/240-V ac, single-phase, 3-wire power. The station lighting systems are divided into three systems (Fig. 9.5-9):

1. Station lighting System 1 (normal) receives power from the normal service buses of the station service ac power distribution system described in Section 8.3.1. In the main control room, the normal ac lighting system feeds approximately 60 percent of the main control room lighting fixtures. Another 20 percent of the fixtures are manually transferrable to one of two available Class 1E buses supplied by a standby diesel generator, which can furnish power for up to 7 days. It is normally connected to the Division II Class 1E bus (Fig. 9.5-9).

2. Station lighting System 2 (safety ac lighting) receives power from the normal uninterruptible power supply (UPS) system and is confined to the main control room. Twenty percent of the total fixtures in the main control room are supplied from System 2.

3. Station lighting System 3 (emergency dc) receives power from the local battery packs, which are normally fed from the normal ac system. Local battery packs are installed in the following areas as indicated in Table 9.5-2:

   a. Main control room (egress)

   b. Standby diesel generator building

   c. Class 1E switchgear rooms

   d. Standby service water pump house

   e. Class 1E battery rooms

   f. Standby MCCs and load centers

   g. Remote shutdown panel rooms

   h. Means of egress and building exits.

The main control room and remote shutdown panels are the only areas requiring continuous lighting in excess of 8 hours, which is provided as described above.

In case of failure of the normal ac lighting system, exit signs and means of egress throughout the station are illuminated by system 3. In the event of failure of the normal ac lighting system and a loss of offsite power, portable lighting (battery-powered lanterns) is available for all areas of the plant.

9.5.3.3 Safety Evaluation

In Seismic Category I structures, the lighting fixtures and conduits are supported using support designs referenced on Category I seismic support drawings. The fixtures and conduits in these areas have either been supported by the referenced seismic supports, or have been evaluated to demonstrate that seismic failure of the fixture or conduit will not adversely affect safety-related systems or equipment in the area. In the main control room, they are seismically supported in accordance with structural requirements for control room design: lighting over the main control and computer areas is supplied from a louvre. All ceiling lighting and fixtures are the flourescent strip type and are securely mounted above the indepndent of the louvres. The remaining areas are illuminated by recessed fluorescent fixtures in an acoustical suspended ceiling. The fixtures are double suspended, i.e., from the suspended ceiling and from the structure.

All battery packs are a sealed type and are seismically supported. These battery packs are designed to give sustained illumination for 8 hr following a loss of normal power.

The remote shutdown panel rooms and 20 percent of the main control room fixtures are connected to a Class 1E bus. Special design considerations have been made for the control room lighting system. From the Class 1E bus to the power receptacle, the circuit is designed as Class 1E with two independent overcurrent protection devices installed in the circuit to ensure protection of the Class 1E portion of the circuits. The Class 1E portion of the lighting circuit is installed, as are other Class 1E circuits, using Class 1E cables installed in seismically-supported conduit. Under any DBE condition, the Class 1E power supply will remain operable. The non-Class 1E portions, such as the receptacles, cables, and raceways, are also seismically supported to remain in place and available after a DBE. The light fixtures are seismically installed and utilize lamp clips to ensure their availability under DBE conditions. The lighting transformer and lighting panelboard are seismically qualified and will therefore remain available to furnish Class 1E power to this portion of the main control room lighting system under DBE conditions. From and including the receptacle and plug, it is treated as a non-Class 1E system, with additional safety protection as follows:

1. The transformer load is limited to 75 percent of its maximum rating.

2. The circuit breaker installed on secondary windings of the transformer trips at 100 percent of the transformer rating.

3. No load other than the lighting fixtures is connected to this circuit.

4. Wiring for this system is run in separate conduits.

Light fixtures installed in the two remote shutdown rooms are seismically supported, as are the raceway systems connected to these fixtures.

9.5.3.4 Inspection and Testing Requirements

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Normal operation of the lighting system results in easy identification of malfunctions, and continuous routine maintenance and housekeeping ensures reliability. Battery pack units are provided with local test switches to simulate loss of normal ac power. These are tested periodically to ensure operability of the system components. The testing program for lights in areas required for post fire safe shutdown provides reasonable assurance that the battery pack units will be available to provide adequate lighting for the task for the required duration. The testing program for lights installed for personnel safety provides reasonable assurance that adequate light will be available for egress upon loss of normal lighting.

15←•

9.5.4 Diesel Generator Fuel Oil Storage and Transfer System

The plant is provided with two standby diesel generators and one HPCS power supply diesel generator operating on No. 2D diesel fuel oil, with each engine supplied by a separate diesel generator fuel oil storage and transfer system. The standby and HPCS diesel generator fuel oil storage and transfer systems are shown in Fig. 9.5-2a.

9.5.4.1 Design Bases

Each diesel generator fuel oil storage and transfer system is in accordance with the following criteria:

1. The diesel generator fuel oil storage and transfer systems are designed to Safety Class 3 and Seismic Category I requirements.

2. The equipment mounted on the diesel generator is designed and fabricated to the manufacturer's quality assurance standards and Seismic Category I requirements.

3. The diesel generator fuel oil piping, pumps, valves, and oil tanks are designed, constructed, and tested in accordance with ASME Boiler and Pressure Vessel Code, Section III, Safety Class 3, except as noted in Table 3.2-1.

4. The system design incorporates sufficient redundancy to prevent a malfunction or failure of any active or passive component from impairing the capability of the system to supply fuel oil to at least two of the three diesel engines.

5. The diesel generator fuel oil storage and transfer systems are designed so that there is no interconnection with any other onsite fuel oil system.

6. The storage capacity of the system provides sufficient fuel oil for each diesel generator to operate continuously at rated capacity for 7 days.

7. The system is designed to the requirements of ANSI Standard N195-1976, Fuel Oil Systems for Standby Diesel Generators.

8. The diesel generator fuel oil storage and transfer system is located in and adjacent to the Seismic Category I diesel generator building, which is protected from externally generated missiles. Storage tank fill connections, filters, and vents are located adjacent to each diesel generator room outside the building. Each fill and vent location is located in a concrete enclosure for tornado missile protection. Diesel generators are separated from each other by 2-ft thick reinforced concrete walls that have a 3 hour fire rating.

9. The system will be evaluated for the consequences of moderate-energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room are the air start piping and components and the standby service water piping and components. There are no high-energy lines which could affect the system.

10. The fuel oil day tanks are located in the corner of each diesel generator room as far away from the diesel generator hot surfaces as possible. The fuel oil piping to and from the day tank(s) and diesel(s) is run along the wall of each diesel generator room as far away from the diesel hot surfaces as possible. The piping is run to the diesel only where required for connections. Exposure to open flames has been considered in the fire protection evaluation as outlined in Appendix 9A.

9.5.4.2 System Description

The diesel generator fuel oil storage and transfer systems consist of:

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1. Three buried diesel fuel oil storage tanks, one for each diesel engine. Each storage tank has an effective storage capacity of 47,690 gallons. Each diesel generator fuel oil storage tank is sized to store sufficient fuel oil for continous operation at its rated capacity for 7 days. Each fuel storage tank is filled from its own individual tank truck fill station, located above the Probable Maximum Flood (PMF) elevation, adjacent to the diesel generator building within the plant security fence. Each fill supply pipe is capped when not in use, and provided with a locked-closed isolation valve and a duplex strainer capable of filtering out particles 75 microns and larger. The duplex strainer is designed to allow for filling through one side of the strainer while the other side is being cleaned. Each tank is vented through a flame arrestor to the atmosphere.

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2. Three 10 gpm full-capacity, electric motor-driven, tank-mounted at el 86'-6", vertical centrifugal wet-pit fuel oil transfer pumps, one pump for each diesel generator fuel oil storage tank. The pumps require a 5-ft absolute net positive suction head which is well below the 11 5/8-in minimum oil level of the tank fuel oil. Pumps are installed inside each tank as shown on Figure 9.5-2a to satisfy both NPSH and minimum submergence requirements. No priming is required. Each fuel oil transfer pump motor is powered from the associated diesel generator bus (Section 8.3.1.2.1.2.5).

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3. Two parallel filter units are provided in each fuel transfer pump discharge line. Each filter unit is sized for full pump flow, and capable of filtering out particles 10 microns and larger. Valving is provided to allow changing of the filter element in one filter while the other is in service. A differential pressure alarm is provided for the filters as described in Section 9.5.4.5.

•→11

4. Three diesel generator fuel oil day tanks, one for each diesel engine, are situated in the diesel generator rooms. Each diesel generator fuel oil day tank is sized to store 612 gallons of grade No. 2D diesel fuel oil subject to the following requirements:

11←•

Kinematic Viscosity	
@ 40°C cST	1.9-4.1
Sulfur, percent	0.50 max
Carbon Residue, percent	0.35 max
Ash, percent	0.01 max
Water and Sediment, percent	0.05 max
Flash Point, °F (P.M.C.C.)	125 min
90% Distillation, °F	540-640 max
Cetane No.	40 min
Copper Strip Corrosion	No. 3 max

Fuel oil as specified here meets or exceeds the requirements imposed both by vendor recommendations and ASTM D975-81. All purchased grade No. 2D diesel fuel oil has a cloud point lower than the 3-hr minimum soak temperature expected at the site during seasonal periods in which the oil is to be used. Each diesel generator fuel oil day tank is supplied with a flame arrestor on the vent.

Each diesel generator is mounted at an elevation sufficient to ensure that adequate NPSH is available to the engine-mounted fuel transfer pump, even at the low day tank fuel oil level.

Each fuel oil transfer pump starts automatically on low level in its respective fuel oil day tank. Fuel oil from the day tank flows by gravity to the engine-mounted fuel oil system, which boosts the pressure to that required by the fuel injection header. Each of the two standby diesel generators is provided with a back pressure control valve in the fuel return line to control the injector header pressure. Injector header pressure control on the HPCS power supply diesel is provided by a back pressure relief valve. Excess fuel oil is returned directly to the fuel oil day tank.

9.5.4.3 Safety Evaluation

As a result of the redundancy incorporated in the system design, the diesel generator fuel oil system provides its minimum required safety function under any of the following conditions:

1. Loss of offsite power coincident with the failure of one diesel generator

2. Loss of offsite power coincident with the failure of one diesel generator fuel oil transfer pump associated with each diesel generator.

Each diesel generator fuel oil storage tank is sized to store sufficient diesel fuel oil for a minimum of 7 days of continuous operation at its rated capacity. Fuel oil may be delivered to the site within 24 hr from terminals in Baton Rouge, Louisiana. Local Baton Rouge and vicinity sources of fuel oil supply are: Exxon Corp. in Baton Rouge, APEX Co. and Placid Oil Co. in Port Allen, and LaJet Oil Co., in St. James, Louisiana. Sufficient alternate land routes to the River Bend Station site are available in order to maintain fuel oil deliveries even under adverse environmental conditions.

Fuel oil trucks destined for River Bend Station from fuel oil terminals in the Baton Rouge vicinity would travel north on US Highway 61, a distance of approximately 25 miles. Along this route, the bridge crossing at Thompson's Creek, about 3 miles south of the site, is most susceptible to flooding. Submergence of this bridge has not been observed since its construction in 1962 (2) and flooding is not expected in the event of a PMF in the site area; however, alternate land routes are available if US Highway 61 becomes impassable. For example, an alternate route could be State Highway 19 north to State Highway 10 west, then south on US Highway 61 to the site, a distance of approximately 45 miles. Other alternate routes can be postulated (Fig. 2.1-1). Even if high floodwater levels of local streams and ponding of rainfall on road surfaces due to a PMF were to inhibit passage on US Highway 61 and other area routes, Section 2.4 shows that the peak PMF flow for Grants Bayou, West Creek, and other small streams is expected to pass in 24 hours or less. In addition, flooding of the North Access Road and the road surrounding the plant would not occur (Section 2.4.3.5.2).

•→11

Each of the diesel generator fuel oil day tanks is sized to store a maximum of 612 gallons of diesel fuel oil, as allowed by the National Fire Protection Association (NFPA) Standard No. 37, Stationary Combustion Engines & Gas Turbines (1979). This storage capacity provides for over 1 hr of continuous operation of the diesel generator at full load. The sulfur content of the diesel fuel oil is specified at 0.5 percent maximum, by weight, to minimize corrosiveness of sulfur compounds in the diesel engine exhaust gas.

11←•

The diesel generator fuel oil storage tank is adequately protected against long-term corrosion by the following means:

1. Sufficient thickness has been included in the design of this carbon steel tank to allow for the 1/8 in of corrosion expected over a 40-yr period.

2. System piping is protected against corrosion as follows:

    a) Buried piping is coated with coal tar enamel that conforms to the American Water Works Association Standard C203}3{.

    b) Piping not buried is protected by a zinc-rich primer and a polyurethane finish coat.

3. The exterior surface of the storage tank is shot blasted in accordance with the Steel Structure Painting Council (SSPC) standard SPG [4]. The surface is then coated with zinc-rich epoxy primer followed by a top coat of coal tar epoxy that conforms to the SSPC-PA1 standard[5].

4. The storage tank is located in a dry sand-filled, concrete vault and is not exposed to groundwater.

5. A diesel fuel oil additive is used in the fuel oil storage tanks to prevent oxidation of the fuel oil and to allow dispersion of gums and tars that could plug fuel lines. The additive also contains agents to prevent internal storage tank corrosion and biotic growth in the fuel.

6. The tanks are kept normally full to minimize air contact with tank surfaces.

The fuel oil forwarding filters described in Section 9.5.4.2.3 are designed to remove any sediment that might be stirred up during refueling.

Plant operating procedures require staggered refill of the diesel fuel oil storage tanks. Refilling of one standby diesel generator fuel oil storage tank will begin after 72 hr of continuous diesel generator operation. Refilling of the second diesel generator fuel oil storage tank will begin after 96 hr of continuous diesel generator operation. Refill is at a controlled rate to minimize turbulence in the storage tank and is completed in time to allow sufficient settlement prior to refilling the next tank. In addition, the procedures require the following considerations when filling during required diesel generator operation. The day tank is verified to be full prior to refilling its associated fuel oil storage tank. Confirmation of day tank fill capability without fuel oil filter clogging is required before the next storage tank is refilled. Further, the storage tanks for the standby diesel generators are filled before the HPCS storage tank.

Water levels in the fuel oil storage tanks are checked periodically. Water-finding paste may be introduced through the sounding tube as a visual method of measuring the water level. In addition, the diesel fuel oil is sampled periodically as described in Section 9.5.4.4. Should the water level be excessive, water is removed through a drain line located in the bottom of the tank.

14←•

The diesel generator fuel oil storage tank is located in a dry sand-filled, concrete vault on the lowest level of the diesel generator building, as shown in Fig. 1.2-28. The diesel generator building is protected against the effects of groundwater and flooding. The design provides for all vents, fill lines, and manholes to be above the PMF elevation or properly sealed against any possible water leakage. The location and climatic conditions are such that the temperature of the storage

14←•

tanks can be expected to be relatively high with respect to the dewpoint. This results in a negligible amount of water vapor being condensed in the tank. Condensation is estimated at less than 1 gpd.

9.5.4.4 Inspection and Testing Requirements

The diesel generator fuel oil supply piping is hydrostatically tested during construction. All active system components, instrumentation, and controls are functionally tested during startup and periodically thereafter, as defined in Regulatory Guide 1.108, Revision 1. The diesel fuel oil is sampled monthly to determine possible contamination or deterioration of the oil in the storage tank. The cause of any identified contamination or deterioration is identified and corrected as necessary to assure proper operation of the diesel generators. This may include using an algae-inhibiting additive, such as biocides, to prevent the growth of algae and fungi. The diesel fuel oil inventory is also periodically checked. The water level in the diesel generator fuel oil storage and day tank is checked monthly and after each operation of the diesel when the period of operation is 1 hr or longer, and excessive accumulated water is removed immediately.

9.5.4.5 Instrumentation Requirements

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Control and protection logic for the diesel generator fuel oil storage and transfer system is shown in Fig. 7.3-15, sheets 1 through 6 (standby and HPCS diesel generators), Fig. 7.3-23, sheets 17 through 28 (standby diesel generators), and Fig. 8.3-12, sheets 1 through 9 (HPCS diesel generator). Diesel generator protective functions are further discussed in Section 8.3.1.1.4.

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Control switches are provided in each diesel generator control room for either automatic or manual operation of the diesel generator fuel oil transfer pumps. Local indicators are provided for measuring the fuel oil pump discharge pressure and the fuel oil strainer differential pressure. A high strainer differential pressure condition activates an alarm in the diesel generator control room, as well as a trouble alarm in the main control room. Local indication of fuel oil pump discharge flow is provided for the HPCS diesel generator only.

10←•

The level of each diesel generator fuel oil day tank is monitored in the main control room from a level transmitter which provides both level control and alarm functions. During operation in the automatic mode, control logic is provided for starting and stopping the fuel oil transfer pump in order to maintain the level inside the day tank within limits. Failure of either the alarms or the control function of the level signal annunciates either a "gross-failure" or a "card out" alarm in the main control room. In either case, the fuel oil transfer pump can still be manually operated from the diesel generator control room, thus ensuring continuous fuel oil supply for the diesel.

12←•

•→12
A low day tank level condition activates an alarm in the main control room. High and low day tank level alarms are provided in each diesel generator control room. A high day tank level condition also activates a trouble alarm in the main control room.
12←•
Alarms are provided in each diesel generator control room for any abnormal condition that occurs in the diesel generator fuel oil transfer system. A diesel generator trouble alarm in the main control room is also activated.
•→1
The level of each diesel generator fuel oil storage tank is monitored in the diesel generator control room. A low fuel oil storage tank level activates an alarm in the main control room. Failure due to loss of power or malfunction of the level transmitter annunciates a common "gross failure/card out" alarm in the main control room.
1←•
A diesel generator fuel oil transfer inoperative condition activates a trouble alarm in the main control room.

9.5.5 Diesel Generator Cooling Water System

Diesel generator cooling water system (DGCWS) provides cooling water to the standby and high pressure core spray (HPCS) diesel generators.

9.5.5.1 Design Bases

The DGCWS is designed in accordance with the following criteria:

1. The DGCWS is capable of removing sufficient heat to allow continuous operation of the diesel engine at maximum load.

2. The DGCWS has the capability of providing heat to the engine to maintain it in a standby condition.

3. The cooling water system for each diesel generator is of Seismic Category I design and is housed within a separate tornado-missile-proof, flood-protected, Seismic Category I structure.

4. The DGCWS is designed to prevent long-term corrosion that may degrade system performance.

5. The DGCWS is designed so that a single failure of any active or passive component on one diesel generator, assuming a loss of offsite power, cannot result in the loss of more than one diesel generator train.

6. The DGCWS has sufficient physical separation to protect the system from internally generated missiles and from pipe whip.

7. The HPCS diesel engine cooling water system piping and components up to the diesel engine interface are designed to seismic Category I, ASME Section III, Class 3 requirements. The engine-mounted piping and components, from the engine block to the engine interface, are considered part of the engine assembly. This piping and associated components,such as valves, fabricated headers, and fabricated special fittings, are designed, manufactured, and inspected in accordance with the guidelines and requirements of ANSI Standard B31.1, Code for Pressure Piping; ANS N45.2, Quality Assurance Program Requirements for Nuclear Facilities; and 10CFR50 Appendix B.

   The engine-mounted cooling water piping and associated components are intentionally over designed (subject to low working stresses) for the application, thereby resulting in high operational reliability. The design of the engine-mounted cooling water piping and components to the cited design philosophy and standards is considered equivalent to a system designed to ASME Section III, Class 3 requirements with regard to system functional operability and inservice reliability.

8. The DGCWS heat exchanger is designed in accordance with ASME Section III, Class 3.

9. The DGCWS will be evaluated for the consequences of moderate energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room, are the air start piping and components, and the standby service water piping and components. There are no high energy lines which could affect the system.

9.5.5.2 System Description

The standby DGCWS is shown in Fig. 9.5-2c and the HPCS DGCWS is shown in Fig. 9.5-2d and 9.5-3c.

Each DGCWS consists of the following components and the associated piping, valves, and controls.

1. One shaft-driven jacket cooling water circulation pump for the standby diesel generator and two engine driven centrifugal water pumps for the HPCS generator.

2. One water temperature regulating valve, which maintains the engine jacket cooling water at a uniform temperature and includes a method of bypassing the heat exchanger for fast engine warmup.

3. One water expansion tank (approximate capacity of 84 gallons) for the HPCS DGCWS and one jacket water standpipe (approximate capacity of 225 gallons) for the standby DGCWS.

4. One electric immersion heater, thermostatically controlled to maintain the engine jacket cooling water during periods when the diesel is not running at a temperature which allows easy starting.

5. One ac motor-driven water circulation pump, for moving the water through the jacket cooling water system when the engine is not running for the standby diesel generator only.

6. One heat exchanger suitable for maintaining the engine jacket cooling water at the desired temperature. It is of the shell and tube type with the jacket water flowing through the shell and the plant standby service water flowing through the tubes.

Component data for the standby DGCWS is shown in Table 9.5-6. The standby DGCWS is a completely self-contained loop with a vertical standpipe located as shown in Figure 9.5-14. The standpipe is not a pressure vessel; it is an atmospheric vessel vented to atmosphere. The standpipe provides the flooded suction for the jacket water pumps, acts as a system vent point for deaeration of the jacket water, provides the point for jacket water system heating and control, and is the system fill and drain point.

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The standby DGCWS provides a total cooling water capacity of 725 gallons which is adequate to maintain the required pump NPSH. Water leakage from the system is not expected, and thus no makeup needs are anticipated for 7 days of continuous operation at full rated load. Any loss of water is noticed through routine checks of the standpipe liquid level gauge. Jacket water low level is alarmed in the standby diesel generator control room, and activates a common trouble alarm in the main control room to alert the operator of abnormal conditions. Makeup water, if needed, is provided from the makeup water system (Section 9.2.3 and Figure 9.2-3).

8←•

The HPCS DGCWS is a completely self-contained closed loop, with an expansion tank. The DGCWS can be vented to ensure that the entire system is filled with water. Surfaces of vent lines in contact with water will resist corrosion because the water used is demineralized and treated. Each time the engine is run all parts of the cooling system are wetted with an inhibitor that provides a protective coating inside the pipes. Running the engine once a month will provide adequate corrosion protection, and no decrease in cooling system life is anticipated. This design precludes piping exposure to air and its associated corrosion.

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The HPCS cooling water system provides a total cooling water capacity of approximately 318 gallons which is adequate to maintain the required pump NPSH. The system does not require makeup water unless it is lost through seepage, leakage, or the pressure relief cap. Any loss of water is noticed through routine checks of the expansion tank sight glass and during shutdown of the diesel generator is manually replaced when necessary through the filler opening at the top of the expansion tank. No makeup needs are anticipated for seven days continuous operation of the HPCS diesel engine at full rated load. In the event that continuous operation exceeds 7 days and cooling water is needed, the makeup water may be added by a pressurized source connecting to the cooling water drain connection. Makeup cooling water is added slowly to the cooling water system to avoid thermal shock.
14←•
The HPCS diesel generator cooling water system has a built-in provision to assure all components and piping are completely filled with water by having two system high point vents, one coming off the manifold, and the other coming off the water side of the lube oil cooler. These high point vents are attached directly to the cooling water expansion tank to maintain the closed system. In addition, there is a low positive pressure in the system from the engine driven water circulating pump, which helps drive out any entrapped air in the system. Thus, the air is purged from the system piping once the engine is running and attains rated speed. The venting of air from the cooling water system does not delay the starting of the diesel generator.

Upon a cold start, if any air is pushed out of the manifold, before it can be vented to the expansion tank, it travels to the top of the lube oil cooler where a second line vents to the expansion tank. The design of the cooler and its mounting configuration results in the air bubble being unable to travel to the discharge of the cooler and ultimately to the cooling water pumps.

In the unlikely event that the crossover manifold develops an air pocket prior to a hot restart, and the water thermostat is now open, any air not vented from the manifold travels through the cooling water heat exchanger before entering the lube oil heat exchanger. Air entrapment in the cooling water heat exchanger is not possible due to its design and mounting configuration. Baffles, which support the tubes, are not attached to the shell side of the exchanger, but are part of the tube bundle. The exchanger is horizontal, with the water intake and discharge on opposite ends. Once the bubble clears the exchanger it travels directly to the lube oil heat exchanger, whose venting is described above.

Component data for the HPCS DGCWS is as follows:

Lube Oil Heat Exchanger

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Flow rate:	1100 GPM
Inlet temp.:	166 °F
Outlet temp.:	170 °F
Heat transfer rate:	2,085,000 Btu/hr
Design margin:	Rise in A 15°F rise in jacket water temperature can occur with no impact on diesel operation.

Engine Water Jacket and Turbocharger After-Coolers

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(The cooling water is circulated in parallel paths for these two components.)

Flow rate:	1100 GPM
Inlet temp.:	170 °F
Outlet temp.:	180 °F
Heat transfer rate:	5,475,000 Btu/hr
Design margin:	The after-coolers are sized to meet the required heat removal rate up to the point where the aftercooler ΔP increases by 10 in of water as the heat exchanger becomes dirty.

The total heat rejection to cooling water system is 35 Btu/min per HP or 7,560,000 Btu/hr for 3600 base HP. The cooling water heat exchanger is rated for 8,580,000 Btu/hr including 1.10 safety factor and 0.002 fouling factor. This ensures a sufficient margin of heat transfer capacity.

The DGCWS provides cooling water to the diesel engine, lube oil heat exchanger, and turbocharger aftercoolers, and rejects heat to the standby service water system. The plant standby service water (Section 9.2.7) interfaces with the DGCWS only at the cooling water heat exchanger. When the diesel engines are in the standby condition, the cooling water is maintained at a constant temperature by circulating through a separate electric immersion heater. This keepwarm feature provides the engine with the capability of quick start and load acceptance after a shutdown. The immersion heater is thermostatically controlled and operates in conjunction with a temperature regulating valve. Forced circulation of the cooling water during standby conditions is used for the standby diesel generators and natural circulation of the cooling water is used for the HPCS diesel.

The diesel generator cooling water is treated as appropriate to preclude long-term corrosion and organic fouling.

The power source for the electric jacket water heater is the 480-V, 60 hz, 3 phase accessory power bus. The heater is a resistance coil immersion type heater rated at 15 kw. The jacket water heater element is installed near a low point in the diesel generator jacket water supply, and by natural convection circulation the hot water from the heater, by being less dense, rises causing a natural flow. This flow causes a thermosiphon effect drawing cooling water over the heater, which is set to turn on at 125°F and shut off at 155°F. The heat conduction from the water channels and the engine will keep the lube oil cooler. The lube oil is circulated through the engine by ac motor drive circulating oil pump or by a backup dc motor driven soak back pump.

The standby diesel generators have a lubricating oil sump heater in addition to the jacket water heater to maintain the standby diesel in a warm condition during the standby mode. In the unlikely event that the engine jacket water heater fails and the temperature falls below a preset condition, a low temperature alarm in the diesel generator control room and a trouble alarm in the main control room alert the operator to the condition. The diesel engine at this time can be run in its standby mode until jacket water heating is reestablished.

9.5.5.3 Safety Evaluation

Each DGCWS is designed to meet Seismic Category I requirements and is housed inside a Seismic Category I structure. The DGCWS is designed so that failure of any one component on one diesel generator results in the loss of cooling water supply to only one diesel generator. There are no interconnections between the DGCWS of any diesel generators. The loss of one diesel generator and its associated load group does not prevent safe shutdown of the unit (Section 8.3.1.2.1).

9.5.5.4 Inspections and Testing Requirements

The DGCWS is designed to permit periodic testing and inspection of all components.

The DGCWS operability, including its associated instrumentation and controls, is demonstrated during the regularly scheduled tests of the diesel generators. The DGCWS is hydrostatically tested prior to startup. The cooling water is sampled and analyzed monthly to verify that its quality meets the diesel manufacturer's recommendations.

The testing of the DGCWS simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc) and environments (temperature, humidity, etc) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DGCWS components, instrumentation, controls and alarms are in accordance with Regulatory Guide 1.108, Revision 1 and engine manufacturer recommendations.

The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

The water chemistry program involves maintaining proper alkalinity levels using a corrosion inhibitor such as sodium molybdate, ensuring proper chloride levels and adding EPA approved biocides should the need arise. These measures significantly reduce long-term corrosion and problems related to organic fouling.

9.5.5.5 Instrumentation Requirements

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Control and protection logic for the DGCWS is shown in Fig. 7.3-23, sheets 18 through 30 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

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Control panels located in each diesel generator control room accommodate instruments and controls for operation of the diesel generator cooling water system. Alarms are provided on the control panels for any abnormal diesel generator cooling water system temperature, pressure, level, or equipment malfunction. Diesel generator protective functions are further discussed in Section 8.3.1.1.4. A trouble alarm is provided in the main control room for each diesel generator. Indicators are provided in the diesel generator control rooms for the following:

1. Temperature of the standby service water to and from the engine jacket cooling water heat exchangers.

2. Temperature of cooling water to and from lube oil heat exchangers.

3. Intercooler inlet and outlet temperature.

4. Cooling water expansion tank level.

The standby diesel generator cooling water systems include jacket water low pressure and high temperature engine trips. In normal and test operating modes, a low pressure or a high temperature condition shuts down the diesel generator. These trip signals are automatically bypassed during emergency operation. EGS-EG1A and EGS-EG1B have been modified to bypass the high temperature trip signals only under LOCA conditions or by a manual bypass switch.

The HPCS diesel generator cooling water system includes two locally mounted temperature switches in the engine outlet line. The first switch is used to alarm on the local control panel in the event of high coolant temperature and also provides an input to a common trouble alarm in the main control room. The second switch is used to automatically shut down the engine in the event of high-high coolant temperature. This trip is automatically bypassed on a LOCA signal.

DGCWS indications and alarms are provided to alert the operator to the possible need for system maintenance. There are no indications or alarms of abnormal DGCWS operating conditions for which the operator must take action. Section 8.3.1.1.4 discusses the conditions which automatically trip the diesel generators.

The diesel generator engine jacket cooling water temperature is maintained at a minimum temperature when the engine is not running by a thermostatically controlled immersion heater. When the engine is running, the temperature of the cooling water is controlled at its set point by modulating a self-contained, thermostatically controlled valve in the cooling water line.

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Engine jacket cooling water leakage will result in low water level in the cooling water expansion tank. This can be observed by a remote liquid level gauge mounted adjacent to the expansion tank. This level will be routinely checked and noted for any abnormalities. Furthermore, each of these will activate a common "Diesel Engine Trouble" alarm in the main control room, under alarm conditions:

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1. Loss of cooling water due to any leakage will be reflected as "Low Expansion Tank Water Level" alarm (standby or operating mode).

2. During operation mode, the cooling water leakage will result in a drop of water pressure and activate a "Low Cooling Water Pressure" alarm.

3. During the operating mode, persistent leakage will also cause a rise in the cooling temperature and a "High Water Temperature" alarm will annunciate at local panel. These will alert the operator to the system trouble and operating procedures will be followed to take corrective action.

4. Lube oil leakage into the cooling water system will result in a drop of pressure and will be alarmed as a "Low Lube Oil Pressure" alarm at the local panel.

9.5.6 Diesel Generator Starting System (DGSS)

The DGSS for the standby diesel generators and the High Pressure Core Spray (HPCS) diesel generator is shown in Fig. 9.5-2b and 9.5-2d.

9.5.6.1 Design Bases

The DGSS is designed in accordance with the following criteria:

1. Each emergency diesel generator is provided with a separate and independent compressed-air starting system.

2. The components of the DGSS essential to the starting of a diesel engine are designed to Safety Class 3, and Seismic Category I requirements. The components of the DGSS are housed within the diesel generator building which is a Seismic Category I structure capable of protecting the system from extreme natural phenomena, such as earthquakes, tornadoes, hurricanes, and floods.

3. The DGSS is designed so that a single failure of any active or passive component, assuming a loss of offsite power, cannot result in the loss of more than one diesel generator starting system train.

4. Piping which forms integral part of the diesel engine is designed in accordance with ANSI Piping Code B31.1. The air receivers associated with the DGSS are designed and constructed in accordance with the requirements of ASME Code, Section III, Class 3.

5. Each redundant DGSS train is capable of providing the standby diesel generator with eight starts (five of them are 10 sec starts) from two air receivers without recharging the associated air receivers.

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6. The HPCS diesel generator air start subsystem has sufficient capacity to accelerate the diesel generator from standby conditions to operating speed within 10 seconds five times without recharging. Either the forward or rear air start subsystem has the capacity to satisfy these multiple start requirements when initially charged to 200 psig.

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7. The DGSS will be evaluated for the consequences of moderate energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room are the

air start piping and components, and the standby service water piping and components. There are no high energy lines which could affect the system.

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9.5.6.2 System Description

9.5.6.2.1 Standby Diesel Generators

Each DGSS for each standby diesel generator consists of the following major components and associated piping, valves, and controls:

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1. Two starting air compressors

2. Two starting air aftercoolers

3. Two starting air membrane air dryers with filters (nonsafety-related)

4. Four air receivers, 76 cu ft each.

A starting system, consisting of two redundant trains, is provided for each diesel engine.

The major system components are located external to the diesel generator skid in the diesel generator building.

Each standby diesel generator is provided with two separate 250 psig air-cooled, motor-driven compressors. Each compressor is designed to recharge an air receiver from a minimum starting pressure of 210 psig to a maximum starting pressure of 250 psig. Each compressor discharges to two starting air receivers which are connected in parallel. The air compressor is provided with 1E power.

An air-to-air type aftercooler is provided integral with the air starting compressors to cool the compressed air prior to entering the air dryer. The compressed air passes on the tube side of the cooler, and cooling air is fan-blown over the finned tubes.

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The compressed air is dried using a membrane type dryer. Two prefilters upstream of the membrane dryer remove particles down to 0.01 micron, including water and oil aerosols from the compressed air. The membrane type compressed air dryers are capable of producing a constant dew point of -10°F at 200 psig.
•→9 9←• 12←•
The on-engine portion of the air starting system includes a header, two solenoid control valves, two gear-driven distributors, and a pilot-operated air starting valve for each cylinder. During engine starts, starting air is admitted to the header when the solenoid valves are opened. There is a solenoid valve at either end of the header, each provided with a check valve on the header side to prevent pressure loss should either supply be low or inoperative. Pressure in the air starting header is supplied to the air starting valves in each cylinder, and to each of the two air starting distributors. Dual air starting distributors are mounted on the camshaft so that if, for any reason, one distributor fails to properly energize the air starting inlet valves to the cylinders, the other distributor properly activates them. Shuttle valves mounted at each cylinder head air start valve assure the proper operation of the air start valve from either distributor. The pressure in the distributors causes spool valves to engage and follow the profile of the air starting cams on the ends of the camshaft. The cam profiles are

so designed that at least one spool valve is always in position to emit a pilot signal to the proper cylinder, causing that cylinder's air starting valve to admit 250 psig air into the combustion chamber, forcing the piston down to rotate the crankshaft. As the engine rotates, timed and sequenced pilot air signals are emitted, starting 5 deg before top dead center and ending at 115 deg after top dead center. When the starting signal is cut off, the spool valves lift off the cam.

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In addition to supplying dry air for starting of the engines, the standby diesel generator DGSS also provides control air for the pneumatic logic system. Control air is required for stopping of the standby diesel generators and other non-essential control functions. The air receivers in conjunction with the starting air compressors, aftercoolers, air dryers and filters provide the short term and long term air supply for the control logic system. The supply for the control air comes from the starting air header on the engine which is connected to the air receivers. Two sources of air are provided, one from the forward air start subsystem upstream of the forward solenoid and one from the rear air start subsystem upstream of the rear starting solenoid. These two lines are routed individually to the engine control panel. Each control air supply has its own filter and pressure regulator. The air pressure is reduced from the nominal 250 psig at which the air receivers are maintained, to a nominal 60 psig. Each control air supply has a check valve which maintains the independence of the two starting air subsystems. Downstream of the check valves the two control air supplies join together to form a common supply to the pneumatic logic. Either source can supply the control air to operate the pneumatic logic system. Low pressure control air activates an alarm in the diesel generator control room. This condition also activates a standby diesel generator trouble alarm in the main control room. A control air pressure indicator is provided in the diesel generator control room.

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9.5.6.2.2 HPCS Diesel Generator

The DGSS for the HPCS diesel generator consists of the following major components and the associated piping, valves, and controls:

1. Two starting air compressors (nonsafety-related)

2. Two starting air dryers (nonsafety-related)

3. Two starting air receivers (64 cu ft each)

4. Two starting air motors.

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There are two independent air starting systems. The air supply system contains one receiver in each redundant system. Each system has one air compressor for charging air into the air receivers.

Each electric motor-driven air compressor is provided with non 1E power. Each compressor is automatically started when the air pressure in its associated receiver drops below 216 psig and shuts off when the air pressure reaches 240 psig.

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Additional discussion of instrumentation requirements for the air compressors is provided in Section 9.5.6.5. The air receivers are equipped with safety/relief valves which operate at 250 psig. Both air compressors are provided with intake air filters.

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Each air starting system has two rotary vane air motors. On receipt of the engine start signal, a normally closed solenoid valve opens and air flows to the piston for the pinion gear of the lower motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper motor pinion gear piston which, in turn, engages its pinion gear with the engine ring gear. Full engagement of the upper pinion gear permits air flow to the air valve which, in turn, opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil/air mist into the starting motors. The motors drive the pinion gears, rotating the ring gear and cranking the engine. The engine can be started with one bank of dual air starting motors. However, to ensure positive starting, both solenoids are energized simultaneously and both banks of dual starting motors crank the engine.

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The compressed air is dried using a membrane type dryer. The dryer's maximum operating pressure is 300 psig. Two prefilters upstream of the membrane dryer remove particles down to 0.01 micron, including water and oil aerosols from the compressed air. The membrane type compressed air dryers are capable of producing a constant pressure dew point of -10°F. The dryers have a capacity of 15.6 scfm when drying air at 200 psig with 22.4 scfm 150°F saturated inlet air at 110°F ambient temperature to obtain a -10°F dew point.
8←•

9.5.6.3 Safety Evaluation

Each DGSS is capable of supplying a sufficient quantity of air from its associated air receivers to ensure a successful starting operation of the diesel generator independent of normal plant power sources.

The air starting systems for each diesel generator unit are physically and electrically separated to ensure that no single failure can cause malfunction of two divisions of standby ac power. The starting air manifold is energized by a dc solenoid. The single-failure criterion is enhanced by having a dual-train air starting system for each diesel generator. The consequences of failure of active components of the DGSS of the standby diesel generators are presented in the Failure Modes and Effects Analysis Report.

The electronic and electrical components of the DGSS are mounted in control panels and cabinets located in the diesel generator control room. The diesel generator control room is a separate room within the diesel generator building (see Figure 8.3-11). Diesel generator starting air solenoids are locally mounted on the diesel engine and are designed for nuclear safety-related application. The only sources of water spray that could affect DGSS components are:

1. Fire protection system - This is a dry pipe system that is activated only in the event of a fire.

2. Standby service water system - The consequences of water spray from postulated cracks in the moderate energy standby service water piping installed in the diesel generator building are evaluated in accordance with the guidelines given in Section 3.6 to assure that the ability of the DGSS to perform its safety function is not impaired. Detailed results are provided in Section 3C.3.5.4.

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During normal plant operation, compressed air for each diesel is stored in an individual starting system. The starting system for each diesel is comprised of redundant starting trains. The system for the standby diesel generator stores sufficient air in each redundant train to start the engine eight times without operation of the compressors. For the HPCS diesel generator, the starting air system is sized to have the capacity for at least five successive start attempts without recharging its air start receiver(s). Either the forward or rear air start subsystem has the capacity to satisfy these multiple start requirements when initially charged to 200 psig.
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The starting air receivers (storage tanks) are provided with drains which are opened periodically to remove any moisture or oil carryover which may have accumulated from the starting air compressors. This minimizes the formation of rust within the system. In addition, the system piping for the standby diesel generator is provided with an air strainer installed before the air starting solenoid valve.

The system piping is installed at an elevation lower than the engine inlet, and is provided with a drip leg to provide for removal of any water which may be present in the lines. The HPCS diesel generator air starting piping system is provided with a strainer before the air starting solenoid valve which removes particulates and allows for periodic draining of water present in the lines.
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14←• •→10
The performance of the DGSS filters and strainers for the standby diesel generators is monitored by diesel generator testing per the Technical Specifications and periodic maintenance activities.
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In the standby diesel generator air start system, air entering the system passes through a moisture separator, provided at the compressor outlet, and then through a particulate filter which removes particles down to one micron and coalesced liquid water and oil. The air is then passed through a coalescing filter which removes particles down to 0.01 micron and water and oil aerosols. The air is then dried using a membrane type air dryer.
12←• •→8
In the HPCS diesel generator air start system, air entering the system passes through a coalescing filter, provided at the compressor outlet, which removes particles down to one micron and coalesced liquid water and oil. The air is then passed through a high efficiency oil removal filter which removes particles down to 0.01 micron and water and oil aerosols. The air is then dried
8←•

using a membrane type air dryer. Provision is made also for system internal contaminants, e.g., metal flaking, by use of a strainer in the air line to the starters. The air strainer is located on the engine at the inlet point. A pressure switch isprovided at the entrance of the air motor downstream of the strainer.

9.5.6.4 Testing and Inspection Requirements

The system is operated and tested initially with regard to flow path, flow capacity, and mechanical operability in accordance with requirements given in Chapter 14. To ensure continued integrity of the DGSS, scheduled inspection and testing of equipment, including associated instruments and controls, are performed as part of the overall engine performance checks at regular intervals. Filters and strainers are checked for cleanliness during routine testing and inspection.

Testing of the DGSS simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

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Periodic surveillance testing and inservice inspection programs for the DGSS components, instrumentation, controls, and alarms are in accordance with Regulatory Guide 1.108, Revision 1, and engine manufacturer recommendations. All diesel generator functional failures are analyzed in accordance with 10CFR50.65 and Technical Specifications. The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

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There are no periodic inspections or maintenance for the standby or HPCS diesel generator starting air membrane type air dryers because there are no active components in the dryer. Replacement of the upstream filters on a periodic basis and proper maintenance of the air compressors will ensure that the membrane air dryers will function as designed. In addition, the air receiver will be checked on a weekly basis for the presence of moisture.

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9.5.6.5 Instrumentation Requirements

Control and protection logic for the DGSS is shown in Figs. 7.3-16 and 7.3-23, sheets 17 through 28 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

Control switches are provided in the standby diesel generator control room for either automatic or manual operation of the standby diesel generator air starting compressors.

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Control switches are provided locally in the HPCS diesel generator room for either automatic or manual operation of the HPCS diesel generator air starting compressors.

8←• 8A←•

In the automatic mode, the standby diesel generator compressors start whenever the air receiver pressure reaches the low set point, and stop when the pressure returns to normal. A low air receiver pressure activates an alarm in the diesel generator control room. This condition also activates a standby diesel generator trouble alarm in the main control room. Air starting pressure indicators are provided in the diesel generator control room. Diesel generator protective functions are further discussed in Section 8.3.1.1.4.

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For the HPCS diesel generator compressor, there are two locally mounted pressure switches. The other pressure switch provides a low pressure alarm on the local control panel, and also provides an input to the "common trouble alarm" in the main control room. If this alarm annunciates and the compressors have not automatically started at the required pressure, they are manually started locally.

8←•

DGSS indications and alarms are provided to alert the operator to the possible need for system maintenance. There are no indications or alarms of abnormal DGSS operating conditions for which the operator must take action. Section 8.3.1.1.4 discusses the conditions that automatically trip the diesel generators.

Control switches are provided in the main and diesel generator control rooms for control of the diesel generator air starting solenoid valves. In the operational mode, the appropriate solenoid valve is energized to open:

Standby Diesel Generator

1. For 5 sec or until the diesel generator reaches rated speed when a normal start signal exists.

•→6

2. Continuously or until the diesel generator reaches rated speed when an emergency start signal exists (i.e., manual initiation, a LOCA signal, or sustained bus undervoltage). Should the diesel engine fail to start immediately, the engine continues cranking until the pressure in the air receivers falls to 120 psig. At this pressure, the air starting solenoid valves close to conserve starting air such that a subsequent manual start of the diesel engine may be attempted.

6←•

HPCS Diesel Generator

1. For 20 sec or until the diesel generator reaches 150 rpm or engine oil pressure reaches 21 psi when a normal start signal exists.

2. Continuously or until the diesel generator reaches rated speed when an emergency start signal exists (i.e., manual initiation, a LOCA signal, or sustained bus undervoltage). The engine continues cranking until compressed air is exhausted to the pressure unable to sustain cranking.

In the maintenance mode, the solenoid valve may be momentarily energized to open by means of the diesel generator "roll" pushbutton located in the diesel generator control room.

9.5.7 Diesel Engine Lubrication System (DELS)

The three emergency diesel generators, one high pressure core spray system (HPCS) and two standby, each have a DELS which provides essential lubrication to the components of their respective engines. The standby DELS system is shown in Fig. 9.5-2c, and the HPCS DELS is shown in Fig. 9.5-2d.

9.5.7.1 Design Bases

The DELS systems are designed in accordance with the following criteria:

1. Each DELS is designed to provide lubricating (lube) oil to the diesel engine during diesel generator operation.

2. The DELS is designed to maintain the temperature of the lube oil and to prelubricate the required components while in the standby status to eliminate dry start and enhance the engine's starting ability.

3. Each DELS is of Safety Class 3, Seismic Category I design and is housed within a separate Seismic Category I structure capable of protecting the system from extreme natural phenomena, missiles, and the effects of pipe whip.

4. Each diesel is provided with an independent DELS designed so that a single active or passive failure of any component within a DELS cannot result in the loss of function of more than one diesel generator train.

5. The HPCS diesel engine lubrication oil system piping and components up to the diesel engine interface are designed to Seismic Category I, ASME Section III, Class 3 requirements. The engine-mounted piping and components, from the engine block to the engine interface, are considered part of the engine assembly and are qualified to Seismic Category I requirements as part of the diesel engine package.

   This piping and associated components, such as valves, fabricated headers, and fabricated special fittings, are designed, manufactured, and inspected in accordance with the guidelines and requirements of ANSI Standard B31.1, Code for Pressure Piping; ANSI N45.2, Quality Assurance Program Requirements for Nuclear Facilities; and 10CFR50 Appendix B. The engine-mounted lubricating oil piping and associated components are intentionally over designed (subject to low working stresses) for the application and thereby have high operational reliability.

   The design of the engine-mounted lubricating oil piping and components to the cited design philosophy and standard is equivalent to a system designed to ASME Section III, Class 3 requirements with regard to system functional operability and inservice reliability.

6. The DELS will be evaluated for the consequences of moderate energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room are the air start piping and components and the standby service water piping and components. There are no high energy lines that could affect the system.

9.5.7.2 System Description

Each of three diesel generators (two standby and one HPCS) has its own lubrication system. Each DELS consists of the following major components and the associated piping, valves, and controls:

1. One engine-driven lube oil pump.

2. One motor-driven lube oil before-and-after pump (standby diesel generator).

3. One lube oil sump tank (standby diesel generators 1A and 1B).

4. One lube oil sump pan (HPCS diesel generator).

5. One lube oil cooler

6. Two lube oil strainers.

7. Two lube oil full-flow duplex filters.

8. One lube oil immersion heater (standby diesel generators only).

9. One ac and one dc (standby) motor-driven turbo-charger soakback pump (HPCS diesel generator only).

10. One ac and one dc (standby) motor-driven circulating pump (HPCS diesel generator only).

The lube oil sump for the HPCS diesel is integral with the engine, and lube oil is warmed through the main lube oil heat exchanger during standby.

Table 9.5-3 contains the applicable data for the above components. The codes and standards applicable to the DELS are listed in Table 3.2-1.

Each standby diesel engine is provided with two lube oil pumps.

•→8

The primary lube oil pump is engine-driven, and the lube oil before-and-after pump is driven by an electric motor. The engine-driven pump draws oil from the sump through a strainer and discharges it through the lube oil cooler directly to the filter. Filtered oil is then passed through a strainer to the engine lube oil header. Oil returns to the sump tank by gravity flow. An integral safety valve on the pump prevents excess discharge pressure, and a pressure-regulating valve controls the pressure in the engine lube oil header. The motor-driven pump provides a means for prelubrication of the diesel engine before starting and to aid in cooling the diesel engine after it has stopped. A keep-warm circuit is provided to maintain the lubrication oil charge, and thereby the diesel engine, in a warm and lubricated condition when in standby status. Immersion heaters at the sump tank heat the oil, which is then pumped by the keep-warm pump to the keep-warm filter and strainer and then

8←•

•→8
to the main diesel engine lubricating oil header. The turbocharger bearings are lubricated by the engine lubricating oil system during normal engine operation. When the engine is in standby status, however, oil is not circulated to the turbocharger. To prevent failure of the bearings during a start, a drip lubrication system is provided. Lubricating oil from the "keep warm" supply is passed through an adjustable needle valve to a sight glass. The sight glass, one for each turbocharger, provides a means for positive determination of oil flow to the bearings, and the needle valve allows the flow to be adjusted. This flow is sufficient to provide for proper lubrication of the bearings without flooding the turbocharger.

For planned test starts, a manual turbocharger prelube is provided to minimize wear on the turbo bearings. The manual shutoff valve is opened for a short time immediately before starting and when stopping the engine, but is left closed when the engine is up to speed and under load. It is also left closed in standby condition, with the drip system providing lubrication.

8←•
The HPCS diesel engine has a main lube oil pump, lube oil piston cooling pump, scavenging pump, soak back pump, and circulation pump. The main lube oil pump provides oil to the engine bearings, gears and turbocharger, and is in a common casing with the piston cooling pump. All of the pumps, except the soak back and circulation pumps, are driven by diesel engines.

The HPCS lube oil system piping and connections have been modified to implement the diesel manufacturer's recommendation MI-9644, which is consistent with LRG-II, Item 1-PSB. Lube oil flows to the preheat system and to the turbocharger will be separated. The ac motor-driven circulating pump provides 6-gpm flow to the preheat system, and the VDC motor-driven soakback pump provides 3-gpm flow to the turbocharger. Both of these pumps have the capability to operate continuously. Vent lines with orifices have been added to the lube oil filter and lube oil cooler to bleed off any entrapped air and the vents are connected to the engine camshaft housing to discharge any oil flows back to the engine. A vent has also been added to the lube oil cooler discharge pipe to prevent a siphon effect that would draw oil out of the cooler into the engine strainer box. Two new sight glasses have been added for visual monitoring of the oil level during standby.

In addition, the cooler discharge pipe has been changed to form an inverted U connection to the oil strainer tank. An additional piping connection has been made from the bottom of the cooler to the pressure pump discharge line through a check valve and then to the gallery. This will flood the main oil gallery that supplies oil to the main bearing, the accessory drive, the turbo, and the top deck. This will minimize the time for oil to reach these components during a fast start, as well as maintain lubrication of the main bearings. Details of the HPCS DELS are shown on Fig. 9.5-15.

The lube oil circulating and soakback system is furnished with two continuously running ac motor-driven pumps. These pumps circulate the lube oil to lubricate and maintain oil pressure on the accessory rack (filter/coolers), engine moving parts, and turbocharger bearings in the engine standby and operating modes. A backup dc motor-driven pump is provided in parallel with each ac pump to accomplish the prelubrication function in the event of ac power loss.

One of the two ac pumps is a turbocharger lube oil pump which continuously circulates 3 gpm preheated lube oil from the engine sump to the turbocharger. This oil flow lubricates the turbocharger bearings during engine standby, supplements oil pressure during engine fast start, and removes excessive heat from the bearings after the engine is shut down. This continuous lubrication eliminates the dry start and enhances the first-try starting reliability.

The other ac pump is a circulating oil pump which continuously circulates 6 gpm preheated oil from the engine sump through an inline strainer, a 30-psi relief check valve, the lube oil filter, and the lube oil cooler to the engine oil gallery. This oil flow lubricates the crankshaft bearings and also keeps engine oil passages full during engine standby.

The ac circulating oil pump is driven by a 1-hp, 480-V ac, 3-phase motor. The ac turbocharger lube oil pump is driven by a 3/4-hp, 480-V ac, 3-phase motor. Both of the backup dc pumps are driven by 3/4-hp, 125-V dc motors. The operation of both pumps is monitored by an alarm switch.

A thermostatically controlled electric immersion heater (Section 9.5.5) maintains the lube oil near normal operating temperature by warming the engine jacket water. The jacket water is circulated through the lube oil cooler to warm up the lube oil. The electric heater is energized during engine standby whenever the jacket water temperatures falls to 125°F and turns off whenever water temperature reaches 155°F. This will maintain the lube oil temperature at approximately 100°F -5°F. The minimum required standby temperature for the lube oil is 85°F, above which the engine is capable of fast start without degradation. This heated lube oil is circulated through the engine during standby to keep the moving parts warm to enhance the first-try starting reliability.

A 30-psi relief valve prevents oil backflow during engine operation if the circulating oil pump is not running. A lube oil filter and lube oil cooler are each provided with a vent to remove trapped air which may impede the oil flow. A lube oil cooler discharge line also is provided with a vent to prevent siphoning effects that would draw oil out of the cooler into the strainer. The vents are connected to the engine camshaft housing to discharge oil flow back into the engine. The lube oil flow path is designed to keep the engine lower gallery flooded by gravity during the standby condition, thus minimizing the time required for oil pressure buildup at the turbocharger bearings and upper deck during fast start.

The DELS is provided with various filters and strainers to maintain the required quality of the lube oil during engine operation. The filters are changed and the strainers are cleaned periodically to assure an adequate supply of clean oil to the engine. Crankcase pressure relief devices are provided for venting each diesel engine and to prevent overpressurization of the crankcase. The lube oil sump tank for the standby diesel generator contains enough oil for 7 days operation at the rated load, without adding makeup lube oil. The HPCS diesel sump pan also contains enough oil for 7 days of operation without adding makeup lube oil. Makeup lube oil is added to the engine lube oil sump tank or pan as required and in accordance with the manufacturer's recommendations.

The standby diesel generator DELS is provided with relief valves as shown on Figure 9.5-2c. The functions of these valves are as follows:

1. Before and after pump relief valve - Acts to protect the before and after system from over pressurization. This valve is downstream of, and external to, the motor-driven before and after pump. Relief is to the sump tank.

•→12

2. Pressure control valve - Acts to control and regulate engine lube oil header pressure. Header pressure is the actual internal engine oil pressure. The valve has a sensing line connected to the engine lube oil inlet header and one port connected to the lube oil line on the discharge side of the engine-driven pump. The other port is the valve discharge to the lube oil sump tank.

12←•

3. Engine-driven pump relief valve - Acts in conjunction with the pressure control valve to relieve the system of excessive engine-driven pump overpressures. Relief is to the sump tank.

4. Roll-back relief valve - Protects the engine-driven pump and system from reverse rotation pumping when the engine shuts down. When the engine rolls to a stop it will seek a balance point, and for a second or two, because of the large rotating and reciprocating masses, will roll very slightly in both directions of rotation.

9.5.7.3 Safety Evaluation

Each DELS is designed to Seismic Category I requirements and for each diesel is housed inside a Seismic Category I structure. The DELS is designed so that a failure of one component does not result in the loss of lube oil supply to more than one diesel engine. There are no cross connections or common lines between the individual DELS.

The operating pressure, temperature differentials, flow rate, and heat removal rate of the system, external to the engine, are in accordance with the manufacturer's recommendations. The system has been provided with sufficient protective measures, such as chemical analysis of the lubrication oil, to maintain the required quality of the oil during diesel engine operation. Protective features such as spring-loaded relief ports have been provided to prevent damage to the crankcase in the event of a diesel crankcase explosion.

The lube oil is drawn from the sump tank through the heater and pumped up to the lube oil header. The recirculation maintains the diesel engine in a warm condition to keep the lube oil viscosity near the proper value for the operating diesel engine, and supply continuous lubrication to the main crankshaft. This enhances the quick starting reliability of the diesel engines from the standby status.

The effect of a loss of one diesel generator and its associated load group is discussed in Section 8.3.1.2. The failure of any component of one of the DELS does not preclude the safe shutdown of the plant following a LOCA and/or a loss of offsite power.

The entry of foreign matter into the DELS is prevented by providing administratively controlled access to the diesel generator building. Sufficient space has been provided to permit inspection of DELS components, as shown in Fig. 1.2-28.

9.5.7.4 Testing and Inspection Requirements

The DELS is designed to permit periodic testing and inspection of major components. The DELS operability, including its associated instrumentation and controls, is demonstrated during the regularly scheduled tests of the diesel generators. The DELS is tested prior to startup.

The lube oil is sampled and analyzed once every 3 months to verify that the quality of the oil is such that it can perform its function.

The testing of the DELS simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demand were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DELS components, instrumentation, controls and alarms are in accordance with Regulatory Guide 1.108, Revision 1 and engine manufacturer recommendations.

The system is designed such that testing can be accomplished on a diesel generator with the plant in normal operation or shutdown without impairing the reliability or redundancy of the remaining diesel generators.

9.5.7.5 Instrumentation Requirements

Control and protection logic for the DELS is shown in Figs. 7.3-17 and 7.3-23, sheets 17 through 28 (standby diesel generators), and in Fig. 8.3-12 (HPCS diesel generator).

Control switches are provided in each diesel generator control room for either automatic or manual operation of the diesel generator motor-driven lube oil circulating pumps and associated lube oil heaters.

In the automatic mode of operation, the following conditions exist:

1. Standby Diesel Generators

    a. Lube oil circulating pump starts whenever its associated diesel generator is not running.

    b. Lube oil heater is energized when the lube oil temperature drops below its set point, while the associated pump is running.

    c. Lube oil circulating pump stops whenever its associated diesel generator is running.

    d. Lube oil heater is deenergized when the lube oil temperature rises above its set point.

    Control logic is provided for deenergizing a lube oil heater when its lube oil circulating pump is not running.

2. HPCS Diesel Generator

   a. Lube oil circulating pump runs continuously.

   b. When the lube oil ac circulating pump or ac turbocharger soak back pump are not running, the associated dc (standby) pump operates.

   • →12

   c. Lube oil heating system jacket water (immersion heater, Section 9.5.5) is energized when the jacket water temperature drops below a set point and diesel generator in the standby mode.

Standby Diesel Generators

Alarms are provided in the standby diesel generator control rooms for abnormal conditions that occur in the standby DELS. A standby DELS trouble alarm in the main control room is also activated. Diesel generator protective functions are further discussed in Section 8.3.1.1.4.

The lube oil sump tank is provided with level switches for high and low level alarms in the diesel generator main control room and annunciation in the main control room as part of the DELS trouble alarm. The sump tank is also provided with an immersion heater and thermostat to maintain the lube oil temperature during the diesel engine standby mode.

A lube oil high temperature condition actuates an alarm in the diesel generator control room, as well as the trouble alarm in the main control room. The lube oil high temperature annunciators are not blocked, and operate during all modes of diesel generator operation.
12←•

When the diesel engine is running during non-emergency or test operation, a lube oil high temperature condition shuts down the engine. The lube oil high temperature signal is blocked during emergency operation. EGS-EG1A and EGS-EG1B have been modified to have the trip bypassed only by a LOCA signal or a manual bypass switch.

Pressure differential switches are provided across the filters and strainers to monitor and annunciate high lube oil differential pressure in the diesel generator control room, and operate the trouble alarm in the main control room. A differential pressure indicator is provided in the diesel generator control room to monitor the dual filter lube oil pressure.

Pressure switches are provided to monitor and annunciate low lube oil pressure at the supply header and at the turbo charger in the diesel generator control room, and operate the trouble alarm in the main control room. The lube oil pressure annunciators are not blocked and operate during all modes of diesel generator operation. In the non-emergency or test mode of operation, low lube oil pressure causes the engine to shut down. The lube oil low pressure trip signals are blocked during emergency operation.

Pressure indicators are provided in the diesel generator control room to monitor the lube oil supply header and turbo charger lube oil supply line pressures.

Standby DELS indications and alarms are provided to alert the operator to the possible need for system maintenance. There are no indications or alarms of abnormal standby DELS operating conditions for which the operator must take action. Section 8.3.1.1.4 discusses the conditions which automatically trip the diesel generators.

A self-actuating pressure control valve is provided between the engine-driven lube oil pump discharge and the lube oil supply header to maintain a constant lube oil pressure when the engine is running.

HPCS Diesel Generator

•→12

The engine lube oil system contains pressure switches which provide the following three features. The first switch is used as a crank lockout to prevent engine start when low lube oil pressure is present. The second switch is used to alarm low lube oil pressure on the local control panel and input to the common trouble alarm in the main control room. The third switch is used to shut down the engine in the event of low-low lube oil pressure. During a LOCA signal the third pressure switch is bypassed preventing a shutdown of the engine. The second pressure switch used for alarming, however, is not bypassed.

12←•

The HPCS diesel engine lube oil filter is equipped with a differential pressure switch relief valve with an alarm contact which is used for a restricted lube oil filter alarm on the local control panel and input to the common trouble alarm in the main control room.

Oil from the HPCS diesel engine oil cooler is monitored by two temperature switches. The first switch is used to alarm low lube oil temperature on the local control panel and input to the common trouble alarm in the main control room. The second switch is used to alarm high lube oil temperature on the local control panel and input to the common trouble alarm in the main control room.

A pressure switch mounted in the HPCS diesel engine sump is used for high crankcase pressure alarm on the local control panel and input to the common trouble alarm in the main control room.

9.5.8 Diesel Generator Combustion Air Intake and Exhaust System

The diesel generator combustion air intake and exhaust system (DGCAIES) supplies clean combustion air to each diesel engine and exhausts the products of combustion from the diesel engine to the atmosphere in a manner that does not affect the operational functions of the diesel engines when the diesel generator set is required to operate continuously at the maximum rated output.

9.5.8.1 Design Bases

The DGCAIES is designed in accordance with the following criteria:

1. Each diesel generator unit has an independent combustion air intake and exhaust system. A single active failure in an engine combustion air intake and exhaust system does not cause loss of function of more than one diesel generator.

2. Each combustion air intake is designed to reduce continuously contaminating substances such as dirt and larger airborne particulates over the entire time period that emergency power is required, assuming the maximum airborne particulate concentration at the combustion air intake.

3. The DGCAIES is of Seismic Category I design and is housed within a Seismic Category I structure capable of protecting the system from rain, snow, ice, sleet, and missiles. Individual component safety classifications are listed in Table 3.2-1. Piping for the diesel generator combustion air intake and exhaust system is Seismic Category I and is in accordance with ASME Boiler and Pressure Vessel Code, Section III.

4. Suitable design precautions are taken to preclude degradation of the diesel engine power output due to exhaust gases and other diluents that could reduce the oxygen content of intake air below the acceptable level.

5. Each DGCAIES is sized and physically arranged so that no degradation of engine function is experienced when the diesel generator set is required to operate continuously at the maximum rated output.

6. The DGCAIES will be evaluated for the consequences of moderate energy line breaks in accordance with the guidelines given in Section 3.6. The moderate energy lines installed in the diesel generator room are the air start piping and components, and the standby service water piping and components. There are no high energy lines which could affect the system.

9.5.8.2 System Description

The configuration of the DGCAIES is shown in Fig. 9.5-6 and 9.5-7, and its location within the diesel generator building is shown in Fig. 1.2-28. The DGCAIES consists of the following components and associated piping and expansion joints:

1. Intake air filter

2. Intake air silencer (standby diesel generators only)

3. Exhaust silencer.

An independent DGCAIES is provided for each diesel generator. The system components are sized and physically arranged so that no degradation of the operation of the engine occurs when the diesel generator is required to operate continuously at rated output. Table 9.5-4 contains the applicable data for the previously listed components.

•→16 •→14

Air is drawn into the diesel generator combustion air intake mounted in the wall. A protective screen is provided at the intake to prevent the entrance of foreign objects. Air is drawn from the outside atmosphere through a disposable filter and the turbocharger to the engine. Intake air is cooled in the aftercooler by the engine cooling water system in order to improve engine operational efficiency. The air intake capacity of each standby diesel engine associated with the standby diesel generators is 14,194 scfm. The air intake flow to the HPCS diesel engine is 10,200 scfm.

14←• 16←•

All components of the DGCAIES are located inside the diesel generator building, which provides protection from rain, ice, snow, and sleet. Exhaust gases are discharged through the turbocharger from the exhaust manifold and are expelled through ductwork (pipe) and an exhaust silencer to the exterior of the diesel generator building. Exhaust silencers are located in separate rooms. The exhaust gas flow from each standby diesel engine is 31,600 acfm at 850°F, and from the HPCS diesel engine is 23,800 acfm at 800°F.

The Division III diesel engine turbocharger has a single-stage turbine with connecting gear train. The connecting gear train is necessary for engine starting, light load operation, and rapid acceleration. Under these conditions, there is insufficient exhaust heat energy to drive the turbine fast enough to supply the necessary air for combustion. The engine drives the turbocharger through the gear train assisted by exhaust gas energy. When the engine approaches full load, the heat energy in the exhaust is sufficient to drive the turbocharger without assistance from the engine. At this point, an overrunning clutch in the drive train disengages, and the turbocharger drive is mechanically disconnected from the engine gear train.

The Division III diesel generator is equipped with a heavy-duty turbocharger which is designed to withstand the rigors of light-load operation. This turbocharger is capable of 3,000 cumulative hr of operation at full-speed, light-load operation before overhaul is required.

The Division III diesel generator is limited to running at rated speed at no load to prevent fouling of the fuel injector. Operation at this condition may last up to 4 hr for Division III. After this period, the diesel generator will be loaded according to the manufacturer's recommendation (for Division III, greater than 50-percent load for 30 min prior to shutting down the engine).

9.5.8.3 Safety Evaluation

The failure modes and effects analysis for the diesel generator combustion air intake and exhaust system is part of the analysis performed for the diesel generator start/protection systems. This analysis is included in the FMEA document.

Each DGCAIES is designed to Seismic Category I requirements and is housed inside a Seismic Category I structure (Fig. 1.2-28). The DGCAIES is designed so that failure of any one component can result in the loss of function of only one diesel generator. The loss of one diesel generator and its associated load group does not prevent safe shutdown of the unit (Section 8.3). Thus, failure of any one component of the DGCAIES does not preclude safe shutdown of the plant following a LOCA and loss of offsite power.

Since each combustion air intake and exhaust train is housed within the Seismic Category I diesel generator building, they are protected from externally generated missiles. No high-energy piping is present in the diesel generator building that could present a potential hazard to the operational function of this system.

The provision of a physically separated and independent intake and exhaust train for each diesel generator unit satisfies the requirements of the single-failure criterion for complete independence between units. Fig. 9.5-6 and 9.5-7 show the physical location of the intake and exhaust.

The diesel engine combustion air intake is located within the diesel generator building, and precipitation cannot directly enter the diesel engine air intake. The air intake has a disposable filter to remove airborne dust or other particles and prevent clogging of the intake line. The combustion air being ducted from the outdoor air opening to the engine intake is immune to any accumulation of fumes of gases within the room due to failure of the normal ventilation system. The fire protection system for the diesel generator rooms consists of a dry, preaction-type water sprinkler system. Its accidental discharge, therefore, does not produce any noxious gases that affect the oxygen concentration of the diesel generator combustion air.

The air intake is located so that only negligible dilution or contamination of the intake air occurs due to exhaust products, other gases, or dust that may be intentionally or accidentally released onsite. No dilution or contamination is possible which can affect diesel generator rated output. There is nothing in the vicinity of the air intake that could act as a potential restriction to the inlet airflow. The location of onsite stored gases (CO_2 and H_2) is such that accidental release of these gases does not affect the performance of the diesel generators.

•→14

The air intake is located within the diesel generator building, which is designed to withstand tornado missiles. The air intake is protected from tornado missiles by a labyrinth wall that prohibits line-of-sight tornado missiles from impacting the intake structure (Fig. 1.2-28). The labyrinth wall is also capable of withstanding tornado missiles.

14←•

The exhaust piping for the standby diesel generators and the HPCS diesel generator, as shown in Fig. 9.5-6 and 9.5-7, has been routed inside the diesel generator building to provide protection from tornado missiles. The exhaust silencers and that portion of the ductwork are enclosed in a missile-proof enclosure.

The exhaust gases are discharged through the turbocharger to the exhaust manifold and expelled through ductwork and an exhaust silencer to the exterior of the diesel generator building. Silencers are located in separate rooms.

•→8 •→15
The combustion air intake is located at el 129'-6" on east elevation covered by labyrinth wall, whereas the exhaust opening is located at el 131'-11" on west elevation. The intake and exhaust openings have a horizontal physical separation of 70 ft. The recirculation of combustion products from diesel exhaust to the air intake is precluded by the horizontal separation, high discharge velocity, and intake labyrinth wall (Fig. 1.2-28).
8←• 15←•
The diesel generator control panel, switchgear, and electrical equipment associated with starting the diesel engines are located in a separate control room in the diesel generator building. The filtered ventilation system air is designed to protect the electrical equipment against fibers, flyings, dust and dirt, lint, seepage, dripping, and external condensation of noncorrosive materials, thus ensuring that the equipment cannot become inoperable due to foreign material.
•→14
The frequency of dust storms is very low; approximately 9 dusty hours occur annually in the River Bend Station area. (A dusty hour is defined as a dust condition that reduces the prevailing visibility to under 7 mi or 11.3 km, and the concentration associated with a dusty hour is 3 to 5 mg/m^3 or greater[(1)].
14←•
The entrance of dust into the diesel generator rooms is minimized by certain features that are incorporated into the design of the ventilation system for each room. During normal operation (i.e., plant in operation, diesel generator not running), the ventilation supply air fan for the room draws air through louvers, with an intake velocity of less than 25 fpm. This minimizes the possibility of dust accumulation on a diesel engine. Also during normal plant operation, the equipment and personnel access doors are normally kept closed.

9.5.8.4 Inspection and Testing Requirements

The DGCAIES is checked for system leaks and blockage following initial installation and testing of the diesel engines (Chapter 14).
•→14
Replacement of air intake filters is performed periodically. Inspection of the adapter and screen assemblies in the exhaust manifold is performed as needed. Routine inspection and scheduled testing of the diesel engines verify the integrity and operability of the DGCAIES, including its associated instrumentation and controls.
14←•
Testing of the DGCAIES simulates, where practicable, the parameters of operation (automatic start, load sequencing, load shedding, operation time, etc.) and environments (temperature, humidity, etc.) that would be expected if actual demands were placed on the system.

Periodic surveillance testing and inservice inspection programs for the DGCAIES components, instrumentation, controls and alarms are in accordance with Regulatory Guide 1.108, Revision 1, and engine manufacturer recommendations.

The system is designed so that testing can be accomplished on a diesel generator with the plant in normal operation or shut down without impairing the reliability or redundancy of the remaining diesel generators.

9.5.8.5 Instrumentation Requirements

Control panels located in each diesel generator control room accommodate instruments and controls for operation of the diesel generator combustion air intake and exhaust system. Combustion air intake manifold pressure (taken between the turbocharger and the engine cylinder head) and crankcase vent pressure indicators are provided at the engine control panels located in each diesel generator control room. Low pressure measured by the intake manifold pressure sensor provides an indication of turbocharger malfunction or intake air filter clogging. Exhaust stack and cylinder exhaust port temperature indicators are also provided.

For the standby diesel generators, a high crankcase vent pressure condition automatically trips the diesel engine in all operating modes, except during engine startup or an emergency operation. The HPCS diesel generator does not have an automatic high crankcase vent pressure trip, but can be tripped manually either from the main control room or the HPCS diesel generator control panel (after receipt of the alarm).

A high crankcase vent pressure condition for each of the diesel generators in any operational mode also activates a trouble alarm on the main control room panel and on the diesel generator control panel. Diesel generator protective functions are further discussed in Section 8.3.1.1.4.

Indications of DGCAIES system conditions alert the operator to the possible need for system maintenance. There are no annunciated alarms for the combustion air intake and exhaust system for which the operator must take action.

9.5.9 Storage of Gases Under Pressure

The storage of gases under pressure is required for routine operation of the power plant.

9.5.9.1 Design Bases

The storage of gases under pressure is designed in accordance with the following criteria:

1. Storage conditions and relief valve capacities are designed as required by ASME Section VIII for fixed containers, Department of Transportation regulations for portable cylinders, and NFPA codes for flammable gases.

2. The containers are designed not to create damaging missiles through the use of restraints.

3. The containers are well separated from main control room and diesel generator air intakes.

4. The storage of gases is designed to Occupational Safety and Health Administration requirements.

5. All cylinders, except for the MSIV accumulators and the hydrogen analyzer system calibration gas and reagent gas bottles are equipped with safety relief devices set below or at the vessel design pressure. The MSIV accumulators are designed for 340°F, and for 150 psig in Auxiliary Building (Outboard MSIV), and for 235 psig in Reactor Building (Inboard MSIV). Since unloaders mounted on the instrument air compressor (the air supply source) are set below 135 psig, individual tank relief valves are not required.

   The hydrogen analyzers calibration and reagent gases are stored at pressures below the design pressure of the cylinders; therefore, individual tank relief valves are not required.

6. The plant storage facilities for various gases and air are designed to provide sufficient capacity for, and to be capable of positive action in, the systems with which they are associated.

9.5.9.2 System Description

Table 9.5-5 lists the storage facilities for air and other gases and their characteristics. These include the storage of:

1. Carbon dioxide for fire protection and generator purge.

• →16

2. Backup hydrogen for generator rotor cooling.

16←• • →14 • →13 • →12

3. Air for instruments and services; air in accumulators for the operation of MSIVs and controls; air in air receivers for starting the diesel generator for the high-pressure core spray (HPCS) system; air in air receivers for starting the standby diesel generators, air bottles to be used as a backup to Instrument Air for Control Building HVAC dampers.

12←• 13←• 14←•

4. Nitrogen cylinders for nitrogen blanketing of the closed loop cooling water surge tanks and auxiliary boiler, for supplying nitrogen to the reactor plant sampling system and the total organic carbon analyzer in the radwaste system, and permanent storage of CRD accumulator recharging cylinders.

5. Halon 1301 for fire protection.

6. Hydrogen (in nitrogen) for hydrogen analyzer calibration gas.

7. Oxygen for hydrogen analyzer reagent gas.

•→16 •→12

8. Hydrogen for water chemistry control and generator cooling.

16←•

9. Oxygen for water chemistry control.

10. Oxygen (in nitrogen) for oxygen analyzer calibration gas.

12←•

In addition to those listed above, gases such as oxygen, hydrogen, argon, helium, and nitrogen are required from time to time for repair and maintenance processes (e.g., welding), and are used throughout the plant and stored in the shop area. Small quantities of compressed gases used in radiation counters are stored in the health physics laboratory area.

9.5.9.3 Safety Evaluation

The accidental release of gases stored under pressure has been analyzed for the following cases:

1. Carbon dioxide for fire protection (Section 9.5.1).

2. Hydrogen for generator rotor cooling and carbon dioxide for generator purge.

3. Air for instruments, service, and controls (Section 9.3.1)

4. Air for standby and HPCS diesel generators which provide onsite emergency power (Section 9.5.6)

5. Halon 1301 for fire protection (Section 9.5.1)

6. 10-percent hydrogen in 90-percent nitrogen for hydrogen analyzer calibration gas

7. Oxygen for hydrogen analyzer reagent gas

8. Nitrogen stored in containment for recharging CRD accumulators

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9. Hydrogen and oxygen for water chemistry control (Section 9.5.10.3)

10. Oxygen (in nitrogen) for oxygen analyzer calibration gas.

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The setting of pressure relief valves at a value at or below design pressure prevents the possibility of pressure buildup as a result of temperature increases. The quantity of gas discharged due to relief valve lifting does not cause any hazardous conditions.

The locations of tanks and cylinders relative to equipment essential for initiating and maintaining a safe shutdown are such that the possibility of interaction between them in the event of an accident is precluded, with two exceptions:

1. The air tanks for the standby diesel generators (200 psig operating pressure) are designed to ASME Code Section III, Class 3 standards. The tanks are secured in such a way that a rupture of a tank has a minimal adverse effect upon the related diesel generator or controls. Each diesel generator is separated from the others by a 2-ft concrete wall (Fig. 1.2-28). Therefore, a rupture of any of the air tanks in a given diesel generator room does not affect the adjacent diesel generator units.

2. The accumulators for the inboard main steam isolation valves and the safety relief valves of the nuclear boiler system are located in the drywell. The arrangement of the air accumulators and associated piping and the support/restraint system is such that an accumulator or piping failure does not affect adjacent equipment. Outboard main steam isolation valve air accumulators are similarly arranged to preclude damage to adjacent equipment. The nuclear boiler pressure relief system is discussed in Section 5.2.2. Main steam isolation valves are discussed in Section 5.4.5.

Fig. 9.5-10 shows the general arrangement of the bulk hydrogen and carbon dioxide storage facility. The generator hydrogen and carbon dioxide storage facility consists of a concrete pad. The storage area is open to prevent the accumulation of hydrogen. A tractor-trailer bed with DOT-coded hydrogen storage bottles is left while the hydrogen is consumed (approximately 1 month), then exchanged for a filled trailer. Separate skid-mounted, bulk hydrogen storage bottles are located behind the normal supply trailer to provide hydrogen in the event of unexpected generator repairs or irregularities in hydrogen deliveries to the site. The carbon dioxide gas used for generator purge is stored as a liquid in a low-pressure cryogenic storage unit next to the hydrogen trailer. Table 9.5-5 gives tank volumes and operating pressures.

Each storage bottle is mounted in supporting frames, restrained from movement. Shutoff valves, bursting disc assembly, and vent are provided for each storage bottle.

The facility is located in the yard, approximately 90 ft from the nearest building (Fig. 1.2-2). It is completely fenced in and provided with posted "No Smoking" signs. Access by unauthorized personnel is controlled by permanent warning placards and a locked gate. The nearest safety-related structures are the auxiliary building and the control building. These buildings are located approximately 400 ft away from the hydrogen storage facility and separated from it by the turbine building and normal switchgear-transformer area, respectively.

Bulk hydrogen storage units and the carbon dioxide tank use pressure regulators to reduce the bottle pressure to 85 psig. Safety relief valves protect the downstream piping and valves against failure of the pressure regulators. Hydrogen and carbon dioxide piping is routed underground from the gas storage facility to the turbine building. Inside the turbine building piping is routed through ventilated areas and located to minimize the possibility of physical damage. A vent line piped to the atmosphere through the turbine building roof is provided for generator purge and safety relief valve discharges.

The hydrogen analyzer calibration and reagent gases are stored in permanently attached supporting frames, restrained from movement. Pressure regulators on the bottles and pressure control valves in the hydrogen analyzer panels maintain the gas pressure at 25 psig. These two devices protect the downstream piping and instruments against gas overpressure.

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See Section 9.5.10.3 for a discussion of design considerations for siting the bulk hydrogen and oxygen storage tanks for the Hydrogen Water Chemistry System. The gas storage and supply equipment at this facility including all pressure regulating and overpressure protection equipment is owned, operated and maintained by the gas vendor. Relief valves are provided for each storage vessel, and isolatable piping that may contain liquid gas. Pressure regulating valves limit the supply pressures of H2 and O2 and a relief valve is provided immediately downstream of these pressure regulating valves to protect downstream piping against regulator failure. Regulating valves are provided just outside the Turbine Building entrance for the supply header to the Generator Hydrogen system. A downstream relief valve is provided to protect against failure of the regulating valve. The relief valve has an extended tailpipe to release hydrogen above grade elevation.

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The air bottles stored in the Control Building as backup to Instrument Air for Control Building HVAC dampers are stored in a seismically qualified rack, which provides adequate protection from inadvertent damage. They have pressure relief devices installed per US Dept. of Transportation requirements. Downstream piping and instrumentation is protected by the IAS accumulator relief valves.
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9.5.10 Hydrogen Water Chemistry System

9.5.10.1 System Description

Hydrogen and oxygen gases are supplied by an onsite cryogenic Storage Facility, which is owned, operated and maintained by the gas supply contractor. The liquid is vaporized as needed and in case of hydrogen, compressed to the required supply pressure. Oxygen is not compressed but supplied to the process at the liquid tank pressure. Hydrogen is supplied from a nominal 18,000 gallon cryogenic bulk liquid tank which is mechanically restricted to less than 16,500 gallon (10,000 lb) capacity and the oxygen is supplied from a nominal 9,000 gallon cryogenic bulk liquid tank. These tanks are designed and constructed in accordance with the ASME Boiler & Pressure Vessel Code, Section VIII, Division 1. Hydrogen storage capacity is limited to less than 10,000 lbs which is below the threshold limits per OSHA 1910.119 and EPA 40CFR68. Therefore development of an OSHA process safety plan and an EPA Risk Management Plan is not required.

Excess flow check valve protection is provided at the storage facilities to ensure large leakage sources are limited to the storage facility location for which separation from any safety related structures or air pathways into safety-related structures has been evaluated.

9.5.10.2 Design Basis

The purpose of the Hydrogen Water Chemistry (HWC) system at River Bend Station (RBS) is to reduce rates of stress corrosion cracking (SCC) in recirculation piping and lower reactor vessel internals. The corrosion potential in an operating BWR can be reduced by injecting hydrogen into the reactor feedwater system. In high gamma radiation regions, such as the downcomer, excess hydrogen reacts with H_2O_2, oxygen and other oxidizing species to form water. Therefore, hydrogen injection will result in a less oxidizing environment and, thus, lower corrosion potentials. The target Electrochemical Corrosion Potential (ECP) is - 230 mV Standard Hydrogen Electrode (SHE). At this target potential, and normal BWR water quality, new cracks should not initiate for piping and vessel internals, and existing cracks will have extremely low and tolerable crack growth rates.

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Hydrogen injection has the potential to significantly change background radiation in steam affected areas of the plant due to an increase in N-16 activity. The main steam line radiation monitors (MSLRM) setpoint is based on background radiation values. Therefore a single setpoint is established which is valid for both the HWC system in service and the HWC system out of service.

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The storage system is designed to perform the following functions at all times. Failure modes associated with gas supply system will not impact ability of station to safely shutdown. The cryogenic hydrogen storage tanks are qualified to withstand seismic loads and tornado winds but are assumed to fail in place from tornado missiles. The Cryogenic Oxygen tank may fail under either seismic or tornado wind loads. Gaseous hydrogen storage tubes are qualified to withstand either seismic loads, tornado wind loads, or tornado missiles.
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The balance of the HWC system is designed to perform the following functions when operating:

a. Inject sufficient hydrogen into the feedwater stream to be capable of maintaining up to a 0.51 ppm dissolved hydrogen concentration order to minimize the potential for stress corrosion cracking of lower vessel internal components. A fuel surveillance program is required for nominal injection rates of greater than or equal to 2.0 ppm.

b. Inject sufficient oxygen into the offgas system to ensure that the excess hydrogen in the offgas stream is recombined.

Intergranular stress corrosion cracking is discussed in Section 5.2.3.4.1.
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9.5.10.3 Safety Evaluation

The hydrogen water chemistry system, including the gas vendor equipment, is designed and installed in accordance with EPRI Report NP-5283-SR-a, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations - 1987 Revision." This system serves no safety function. It is not required to effect or support the safe shutdown of the reactor or perform in the operation of reactor safety features. Systems analysis has shown that failure of the storage facility will not compromise any safety-related systems or prevent safe shutdown. Equipment redundancy is only provided at the storage facility to ensure a reliable hydrogen supply to the hydrogen water chemistry and generator hydrogen cooling systems.

The hydrogen storage vessels shall maintain integrity during a design basis earthquake. The liquid hydrogen tank, including all integral tank attached piping, is designed and qualified to Uniform Building Code (UBC) seismic zone 4 requirements. The liquid hydrogen filled piping between the tank, hydrogen pumps and vaporizers is qualified to UBC seismic zone 1 requirements. Both of these are conservative with respect to the RBS design basis earthquake acceleration values. The design of foundations for the hydrogen storage tank includes tank seismic loading.

Foundations for permanent liquid hydrogen and oxygen storage tanks and gaseous hydrogen storage vessels in support of the station HWC system are designed to keep the associated vessel in place during a design basis tornado. Vessel failure with the corresponding loss of all contents is permitted during the tornado. Siting considerations for the storage facilities included evaluation of impact to nearby safety related structures due to fireball or explosion of hydrogen, and oxygen vapor cloud ingestion into safety related air pathways. Leakage from or failure of either facility was evaluated as acceptable with no adverse impact to safe station shutdown. Redundant pressure relief (hydrogen and oxygen) and vent stack design (hydrogen only) provides protection of storage vessels and liquid filled piping from thermal overpressure due to external fire.

The location of the liquid hydrogen tank was selected to prevent loss of power lines to/from the switchyard or damage to station transformers due to hydrogen facility catastrophic failure. Based on the separation distances (over 1,900 feet) the overpressure wave associated with storage facility failure is bounded by the design tornado wind loads for these structures/components.

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9.5.10.4 Inspection and Testing Requirements

The functional operability of the HWC gas storage system was initially tested at the time of system installation to confirm system operation and functional trips.

The gas storage facility is owned, maintained and operated by the selected gas vendor. Therefore, this equipment is not considered permanent plant equipment.

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References - 9.5

1. Orgill, M.M. and Schmel, G.A. Frequency and Diurnal Variation of Dust Storms in the Contiguous U.S.A. Atmospheric Environment, Vol. 10, No. 10, 1976.

2. March 17, 1982, telecon between S. J. Hope, Stone & Webster Engineering Corporation, and R. Gilbert, LA State Transportation and Development, Department of Bridge Design, Baton Rouge, LA.

3. American Water Works Standard C203, Standard for Coal-Tar Enamel Protective Coating for Steel Water Pipe, 1966.

4. Steel Structure Painting Council Standard SP-6, No. 6, Commercial Blast Cleaning, 1963.

5. Steel Structure Painting Council Standard PA-1, SSPC Paint Application Specification No. 1, Shop, Field, and Maintenance Painting, 1964.

SECTION 9A.1

INTRODUCTION

9A.1.1 Foreword

As requested in the letter dated September 30, 1976, from Mr. Roger S. Boyd of the NRC to Mr. S. L. Adams of GSU, (Exhibit 9A.1-1) a review of the fire protection guidelines contained in Appendix A to Branch Technical Position (BTP) APCSB 9.5-1 dated August 23, 1976, has been made and compared to the fire protection program at the River Bend Station. The specific guidelines of Appendix A which are applicable to plants docketed prior to July 1, 1976, are presented and discussed in Section 9A.3 of the Fire Protection Program Evaluation Report (FPPER).

A detailed fire hazards analysis supporting the River Bend Station fire protection program reevaluation has been made utilizing the guidance provided in Enclosure 2 to the letter dated September 30, 1976, and is presented in Section 9A.2.

9A.1.2 Personnel Qualifications

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Personnel responsible for the preparation of the fire hazards analysis and for the design and selection of fire protection equipment are required to be graduates of an engineering curriculum of accepted standing and have not less than 6 yr of engineering-related experience, 3 yr of which will have been at supervisory level in fire protection work. Membership in the Society of Fire Protection Engineers is acceptable to satisfy the above requirements.

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9A.1.3 References

The September 30, 1976, letter from Mr. Roger S. Boyd to Mr. S. L. Adams is enclosed with this section.

Enclosure 2 to the NRC letter dated September 30, 1976, is included
in Section 9A.2 of this report as Attachment A.

Enclosure 1 (Appendix A to BTP APCSB 9.5-1) to the NRC letter is incorporated in Section 9A.3 of this report as Attachment B.

EXHIBIT 9A.1-1

SHEET 1 OF 2

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SEP 3 0 1976

Docket Nos. 50-458
and 50-459

Gulf States Utilities Company
ATTN: S. L. Adams
Senior Vice President
P. O. Box 2951
Beaumont, Texas 77704

Gentlemen:

FIRE PROTECTION EVALUATION - RIVER BEND STATION, UNITS 1 & 2

By my letter dated May 3, 1976, you were sent a copy of revised Standard Review Plan Section 9.5.1, "Fire Protection," dated May 1, 1976. This revised SRP 9.5.1 contained new guidelines for the NRC staff evaluations of fire protection in our review of nuclear power plant construction permit applications docketed after July 1, 1976. The letter stated (1) that to the extent reasonable and practicable the guidelines in the revised SRP 9.5.1 will be used by the staff in evaluating fire protection provisions of operating plants, applications currently under review for construction permits and operating licenses and future applications for operating licenses for plants now under construction; and (2) that you would be kept informed of our progress as we developed more definitive criteria or acceptable alternatives for the application of the SRP 9.5.1 guidelines to the review of these plants.

Enclosure 1 is Appendix A to Branch Technical Position APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," which gives alternative guidance and criteria acceptable to the staff to be utilized in a reevaluation of the fire protection provisions of the River Bend Station, Units 1 & 2.

We request that you conduct a reevaluation of the fire protection program of your nuclear power plant and compare, in detail, the fire protection provisions currently proposed for your facility(ies) with the guidelines in Appendix A to Branch Technical Position APCSB 9.5-1 In order to begin such a reevaluation, it is necessary that you perform a fire hazards analysis of your facility with the assistance

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OCT 7 1976
S.L.A.

and the technical direction from a qualified fire protection engineer. In order for us to evaluate your fire hazards analysis, we require that you submit the results of your fire hazards analysis in the form described in Enclosure 2, "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation."

Your reevaluation should:

1. Identify the guidelines in Appendix A which are presently met and discuss how this is done;

2. Identify the guidelines for which modifications, procedural changes, or enhanced training of personnel are underway or planned, such that the guidelines will be met, and the date you intend to meet Section B of Appendix A, "Administrative Procedures, Control and Fire Brigade;" and

3. Indicate which of the guidelines you do not now meet or do not intend to meet in the future. For such items, you should provide a basis for your position.

Please respond within 20 days of receipt of this letter to inform us when you will submit the requested information, forty (40) copies of which will be required for staff review.

This request for generic information was approved by GAO under a blanket clearance number B-180225 (R0072). This clearance expires July 31, 1977.

Sincerely,

Roger S. Boyd, Director
Division of Project Management
Office of Nuclear Reactor Regulation

Enclosures:
1. Appendix A to Branch Technical Position APCSB 9.5-1
2. "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation"

cc: See next page

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A.2 FIRE HAZARDS ANALYSIS

9A.2.1 INTRODUCTION/PURPOSE

The fire hazards analysis evaluates the effects of fires involving combustible materials, both fixed and transient, on the ability to safely shut down the plant and minimize radioactive releases to the environment.

The analysis is done by fire area and fire zone. A fire area is an area separated from adjacent areas by fire-rated barriers. Zones within fire areas are used to more clearly define concentrations of combustibles within larger fire areas, the location of safety-related equipment, and the effects of postulated fires. In some instances, zones are bounded by concrete walls, floors, and ceilings, but do not qualify as fire areas because of unprotected penetrations.

The definition of fire barriers is in agreement with the guidance in Appendix A to BTP ASB 9.5-1, i.e., the rating of the barrier or boundary must exceed with margin the fire loading in the area and need not necessarily be a 3-hr rated boundary unless the fire loading warrants such a boundary. In one plant area the erection of a physical barrier between redundant shutdown systems is precluded by the location of cable trays, HVAC ducts and equipment, equipment removal plugs, and other plant features. In the auxiliary building (AB-1, AB-15) a water curtain is used across the boundary separating the redundant systems.

Section 9A.2.5 describes each of the station buildings or structures. Subsections which address the major items contained in Enclosure 2 to the September 30, 1976, letter from Mr. R. S. Boyd entitled, Supplementary Guidance on Information Needed for Fire Protection Program Evaluation, are included. Figures 9A.2-2 through 9A.2-7 contain information on fire areas and zones and Figures 9A.2-8 through 9A.2-13 include information on suppression and detection systems.

The U.S. Nuclear Regulatory Commission (NRC) adheres to the application of a defense-in-depth concept to achieve the high degree of safety required for nuclear power plants. This concept is also applicable to nuclear power plant fire safety. The defense-in-depth approach applies to the fire protection program in designing to achieve an adequate balance in (1) preventing fires from starting; (2) detecting quickly, controlling, and extinguishing promptly those fires that occur; and (3) protecting structures, systems and components so that a fire that is not promptly extinguished will not prevent the Post-Fire Safe Shutdown of the plant. NRC fire protection requirements and guidance implement this defense-in-depth approach and specify a level of fire protection which considers the potential consequences that a fire may have on the Post-Fire Safe Shutdown of the reactor.

The NRC fire protection regulation is Title 10 of the U.S. Code of Federal Regulations, Part 50 Section 50.48, "Fire Protection" (10CFR50.48). Section 50.48 states that each operating reactor must have a fire protection program that satisfies General Design Criterion (GDC) 3, "Fire Protection," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10CFR50. The objective of the fire protection program is to minimize both the probability and consequences of fires.

On October 27, 1980, the NRC approved a new rule concerning fire protection as applied to nuclear power plants. 10CFR50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to

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January 1, 1979," established the minimum acceptable fire protection requirements necessary to resolve certain areas of concern to the NRC Staff and Licensees of plants operating prior to January 1, 1979 and establishes fire protection features required to satisfy GDC 3. The Appendix R requirements of interest here are specified in Section III.G, "Fire Protection of Safe Shutdown Capability."

Guidance for implementing NRC fire protection requirements is contained in (1) Branch Technical Position (BTP) Auxiliary and Power Conversion System Branch (APCSB) 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," May 1976, (2) Appendix A to BTP APCSB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976," August 23, 1976, and (3) Standard Review Plan (NUREG 0800), Section 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants," July 1981. These documents provide information, staff recommendations, and guidance which may be used by the licensees to meet the requirements of 10CFR50.48, Appendix R and GDC 3. These documents also refer the licensees to such national consensus standards as American Society for Testing and Material (ASTM) and National Fire Protection Association (NFPA) standards, for detailed guidance on implementing typical industrial fire protection features such as fire detector, sprinkler systems, and fire barriers.

The Fire Protection Program at River Bend Station is required to be in compliance with the positions of Appendix A to Branch Technical Position APCSB 9.5-1. The Fire Protection Program was reviewed and found acceptable by the NRC as stated in NUREG-0989, RBS Safety Evaluation Report, Section 9.5, Fire Protection. A point-by-point comparison of the River Bend Fire Protection Program and the positions of Appendix A to Branch Technical Position APCSB 9.5-1 can be found in USAR Appendix 9A, Section 9A.3. A point-by-point comparison of the River Bend Fire Protection Program to the requirements of 10CFR50, Appendix R, Sections II and III, can be found in USAR Appendix 9B.

To provide a defense in depth approach to fire protection, the objectives of this Fire Hazards Analysis are:

a. Determine plant areas and consider potential in situ and transient fire hazards in each.

b. Specify measures for fire prevention, fire detection, fire suppression, and fire containment.

c. Determine the consequences of fire in any location in the plant on the ability to safely shut down the reactor or on the ability to minimize and control the release of radioactivity to the environment.

d. Specify measures for alternative shutdown capability as required for each area containing structures, system, and components important to safety in accordance with NRC guidelines and regulations.

This Fire Hazards Analysis summarizes the analysis performed on the River Bend Station. It evaluates the fire detection and suppression capabilities and determines compliance to the design requirements of Appendix A to BTP APCSB 9.5-1 and 10CFR50 Appendix R. This standard covers buildings and structures on site at River Bend that are controlled by federal regulatory requirements. Other non-essential areas
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of the plant such as administrative buildings and warehouses are not evaluated in this document. Controlled plant documents (e.g., P&IDs) are referenced in this standard but are not incorporated directly.

The bases of this Fire Hazards Analysis include the requirements of Appendix A to NRC Branch Technical Position APCSB 9.5-1 and 10CFR50 Appendix R; information/guidance obtained from NRC Appendix R workshops; and information/guidance obtained from the following:

a. NRC Generic Letter 81-12 and Clarification Letters

b. NRC Generic Letter 83-33

c. NRC Generic Letter 86-10

d. IE Information Notice 84-09

e. NRC Regulatory Guide 1.73

The fire hazards analysis was reviewed and found to be acceptable by a qualified fire protection engineer.

9A.2.2 DEFINITIONS

<u>ALTERNATE SHUTDOWN</u>

Alternative shutdown is defined in this report as a post-fire shutdown approach requiring utilization of nonstandard operational practices or plant system or component modifications as discussed below.

(1) Operations:

a. Other than normal post-fire safe shutdown activities from the Main Control Room (MCR);

b. Operations from designated alternative control systems or from outside the MCR. Similarly, it may be necessary to operate different combinations of equipment to achieve Post-Fire Safe Shutdown.

c. Manual operation at equipment location.

(2) Modifications:

Rerouting, relocation, or alteration of existing post-fire safe shutdown systems outside a fire area to ensure the ability to achieve and maintain post-fire safe shutdown conditions.

Alternative Shutdown may require deviation from normal operational practices and shutdown equipment. In this context, procedural guidelines for post-fire shutdown must address operation of shutdown equipment in an unusual manner or from outside the MCR. Similarly, it may be necessary to operate different combinations of equipment to achieve Post-Fire Safe Shutdown.

The NRC's definition for alternative shutdown, as provided in 10CFR50 Appendix R, Section III.L, focuses on plant modifications. The post-fire safe shutdown analysis encompasses

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the Commission's definition and extends it to include the associated procedural aspects of post-fire shutdown in an environment where plant equipment may be damaged.

ASSOCIATED CIRCUIT OF CONCERN

Safety-related and non-safety related cables that have a separation from the fire area less than that required by 10CFR50, Appendix R Section III.G.2 and:

1) Share a common power source with the shutdown equipment, and the power source is not electrically protected from the post-fire shutdown circuits of concern by coordinated circuit breakers, fuses, or similar devices.

2) Share a common enclosure with the shutdown cables, such as a raceway, panel or junction box, where the circuits are not electrically protected from the post-fire shutdown circuit of concern by coordinated circuit breakers, fuses or similar devices.

3) Are circuits that, due to the effects of a fire, can cause the spurious operation of a post-fire safe shutdown component or the spurious operation of a component not required for Post-Fire Safe Shutdown but could disrupt Post-Fire Safe Shutdown and are not provided with an isolation and/or transfer device.

EXPOSURE FIRE

An exposure fire is a fire in a given area that involves either in situ or transient combustibles and is external to any structures, systems, or components located in or adjacent to that same area. The effects of such fire (e.g., smoke, heat, or ignition) can adversely affect those structures, systems, or components important to safety. Thus, a fire involving one train of post-fire safe shutdown equipment may constitute an exposure fire for the redundant train located in the same area, and a fire involving combustibles other than either redundant train may constitute an exposure fire to both redundant trains located in the same area.

FIRE AREA

A fire area is a portion of a building comprised of one or more fire zones that is separated from all other fire areas by 1-hour or 3-hour rated fire barriers. An evaluation is in place which provides justification for the ability of the barrier to withstand the hazards for the area.

FIRE BARRIERS

Those components of construction (walls, floors, and their supports) including beams, joists, columns, penetration seals or closures, fire doors, and fire dampers that are rated by approving laboratories in hours of resistance to fire and are used to prevent the spread of fire, are identified as fire barriers. Any fire barrier not meeting these requirements requires an engineering justification for use as a suitable fire barrier.

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FIRE SEVERITY

The fire severity is determined by comparing the calculated fire heat load for a fire area to the heat rate for the standard Exposure Fire (ASTM E 119). The classification for fire severity is then classified as a time duration.

The process is as follows: The heat load is determined for each area. This loading is divided by the floor area of the fire area. Then the quotient is divided by a factor of 80,000 Btu/ft^2/hr (standard Exposure Fire rating) (Ref NFPA Fire Protection Handbook). This results in a fire loading related to time for a fire. The time duration designations used at River Bend are ≤1, >1 but ≤3, and >3 hour fires.

FIRE ZONE

A fire zone is a subdivision of a fire area that is separated from other fire zones within the fire area by less than 3-hour rated barriers. Fire protection consideration is given to individual fire zones to satisfy specific conditions of each zone. In most cases, individual fire zones are comprised of a single room/elevation.

HEAT LOAD

The total amount of heat produced (BTUs) in an area if all of the combustibles were to be consumed in a fire. Also called fire heat load.

IN SITU COMBUSTIBLES

Any flammable or combustible material that is permanently installed or situated in a defined location is an in situ combustible. Cables in a conduit or totally enclosed cable trays are not considered combustibles.

INTERVENING COMBUSTIBLE

Intervening combustibles are in situ combustible materials which are located between redundant post-fire safe shutdown systems or components.

NON-COMBUSTIBLE

Non-combustibles are materials which, in the form in which they are used and under the conditions anticipated will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Non-combustibles are also defined as material having a flame spread of less than 25 and an associated smoke development less than 450 as defined in ASTM Standard E 84.

QUALIFIED FIRE PROTECTION ENGINEER

A qualified fire protection engineer is a person who meets the eligibility requirements for member status in the Society of Fire Protection Engineers.

SAFETY RELATED

Systems, structures, and components necessary to ensure:

a. The integrity of the reactor coolant pressure boundary,

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b. The capability to shutdown the reactor and maintain it in a cold shutdown condition, or

c. The capability to prevent or mitigate the consequences of accidents that could result in potential off-site exposures comparable to the guideline exposures of 10CFR100.

POST-FIRE SAFE SHUTDOWN EQUIPMENT

Equipment (i.e., systems, components, cables, piping, valves) which may be used for achieving and maintaining safe shutdown in the event of a fire in a plant area is defined as post-fire safe shutdown equipment. There are several bases for this definition. Redundant paths of achieving safe shutdown are available to the operator in the event of a fire. Appendix R, Section III.G, recognizes this inherent redundancy and requires that at least one such pathway be sufficiently protected to remain free of damage (this is applicable to hot, transition to cold shutdown, and cold shutdown) or be repairable to allow for timely achievement of cold shutdown in the event of a fire. Verification that at least one path of post-fire safe shutdown systems is free of fire damage for each fire area demonstrates compliance with the rule. Where a post-fire safe shutdown path cannot be shown to meet the requirements of Appendix R, Section III.G with the existing plant configuration, and where the technical basis to support an exemption request cannot be demonstrated, fire protection and/or post-fire safe shutdown system modifications are implemented to ensure availability of a post-fire safe shutdown pathway.

The post-fire safe shutdown equipment and cables include those that meet acceptable definitions for the associated circuits. (See Criterion 240.201A for a detailed discussion of the Post-Fire Safe Shutdown analysis for each fire area).

TRANSIENT COMBUSTIBLE

Any flammable or combustible material that is not permanently installed or situated in a defined location is a transient combustible. Transient combustibles are those combustibles required to be used in the plant area for the purpose of repair, maintenance, and fuel loading operations, which are neither of fixed quantity or quality. These combustibles include paper, wool, rags, packing materials, lubricating oils, etc., and are under the scrutiny of administrative control.

9A.2.3 FIRE HAZARDS ANALYSIS METHODOLOGY

9A.2.3.1 Methodology

A simplified methodology for developing the Fire Hazards Analysis is given in Figure 9A.2-1. This section discusses specific RBS design features which are important in the analysis.

To perform a fire hazards analysis on the River Bend Nuclear Station, the following steps are performed:

a. Determine the boundaries of fire areas
b. Determine fire risk
c. Develop a defense strategy
d. Determine post-fire safe shutdown equipment affected
e Determine plant response to fire

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Detailed information for the above steps is provided below:

A) Determination of the plant fire areas - each building on site was reviewed for the development of fire area boundaries. The philosophy was to 1) restrict the fire area size, 2) minimize the propagation of a fire, and 3) to group like components/trains together (i.e. RHR-A, Division III diesel). By using this philosophy, each separate fire area was determined. Drawings EB-3AB, EB-3AC, EB-3AD, EB-3AE, EB-3AH and EB-3AJ (Figures 9A.2-2 through 9A.2-7) identify the physical location of the fire areas. A complete listing of the fire areas is presented in Section 9A.2.5.

B) Determination of Fire Risk - Each fire area is then reviewed for all combustibles located in the area. Each type of combustible is categorized and summarized. The fire loading and severity of each area is then determined.

The combustible program at River Bend Station is controlled to the extent that combustibles located on site are maintained so as to not prevent the Post-Fire Safe Shutdown of the plant following a fire. In situ combustibles such as cable insulation, stored fuel, or equipment lubrication reservoirs have been identified and evaluated for the safety of the plant. In situ combustibles within the plant are controlled primarily by minimizing the use of combustible materials and isolating the combustible or avoiding the communication of combustibles by separation.

The combustibles are tracked in the Combustible Loading Calculation. This calculation lists the in situ combustibles on the plant site. The calculation separated the plant into fire areas. Each area has a listing of major components and other combustibles located in the area. A correction factor, listed as baseline, is added to each area to account for miscellaneous equipment not accounted for in the listing.

In certain areas of the plant there are storage areas for combustibles. These are called "Designated Storage Areas" and are controlled by administrative procedures. These procedures provide the minimum requirements for the safe storage of combustibles. The guidelines provided in these procedures will help in preventing fires on the plant site.

The transient combustibles listed for each fire area are postulated amounts based on a conservative estimate of transient combustibles likely to be in the plant during normal maintenance operations. Because they are estimates, they are not intended to be limiting amounts. Transient combustibles are controlled by administrative procedures. These procedures control transient combustibles by: limiting the quantity brought into the fire areas and requiring removal following completion of work. These procedures also review the requirements for compensatory actions, such as additional fire extinguishers.

Where a fire hazard is present, the design basis fire heat load considers the total heat energy that can be released through complete combustion of combustible materials determined to be available for ignition within the fire area. The electrical cabling heat load is based on maximum fill of each cable tray considering conservative

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combinations of worst-case cable present in that tray. Electrical cables installed in conduit or totally enclosed cable trays were not considered as contributors to the electrical cabling heat load.

An evaluation of potential fire hazards, including in situ and transient combustibles, was performed to determine whether any postulated fire could affect structures, system and components cables required for Post-Fire Safe Shutdown of the plant. Appropriate protective features have been provided to ensure that redundant Post-Fire Safe Shutdown cables cannot be affected by the same fire.

The design basis fire heat loads are computed using the following formula:

$$\underset{\text{Btu/Sq. Ft}}{\text{Fire Heat Load}} = \frac{\left| \begin{array}{c}\text{Combustible Quantity} \\ \text{Present (lb.)}\end{array} \times \begin{array}{c}\text{Combustible Heat of} \\ \text{Combustion (Btu / lb.)}\end{array} \right|}{\text{Fire Zone Floor Area}}$$

The fire severity is determined through a review of the fire heat loading. Once the fire heat loading of an area is determined, the fire severity is determined. The fire severity is a time duration for a fire in a fire area to burn. The fire severity is calculated by dividing the fire heat loading by the room floor area to determine the area loading. Then the area loading is then divided by a factor of 80,000 Btu/ft^2/hr to determine the fire severity. The 80,000 Btu/hr is the standard exposure fire ratio (Ref NFPA Fire Protection Handbook). This results in a fire severity in terms of time duration.

The fire severity values listed in the subsections of Section 9A.2.5 are related to the combustible loading values in the calculation. The fire severity for each area is determined from the combustible loading. No credit is taken for fire detection and suppression when determining the fire severity duration for a fire zone.

The level of fire severity determines the defense strategy. For fire areas where the fire severity is ≤1 hour no suppression is required because the fire cannot affect areas outside of the fire areas. For fire areas with a fire severity >1 hour some type of suppression is provided. This may take the form of an installed sprinkler system or the use of local hose reels located near the fire area by the fire brigade. If the fire severity exceeds 3 hours an analysis is performed to determine the acceptability of the configuration. These analyses review not only the fire loading but review plant configuration, detection and suppression system and the response of the fire brigade.

C) Development of defense strategy - A defense-in-depth strategy is determined for each fire area. This includes the detection, suppression and barrier review of each fire area. Each fire area is reviewed relative to the combustible loading/fire severity. From this, an analysis was performed to determine where detection and suppression systems were needed.

Detection systems are installed throughout the site. The fire detection systems are designed utilizing the guidance of NFPA 72D. There are two types of fire detection systems, detection with action and detection only.

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The plant contains various suppression systems designed to assist in extinguishing fires. The most common system is the fire protection water suppression system. This system includes wet pipe, dry pipe and preaction sprinkler systems used to extinguish fire. Others system include Halon 1301 and CO_2. These systems work in conjunction with hose stations used by the fire brigade to extinguish any fire that might occur at the plant site.

Fire water suppression systems are designed to assure that their rupture or inadvertent operation in a fire area does not significantly impair the design capability of safety related structures, systems, or components in accordance with GDC 3.

Fire areas generally contain only one division of electrical equipment such as MCC and switchgear which might be involved in a fire or be inadvertently sprayed by the fire brigade. Fire brigade usage of fire suppression fog nozzles was evaluated. The Post-Fire Safe Shutdown analysis shows that there is at least one other set of systems, equipment, and cables located outside the fire area free of fire damage, or protected by an approved method.

Locations of the detection and suppression systems are shown in Figures 9A.2-8 through 9A.2-13.

Although all reinforced concrete walls are resistant to fire, only those with rated fire penetration seals are fire barriers and are considered capable of containing a fire. Walls that are considered to be fire barriers are shown on drawings EB-3AB, EB-3AC, EB-3AD, EB-3AE, EB-3AH and EB-3AJ (Figures 9A.2-2 through 9A.2-7) and are inspected on a periodic basis.

All doors, dampers, and electrical and piping penetration seals that are installed in rated fire barriers (walls, floors, and ceilings) are rated by approving laboratories, in hours of resistance to fire, equal to or greater than the barrier in which they are installed. Any modifications/repairs that deviate from the tested or rated configuration are reviewed and approved by a qualified Fire Protection Engineer. All pressure, airtight, bullet resistant and watertight doors are considered equivalent rated fire barriers (Ref. USAR Section 9.5.1.2.14).

D) Determination of post-fire safe shutdown equipment - Each fire area is then reviewed for the post-fire safe shutdown equipment located in the area. This equipment includes not only valves and pumps but also electrical items such as cabling and control panels.

The total list of equipment is determined through the use of Plant Data Management System (PDMS) and plant drawings. All electrical components that have the potential to be affected during a fire in any fire area are determined through a review of the cabling that passes through an area. This is performed by using PDMS. Once the equipment list is determined then the shutdown response can be determined.

E) Determination of Post-Fire Safe Shutdown Response - An analysis is performed wherein each fire area is reviewed for the loss of post-fire safe shutdown equipment and the plant's response to this loss. This analysis is detailed in the Post-Fire Safe Shutdown Analysis, Criterion 240.201A.

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In addition to the commitments listed in USAR Section 9.5.1, the following criteria were used in the determination of the post-fire safe shutdown response:

a. The postulated fire does not occur coincident with a LOCA or natural phenomena (e.g., tornado, seismic event, etc.). The reactor recirculating pumps are designed to withstand a safe shutdown earthquake without rupture of the oil reservoirs, however, the lubricating oil is conservatively included as a combustible in the drywell. The supplemental external oilers are seismically supported.

b. Offsite power may or may not be available at the time of the postulated fire.

c. A single failure is not postulated concurrent with the fire. All failures which occur are as a direct result of the postulated fire.

9A.2.3.2 High Pressure/Low Pressure Interface Valves

A High Pressure/Low Pressure Interface exists when a low pressure system interfaces with a high pressure primary coolant system. The valves that provide separation of the two system have special stipulations associated with them. Criterion 240.201A provides a complete definition and discussion of high/low pressure interface valves.

9A.2.3.3 Safety Relief Valve Spurious Operation

Spurious safety relief valve operation was analyzed separately. Redundant switchgear, load centers, and motor control centers and their control circuits are located in separate fire areas separated by fire barriers or protected using an acceptable method. Any and all spurious operations are postulated but only one is credited happening at a time.

Fire related cable damage to more than one instrument is required to induce a spurious Reactor Pressure Vessel high pressure signal which is not postulated for non-High/Low pressure interface components. However, should this spurious signal occur, adequate control of the Safety Relief Valves remains available from the Control Room to support Post-Fire Safe Shutdown. Additionally, LPCI is available to provide Reactor Pressure Vessel makeup and level control to mitigate the effects of the spurious SRV actuations.

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The SRV circuit logic includes trip units slaved to the SRV pressure relief circuitry that are set to a correspondingly higher control pressure than that of the primary SRV circuit. This parallel circuit is designed to mitigate the effects of non-mechanistic multiple conductor to conductor shorts that could result in the opening of all 16 SRVs.

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Each safety relief valve (SRV) is equipped with an A solenoid and a B solenoid, either of which if energized from the respective separate division opens the SRV (see Section 5.2.2.4.1). Inadvertent SRV opening is analyzed in Section 15.1.4. The control cables for the SRV solenoids are routed in different fire areas outside containment, in different quadrants inside containment, and run in separate conduit throughout the plant except for free air cable (approximately six feet) running immediately to the solenoids. One free air cable run associated with each SRV is wrapped with an approved fire barrier. Each circuit is protected by fuses to ensure that a short circuit in an individual solenoid circuit is mitigated. Mechanical overpressure relief protection is inherent in the valve design.

9A.2.3.4 Exemptions

Section III.G of Appendix R to 10CFR50 specifies the fire protection features needed to ensure that at least one means of achieving and

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maintaining post-fire safe shutdown conditions will remain available during and after any postulated fire in the plant. Appendix R specifies the design basis protective features rather than the design-basis fire. Section III.G.2 of Appendix R requires that one train of redundant trains of cables and equipment necessary to achieve and maintain Post-Fire Safe Shutdown be maintained free of fire damage by one of the following means:

(1) Separation of cables and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier.

(2) Separation of cables and equipment and associated non-safety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

(3) Enclosure of cables and equipment and associated non-safety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detection and an automatic fire suppression system shall be installed in the fire area.

If these provision are not met, Section III.G.3 of Appendix R requires that an alternative shutdown capability independent of the fire area of concern be provided. Section III.G.3 also requires that fire detectors and a fixed fire suppression system be installed in the area of concern. These alternative requirements are not deemed to be equivalent; however, they provide adequate fire protection for those configurations in which they are accepted.

Plant-specific conditions may preclude compliance with one or more of the provision specified in section III.G. In such cases, the licensee must demonstrate, by means of a detailed fire hazards analysis, that existing protection or existing protection in conjunction with proposed modifications will provide a level of safety equivalent to the technical requirements of Section III.G of Appendix R. Exemptions from fire protection requirements may be requested under 10 CFR50.12. Generally, the NRC staff will accept an alternate fire protection configuration on the basis of a detailed fire hazards analysis if:

(1) the alternative ensures that one train of equipment necessary to achieve hot shutdown from either the control room or emergency control stations is free of fire damage: and

(2) the alternative ensures that fire damage to equipment necessary to achieve cold shutdown is limited so that it can be repaired within a reasonable time (minor repair using components stored on the site); and

(3) fire-retardant coatings are not used as fire barriers; and

(4) modifications required to meet Section III.G would not enhance fire protection safety levels above that provided by either existing or proposed alternatives.

The staff will also accept an alternative fire protection configuration on the basis of a detailed fire hazards analysis when the licensee can demonstrate that modifications required to meet section III.G would be
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detrimental to overall facility safety, the alternative configuration satisfies the four aforementioned criteria, and the alternative configuration provides an adequate level of fire safety.

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Six exemptions exist at River Bend Station. They are related to fire areas AB-1, AB-7, AB-15, C-6, C-17 and ET-1. See these fire areas for details of the exemptions.

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9A.2.4 FIRE PROTECTION SYSTEMS DESCRIPTION

The fire protection system consists of an outside yard loop with three fire pumps and one jockey fire pump, fire protection water yard mains, hydrants, sprinkler systems, automatic deluge systems, automatic CO_2 systems, automatic Halon 1301 systems, standpipes, hose stations, portable fire extinguishers, ionization smoke and fire detectors, fire barriers, fire stops, portable breathing apparatus, smoke and ventilation systems, two fire protection water storage tanks, and associated piping, valving and instrumentation.

9A.2.4.1 Detection

Fire and smoke detection systems are provided for all areas of Seismic Category I structures that contain or present an exposure fire hazard to Post-Fire Safe Shutdown or safety-related systems or components, unless otherwise noted in the fire area analysis.

There are two types of detection systems:

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One system is dedicated to be used in conjunction with fixed fire suppression systems. These systems function to detect a fire emergency, alarming locally and in the main control room. Where suppression is automatic, the detection system also functions to actuate the suppression system control (e.g., water spray system in tunnels, transformers, etc.). Where suppression is manually actuated, the detection system includes appropriate components for actuation of the suppression system locally and from the main control room with the exception of the locally controlled charcoal filter system.

The second system is dedicated for detection only, alarming locally and within the main control room. This system is provided in general areas where the fire severity does not justify the need for a fixed suppression system.

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Fire Detection Systems are designed utilizing the guidance of NFPA 72D. For additional information on the detection system see USAR Section 9.5.1.

9A.2.4.2 Suppression

The suppression systems include a fire protection water system, a CO_2 system, a Halon 1301 system and portable extinguishers.

The fire protection water system consists of three fire pumps (one electric and two diesel driven) and closed loop piping to ensure delivery of extinguishing water to any Seismic Category I structure. The system pressure is maintained continuously between 130 and 140 psig by a jockey pump. The fire pumps are started by actuation of pressure switches located on the discharge side of the pumps and stopped manually at the fire pump house. The motor-driven pump starts when system

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discharge pressure drops to 120 psig. The two diesel-driven pumps start when pressure drops to 110 psig and 100 psig, respectively. In addition, to prevent pump runout, if a fire pump is running and pressure drops indicating a flow increase, the second and third fire pumps are started automatically when pressure decreases to 140 psig. If electric motor-driven pump P2 is running and pressure drops to 140 psig, diesel-driven pump P1A starts after a time delay of 10 sec, and diesel-driven pump P1B starts after a time delay of 15 sec. If the electric motor-driven fire pump is out of service and diesel-driven pump P1A is running, diesel-driven pump P1B starts automatically after a time delay of 15 sec when pressure drops to 140 psig. Fire pumps are designed utilizing guidance from NFPA 20.

The fire protection system automatic wet pipe and dry pipe sprinklers discharge water on high ambient temperature. Wet pipe, dry pipe and preaction sprinkler systems are designed utilizing the guidance of NFPA 13. Water Spray Deluge systems are designed utilizing the guidance of NFPA 15. For operation of the various sprinkler systems see USAR Section 9.5.1.

Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating, or ductwork. Operation of the sprinkler system is signaled locally and in the main control room. Sprinkler systems are installed to provide suppression in various areas of the plant. All fire areas with sprinkler systems installed are not completely covered by the suppression systems. This has been reviewed and accepted by the NRC in the Safety Evaluation Report (SSER 3).

$C0_2$ systems are designed utilizing the guidance of NFPA 12. Halon 1301 systems are designed utilizing the guidance of NFPA 12A. For additional information on the gaseous suppression systems see USAR Section 9.5.1. The Halon 1301 system for the control room (PGCC Halon system) is described in NEDO 10466A.

9A.2.4.3 Barriers

Fire barriers are provided to contain the fire within the fire area. Structural steel requiring fireproofing shall be fireproofed in accordance with Underwriters' Laboratories, Inc. (UL) approved designs or to designs evaluated to be equivalent to UL approved designs. Fire-rated doors provided in the fire-rated openings are labeled utilizing the guidance of NFPA 252, except for doors required for pressure-tight, watertight, security and missile protection. These steel doors, varying from $^5/_8$ inch to $3^1/_2$ inches thick, are a specialty item and do not have a listed fire rating. Fire seals are provided at penetrations in the fire-rated barriers or an evaluation is on file providing justification for the adequacy of the fire barrier. Fire-rated walls and doors are shown in Figures 9A.2-2 through 9A.2-7.
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With the exception of special doors (i.e., pressure-tight, watertight, security and missile-protected), the doors installed in fire rated assemblies are labeled fire doors. The security, pressure tight and water tight doors have been evaluated against the fire testing requirements of NFPA-252. Door manufacturers certificates of equivalency or RBS calculations document these evaluations. Missile-protected doors by their nature take precedence to fire ratings. Missile-protected doors are located in exterior building walls for which there are negligible external fire loadings. Therefore, fire rating of these doors is not required.
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Equipment removal plugs are not tested or rated since there is negligible external fire loading and an internal fire would not affect more than one plug.

Building construction is rated noncombustible and fire resistive. Non-combustible and fire-resistive materials are used wherever practical throughout the plant, particularly in safety-related areas containing safety-related structures, systems, and components. The flame spread rating for permanent construction materials of major plant structures, except for resilient floor coverings, are below a rating of 25 as defined in ASTM Standard E84. All metal deck roof construction is FM Class 1 construction or listed by Underwriters Laboratories as classified for fire resistance.

9A.2.4.4 Administrative Procedures and Personnel Qualification

Periodic operational checks, inspections, and servicing required to maintain fire protection systems, including the alarm detection system, follow the guidance provided by the NFPA standards.

Procedures are provided to maintain the performance of the fire protection systems and to set forth the responsibilities, duties, and controls for the fire protection program in the following general areas:

1. Administrative
    a. Responsibilities and authorities
    b. Organizational relationships
2. Fire Protection
    a. Control of ignition sources
    b. Control of transient combustibles
    c. Duties of a fire watch
    d. Fire report
    e. Handling of flammable liquids and gases
    f. Fire-fighting equipment inventory, inspection, and maintenance
    g. Inspection of maintenance and modification activities for fire protection systems
    h. Surveillance of fire protection activities
    i. Permanent storage of combustibles
3. Fire Emergency
    a. Duties and responsibilities
    b. Detection and annunciation
    c. Fire fighting
    d. Recovery
4. Fire Protection Training and Drills
    a. Duties and responsibilities
    b. Outline training course requirements
    c. Drill planning guides
    d. Critique of drills
    e. Documentation.

These procedures utilize the guidance contained in National Fire Protection Association (NFPA) Standards 4, 4A, 6, 7, 8, 27, and 802.

Qualifications of the personnel responsible for the preparation of the Fire Hazards Analysis and for the design and selection of equipment are provided in the USAR Section 9A.1.2. Personnel responsible for the development of the RBS fire protection program; maintenance, inspection, and testing of fire protection equipment; and training of fire-fighting personnel are discussed in USAR Section 9A.3.2.1.
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9A.2.5 Fire Area Analysis

The following Fire Area analyses summarize the safety-related equipment and the fire protection measures provided in each fire zone of the Seismic Category I buildings and other structures on site that are controlled by various regulatory requirements. These areas as shown on Figures 9A.2-2 through 9A.2-7. The administrative buildings and the warehouse buildings are not covered by this Fire Hazards Analysis.

Listing of Fire Areas

Fire Area	Fire Area	Fire Area
AB-1	C-19	RC-5 Does not exist
AB-2	C-20	RC-6
AB-3	C-21	RDW-1
AB-4	C-22	A-1
AB-5	C-23 Does not exist	A-2
AB-6	C-24	A-3
AB-7	C-25	AX-1
AB-8 Does not exist	C-26 Does not exist	AX-2
AB-9 Does not exist	C-27	AX-3
AB-10	C-28 Does not exist	CT-1
AB-11 Does not exist	C-29	CT-2
AB-12 Does not exist	C-30	CT-3
AB-13	DG-1	FP-1
AB-14	DG-2	FP-2
AB-15	DG-3	FP-3
AB-16 Does not exist	DG-4	FP-4
AB-17	DG-5	IS-1
AB-18	DG-6	IS-2
C-1	DG-7	LL-1
C-2	ET-1	MG-1
C-3	ET-2	NS-1
C-4	ET-3	NS-2
C-5	ET-4	NS-3
C-6	ET-5	NS-4
C-7	ET-6	NS-5
C-8 Does not exist	FB-1	NS-6
C-9	PH-1	NS-7
C-10	PH-2	NS-8
C-11	PH-3	NS-9
C-12 Does not exist	PH-4	NS-10
C-13E	PH-5	RB-1
C-13W	PT-1	T-1
C-14	PT-2	T-2
C-15	RC-1 Does not exist	T-3
C-16	RC-2	T-4
C-17	RC-3	T-5
C-18	RC-4	T-6

9A.2.5.1 Auxiliary Building

The Auxiliary Building is divided into Fire Areas prefixed by "AB-". Redundancy is provided for components required for safe plant shutdown. These components are located in separate minimum 3-hr, fire-resistive cubicles and would not be simultaneously subject to damage from a single fire event. The majority of the divisional cables are arranged so that Division I is in the west sections and Division II is in the east sections of the building. The cubicles and east and west sections define

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separate fire areas. Where Division I cables that are required for Post-Fire Safe Shutdown enter a predominantly Division II area, acceptable protection is provided. Where Division II cables that are required for Post-Fire Safe Shutdown enter a predominantly Division I area, acceptable protection is provided. Installation of equipment and cable trays satisfies the requirements of Regulatory Guide 1.75. Continuity of combustibles in these trays does not exist.

The Auxiliary Building contains safety related components for the following systems:

1. Residual Heat Removal (RHR)
2. High Pressure Core Spray (HPCS)
3. Low Pressure Core Spray (LPCS)
4. Reactor Core Isolation Cooling (RCIC)
5. Standby Service Water (SWP) piping and valves
6. Standby Gas Treatment System (SGTS)
7. Auxiliary Building Ventilation (HVR)
8. Main Steam
9. Feedwater
10. Annulus Mixing System
11. Containment Isolation Valves for the following systems:
    a. Reactor Plant Floor Drains (DFR)
    b. Reactor Building Equipment Drains
    c. Service Air
    d. Instrument Air
    e. Condensate Makeup and Draw-off
    f. Reactor Plant Component Cooling Water (RPCCW)
    g. Fire Protection - Water (FPW)
    h. Reactor Water Cleanup (RWCU)
    i. Main Steam Drains
12. Class 1E Electrical Distribution System

Piping and electrical cables pass through the building in tunnels in order to service equipment in adjacent buildings as well as the auxiliary building. The building is a reinforced concrete structure, including exterior and interior walls and the roof.

9A.2.5.1.1 Radioactive Release Analysis

The building ventilation system consists of an air supply system and air exhaust system, each including two 100 percent fans and associated viscous impingement type filters, dampers, and ductwork. Cooling is provided by unit coolers. The exhaust system is capable of discharging directly to the plant exhaust duct or diverting the exhaust to the standby gas treatment system (SGTS) charcoal filters. There are two 100 percent redundant SGTS filter trains each located in a separate 3-hr, fire-rated enclosure. Radiation levels are monitored in the exhaust duct, and high levels sound an alarm in the main control room from which the operator manually diverts exhaust through the SGTS. Concurrently, the supply air system is isolated, creating a slight negative pressure within the building, further prohibiting release of radiation to the atmosphere.

9A.2.5.1.2 FIRE AREA AB-1 West Crescent Area

9A.2.5.1.2.1 Area Description:

Fire Area AB-1 is defined as the west crescent area and consists of four zones; AB-1/Z-1, AB-1/Z-2, AB-1/Z-3 and AB-1/Z-4. Each zone is located
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in the western section of the Auxiliary Building. Zone 1 is the northwest quadrant of elevation 70'-0". Zone 2 is the northwest quadrant of elevation 95'-0". Zone 3 is the western half of elevation 114'-0" and Zone 4 is the northwest section of elevation 141'-0" outside of the filter rooms.

9A.2.5.1.2.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.1.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-43, SD-49, SD-53 and SD-97) arranged to alarm locally and in the main control room. Smoke Detection system SD-164 provides the actuation signal for the water curtain (WS-19) of elevation 70'-0". Smoke Detection system SD-165 provides the actuation signal for the water curtain (WS-20) of elevation 141'-0".

9A.2.5.1.2.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinklers are provided in areas of the building where electrical cable trays are arranged in stacks of seven trays or more. Automatic sprinkler system (AS-12) is located in this area. Alternate suppression systems (hose stations) are available for fire suppression in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.2.5 Fire Barrier:

A water curtain separates AB-1 from AB-15 (west-east) at elevations 70'-0" and 141'-0" and features closely spaced open-head sprinklers with water discharge initiated by tripping a deluge valve activated by cross-zoned fire detectors. Smoke propagation does not represent a hazard to redundant systems and operation of the system does not endanger safety systems on either side of the water curtain in accordance with NRC Generic Letter 83-33. The area in the vicinity of the water curtain does not contain equipment which requires the use of combustible materials for maintenance and the use of the water curtain for protection of the auxiliary building unit coolers enhances the availability of both of these redundant Post-Fire Safe Shutdown support systems.
Three hour rated reinforced concrete construction and a water curtain separates the area from adjacent areas.

Exemptions/Deviations Summary
As an original design consideration, EOI incorporated the use of a water curtain or water spray system between Fire Zones AB-1/Z-1 and AB-15/Z-1 at elevation 70'-0" and AB-1/Z-4 and AB-15/Z-4 at elevation 141'-0". The water curtain provided a means of segregating unit coolers 1HVR*UC11A (zone AB-1/Z-4) and 1HVR*UC11B (zone AB-15/Z-4). An exemption was submitted by EOI to the NRC considering the use of water curtains as a replacement for a 3 hour rated barrier separating AB-1/Z-4 and AB-15/Z-4. The NRC granted a deviation from BTP CMEB 9.5-1 in GSU SER, NUREG 0989, Supplement 3.
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9A.2.5.1.2.6 Post-Fire Safe Shutdown Equipment:

Piping and motor operated valves for LPCS, RHR (loop A), RCIC, RPCCW and SSW. Panels for RCIC, RHR (loop A), LPCS, motor control center, unit coolers, penetration termination cabinets and electrical panels (1EHS*MCC2A/2C/2E/2G/2J/2L).

9A.2.5.1.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-1 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and systems.

9A.2.5.1.3 FIRE AREA AB-2 HPCS & HPCS Hatch

9A.2.5.1.3.1 Area Description:

Fire Area AB-2 is the HPCS pump room area and consists of two zones, AB-2/Z-1 and AB-2/Z-2. Zone 1 is the HPCS pump room located on elevation 70'-0" of the Auxiliary Building. Zone 2 is the HPCS hatch area located on elevation 95'-9" of the Auxiliary Building.

9A.2.5.1.3.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.1.3.3 Fire Detection:

The area is provided with zoned detection systems (SD-28 and SD-98) arranged to alarm locally and in the main control room.

9A.2.5.1.3.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.3.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.3.6 Post-Fire Safe Shutdown Equipment:

HPCS Pump (1E22*PC001), HPCS Fill Pump (1E22*PC003), piping and valves, SSW instrument Rack

9A.2.5.1.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-2 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential

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Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and systems.

9A.2.5.1.4 FIRE AREA AB-3 RHR B Pump Room

9A.2.5.1.4.1 Area Description:

Fire Area AB-3 is the RHR B Pump Room and consists of only one zone. This area is located in the Auxiliary Building on elevation 70'-0" with a grated floor at elevation 95'-9".

9A.2.5.1.4.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.1.4.3 Fire Detection:

The area is provided with a zoned detection system (SD-29) arranged to alarm locally and in the main control room.

9A.2.5.1.4.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.4.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.4.6 Post-Fire Safe Shutdown Equipment:

RHR B pump (1E12*PC002B), heat exchangers (1E12*EB001B/D) and MOV, SSW piping to RHR heat exchanger.

9A.2.5.1.4.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-3 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, Decay Heat Removal, and Essential Mechanical/ Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.1.5 FIRE AREA AB-4 RHR C, RCIC & RWCU

9A.2.5.1.5.1 Area Description:

Fire Area AB-4 is defined as the RHR C and RCIC Rooms and consists of two zones. Zone one is the RHR C Pump Room and is located on the 70'-0" elevation of the Auxiliary Building between Division I and II RHR Pump rooms. Zone 2 is the RCIC Room and is located above zone one on the 95'-9" elevation.

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9A.2.5.1.5.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.1.5.3 Fire Detection:

The area is provided with zoned detection systems (SD-30 and SD-96) arranged to alarm locally and in the main control room.

9A.2.5.1.5.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. The RCIC pump room has an automatic preaction type sprinkler system (PS-1) for protection against a potential oil fire. Water flow is alarmed locally and in the main control room. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.5.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.5.6 Post-Fire Safe Shutdown Equipment:

RHR pump (1E12*PC002C) with piping and MOVs, RCIC pump & turbine (1E51*PC001), compressor (1E51*PC002) and fill pump (1E51*PC003)

9A.2.5.1.5.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-4 could potentially affect systems and components necessary to provide RPV Level Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to insure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.1.6 FIRE AREA AB-5 RHR A Pump Room

9A.2.5.1.6.1 Area Description:

Fire Area AB-5 is the RHR A Pump Room and consists of only one zone. This area is located in southwest quadrant of the Auxiliary Building on elevation 70'-0", with a grated floor at elevation 95'-9".

9A.2.5.1.6.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.1.6.3 Fire Detection:

The area is provided with a zoned detection system (SD-31) arranged to alarm locally and in the main control room.

9A.2.5.1.6.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinkler systems are not provided in this area. Fire loadings

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do not justify a fixed fire suppression system in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.6.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.6.6 Post-Fire Safe Shutdown Equipment:

RHR A Pump (1E12*PC002A) heat exchangers (1E12*EB001A/C) and MOV; SSW piping to RHR heat exchanger

9A.2.5.1.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-5 could potentially affect systems and components necessary to provide RPV Level Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.1.7 FIRE AREA AB-6 LPCS & LPCS Hatch

9A.2.5.1.7.1 Area Description:

Fire Area AB-6 is defined as the LPCS Pump room and consists of two zones AB-6/Z-1 and AB-6/Z-2. Zone 1 is the LPCS Pump Room and is located along the southwestern wall of the Auxiliary Building on elevation 70'-0". Zone 2 is located above zone one on elevation 95'-9" and includes the CRD Rebuild Room.

9A.2.5.1.7.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤1 hour. The major contributor is cable insulation.

9A.2.5.1.7.3 Fire Detection:

The area is provided with zoned detection systems (SD-32 and SD-100) arranged to alarm locally and in the main control room.

9A.2.5.1.7.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinklers are provided in areas of the building where electrical cable trays are arranged in stacks of seven trays or more. Automatic Sprinkler system (AS-12) is located in this area above the CRD Rebuild Room. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.7.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.
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9A.2.5.1.7.6 Post-Fire Safe Shutdown Equipment:

LPCS pump (1E21*PC001) fill pump (1E21*PC002), piping and valves, test return line MOV; SSW instrument rack

9A.2.5.1.7.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-6 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.1.8 FIRE AREA AB-7 D Tunnel

9A.2.5.1.8.1 Area Description:

Fire Area AB-7 is defined as the D Tunnel and consists of only one zone. This area is the piping and electrical tunnel located along the southern portion of the Auxiliary Building on elevation 70'-0".

9A.2.5.1.8.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.1.8.3 Fire Detection:

The area is provided with a zoned detection system (SD-83) arranged to alarm locally and in the main control room.

9A.2.5.1.8.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic Sprinkler system WS-8H is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.8.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.8.6 Post-Fire Safe Shutdown Equipment:

HPCS, RCIC SSW & RHR piping and MOVs, Division I and II cabling in trays

9A.2.5.1.8.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-7 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include providing fire wrap to selected cables to preclude damage in the event of a fire. Shutdown is accomplished by using Division II powered components and system.

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Exemptions/Deviations

Area wide suppression/detection is not provided for AB-7. A deviation was granted to RBS regarding area wide suppression/detection which is required by Section III.G.2.c of 10CFR50 Appendix R when redundant cables or components within a given Fire Area are protected by a fire barrier (Thermo-Lag) having a 1- hour rating. The deviation was granted based on the existence of an area wide fire detection system, a cable tray deluge suppression system, portable extinguishers and manual hose stations. This has been reviewed and accepted by the NRC in the Safety Evaluation Report (SSER 3).

9A.2.5.1.9 FIRE AREA AB-10 MS Tunnel South End

9A.2.5.1.9.1 Area Description:

Fire Area AB-10 is defined as the Main Steam Tunnel and consists of only one zone. This area is located along the southern portion of the Auxiliary Building on elevation 95'-9" between the HPCS and LPCS Rooms, and south of the Jet Impingement Wall on elevation 114'-0".

9A.2.5.1.9.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.1.9.3 Fire Detection:

This area is not supplied with any automatic detection equipment.

9A.2.5.1.9.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.9.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas. The Jet Impingement Wall, a structural steel composite assembly, serves to separate Fire Area RC-2 from Fire Area AB-10. The construction of this wall is not consistent with that of typical 3-hour rated fire barrier wall assemblies. This wall, however, has been qualified to be acceptable for the intended fire protection service and will not affect the redundant post fire Post-Fire Safe Shutdown capability.

9A.2.5.1.9.6 Post-Fire Safe Shutdown Equipment:

Main Steam piping & MOVs; Feedwater piping & MOVs; RWCU and RHR piping; turbine plant drains; RCIC piping.

9A.2.5.1.9.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-10 could potentially affect systems and components necessary to provide RPV Pressure Control and Decay Heat Removal. Mitigating features are not required to ensure at least one

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system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using either Division I or II powered components and systems.

9A.2.5.1.10 FIRE AREA AB-13 Standby Gas Treatment B

9A.2.5.1.10.1 Area Description:

Fire Area AB-13 is defined as Division II Standby Gas Treatment Filter Room and consists of only one zone. This area is located in the southeastern quadrant of the Auxiliary Building on elevation 141'-0".

9A.2.5.1.10.2 In Situ/Transient Combustible Loading/Fire Severity
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The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is charcoal for the Standby Gas Treatment charcoal filter.
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9A.2.5.1.10.3 Fire Detection:

The area is provided with a zoned detection system (SD-101) arranged to alarm locally and in the main control room. Thermistor detector FD-33 is located to detect a fire in the Standby Gas Treatment Filter.

9A.2.5.1.10.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinkler systems are not provided in this area.

The Standby Gas Treatment charcoal filter has an individual water spray system (WS-4B) manually actuated by the opening of local valves. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.10.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.10.6 Post-Fire Safe Shutdown Equipment:

None.

9A.2.5.1.10.7 Post-Fire Safe Shutdown Analysis:

There is no post-fire safe shutdown equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.1.11 FIRE AREA AB-14 Standby Gas Treatment A

9A.2.5.1.11.1 Area Description:

Fire Area AB-14 is defined as Division I Standby Gas Treatment Filter Room and consists of only one zone. This area is located in the southwestern quadrant of the Auxiliary Building on elevation 141'-0".
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9A.2.5.1.11.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.1.11.3 Fire Detection:

The area is provided with a zoned detection system (SD-103) arranged to alarm locally and in the main control room. Thermistor detector FD-34 is located to detect a fire in the Standby Gas Treatment Filter.

9A.2.5.1.11.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic Sprinkler system (AS-12) is located in the cable chase located along the western wall of this area.

The Standby Gas Treatment charcoal filter has an individual water spray system (WS-4A) manually actuated by the opening of local valves. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.11.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.11.6 Post-Fire Safe Shutdown Equipment:

Division I cabling

9A.2.5.1.11.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-14 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.1.12 FIRE AREA AB-15 East Side Crescent

9A.2.5.1.12.1 Area Description:

Fire Area AB-15 is defined as the east crescent area and consists of five zones; AB-15/Z-1, AB-15/Z-2, AB-15/Z-3, AB-15/Z-4 and AB-15/Z-5. Each zone is located in the eastern half of the Auxiliary Building. Zone 1 is the northeast quadrant of elevation 70'-0". Zone 2 is the northeast quadrant of elevation 95'-0". Zone 3 is the eastern half of elevation 114'-0", Zone 4 is the northeast quadrant area of elevation 141'-0" outside the filter room and Zone 5 is the Containment Building Airlock Door area at elevation 170'-0".

9A.2.5.1.12.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

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9A.2.5.1.12.3 Fire Detection:

The area is provided with zoned detection systems (SD-49, SD-52, SD-55, SD-97 and SD-99) arranged to alarm locally and in the main control room.

9A.2.5.1.12.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic sprinklers are provided in areas of the building where electrical cable trays are arranged in stacks of seven trays or more. Automatic Sprinkler system (AS-12) is located in this area, as well as the Water Curtain on elevations 70'-0" and 141'-0". Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.12.5 Fire Barrier:

A water curtain separates AB-1 from AB-15 (west-east) at elevations 70'-0" and 141'-0" and features closely spaced open-head sprinklers with water discharge initiated by tripping a deluge valve activated by cross-zoned fire detectors. Smoke propagation does not represent a hazard to redundant systems and operation of the system does not endanger safety systems on either side of the water curtain in accordance with NRC Generic Letter 83-33. The area in the vicinity of the water curtain does not contain equipment which requires the use of combustible materials for maintenance and the use of the water curtain for protection of the auxiliary building unit coolers enhances the availability of both of these redundant Post-Fire Safe Shutdown support systems.

Three hour rated reinforced concrete construction and a water curtain separates the area from adjacent areas.

Exemptions/Deviations Summary

As an original design consideration, EOI incorporated the use of a water curtain or water spray system between Fire Zones AB-1/Z-1 and AB-15/Z-1 at elevation 70'-0" and AB-1/Z-4 and AB-15/Z-4 at elevation 141'-0". The water curtain provided a means of segregating unit coolers 1HVR*UC11A (zone AB-1/Z-4) and 1HVR*UC11B (zone AB-15/Z-4). An exemption was submitted by EOI to the NRC considering the use of water curtains as a replacement for a 3 hour rated barrier separating AB-1/Z-4 and AB-15/Z-4. The NRC granted a deviation from BTP CMEB 9.5-1 in GSU SER, NUREG 0989, Supplement 3.

9A.2.5.1.12.6 Post-Fire Safe Shutdown Equipment:

Piping and MOVs for HPCS and RHR B & C; panels for RHR (Loops B & C) and HPCS unit coolers; RHR B&C, HPCS and SSW piping; CRD and RPV temperature panels; MCCs; penetration termination cabinets; unit coolers; electrical panels (1EHS*MCC2B/2D/2F/2H)

9A.2.5.1.12.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-15 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe

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Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.1.13 FIRE AREA AB-17 Containment Ventilation Filter Train Room

9A.2.5.1.13.1 Area Description:

Fire Area AB-17 is defined as the Containment Ventilation Filter Train Room and consists of only one zone. This area is located in the southeast portion of the Auxiliary Building on the 170'-0" elevation.

9A.2.5.1.13.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is charcoal.

9A.2.5.1.13.3 Fire Detection:

The area is not provided with a zoned detection system. The Containment Purge Filter contains a thermal detector (FD-28) to indicate a fire.

9A.2.5.1.13.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. The Containment Purge Filter charcoal filter contain a manually actuated sprinkler system (WS-16) within the filter housing. Water flow is alarmed locally and in the main control room. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.13.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.13.6 Post-Fire Safe Shutdown Equipment:

None.

9A.2.5.1.13.7 Post-Fire Safe Shutdown Analysis:

There is no post-fire safe shutdown equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.1.14 FIRE AREA AB-18 D-Tunnel Cable Chase

9A.2.5.1.14.1 Area Description:

Fire Area AB-18 is defined as the D-Tunnel Cable Chase and consists of only one zone. This area is located at the north-east corner of the D-Tunnel on elevation 70'-0" of the Auxiliary Building.

9A.2.5.1.14.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as >1 but ≤ 3 hours. The major contributor is cable insulation.

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9A.2.5.1.14.3 Fire Detection:

The area is provided with a zoned detection system (SD-83) arranged to alarm locally and in the main control room.

9A.2.5.1.14.4 Fire Suppression:

Sprinkler systems are provided in areas of the Auxiliary Building. Automatic Sprinkler system WS-8H is located in this area. Water flow is alarmed locally and in the main control room. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.1.14.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.1.14.6 Post-Fire Safe Shutdown Equipment:

Cables for RCIC and SFC MOVs

9A.2.5.1.14.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area AB-18 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.2 Control Building

The Control Building contains the major controls and related equipment necessary to start up, operate, and shut down the plant. It is a four-story reinforced concrete structure including walls, floors, and roof. Three hour minimum (except as noted below), fire barriers are located throughout to mitigate the consequences of a fire. All of the penetrations in these barriers are either sealed with a 3-hour rated configuration or have been evaluated to be adequate to withstand the fire hazards associated with the area in which they are installed.

El 70'-0" contains cable and air conditioning equipment areas. El 98'-0" contains the standby switchgear rooms, the remote shutdown panel rooms, and the equipment room containing chillers and cable areas. El 115'-0" contains an additional switchgear room, battery rooms, motor generator areas, cable chases, and air conditioning equipment rooms and charcoal filter trains. The main control room is at el. 136'-0". Cable chases extending from el. 70'-0" to the control room level contain the PGCC equipment cables and are enclosed with 3-hr, fire-rated barriers. Fire protection of the PGCC is described in NEDO-10466A. Remote shutdown capability for Division I and Division II are provided to shut down the reactor in the event that the main control room becomes uninhabitable.

The Control Building is divided into fire areas prefixed by "C-". Safety-related cables in trays are arranged so that Division I is located in the west section, Division II in the east section and Division III in separate equipment rooms. Adequate separation is provided by minimum

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3-hr, fire-rated construction except for the walls separating the redundant Division I and II chillers and air-conditioning equipment rooms.

9A.2.5.2.1 Radioactive Release Analysis

The control building contains no radioactive material, therefore no radioactive release from the building is possible.

Electrical equipment within the control building for control and operation of safety-related system components located in other buildings is arranged and segregated so that radioactive release from those buildings to the atmosphere is prevented.

9A.2.5.2.2 FIRE AREA C-1 Cable Chase I (NE)

9A.2.5.2.2.1 Area Description:

Fire Area C-1 is defined as Cable Chase I and consists of a single fire area. This area is located in the northeast quadrant of the Control Building on elevations 70'-0", 98'-0" and 116'-0".

9A.2.5.2.2.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as >1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-20, SD-50, and SD-54) arranged to alarm locally and in the main control room.

9A.2.5.2.2.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Zoned automatic sprinkler systems (AS-6A, AS-6B, and AS-6C) are provided for cable tray areas on elevations 116'-0", 98'-0" and 70'-0", respectively. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating or ductwork. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.2.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.2.6 Post-Fire Safe Shutdown Equipment:

Division II cables in trays

9A.2.5.2.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-1 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required
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to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.2.3 FIRE AREA C-2 Cable Chase II (SE)

9A.2.5.2.3.1 Area Description:

Fire Area C-2 is defined as Cable Chase II and consists of a single fire area. This area is located in the southeast quadrant on elevations 70'-0", 98'-0" and 116'-0".

9A.2.5.2.3.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as > 3 hours. The major contributor is cable insulation.

9A.2.5.2.3.3 Fire Detection:

The area is provided with zoned detection systems (SD-20, SD-50 and SD-54) arranged to alarm locally and in the main control room.

9A.2.5.2.3.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Zoned automatic sprinkler systems (AS-6A, AS-6B, and AS-6C) are provided for cable tray areas on elevations 116'-0", 98'-0" and 70'-0", respectively. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating or ductwork. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.3.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.3.6 Post-Fire Safe Shutdown Equipment:

Division II and III cable in trays

9A.2.5.2.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-2 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.2.4 FIRE AREA C-3 Rm. North of ACU Rooms

9A.2.5.2.4.1 Area Description:

Fire area C-3 is defined as the passageway and consists of only one zone. This area is located north of the Air-conditioning room on the 70'-0" elevation with access to both ACU rooms and Cable Chase I and III.
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9A.2.5.2.4.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.4.3 Fire Detection:

The area is provided with a zoned detection system (SD-20) arranged to alarm locally and in the main control room.

9A.2.5.2.4.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system AS-6C is provided in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.4.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.2.4.7 Post-Fire Safe Shutdown Analysis:

There is no post-fire safe shutdown equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.2.5 FIRE AREA C-4 ACU Rooms (East and West)

9A.2.5.2.5.1 Area Description:

Fire Area C-4 is defined as the Air Conditioning Room including both east and west rooms. This area consists of only one zone. This area is the east and west Air Conditioning Rooms that house the Control Building Air Handling Units located on elevation 70'-0" of the Control Building.

9A.2.5.2.5.2 In Situ/Transient Combustible Loading/Fire Severity

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.2.5.3 Fire Detection:

The area is provided with zoned detection systems (SD-15 and SD-16) arranged to alarm locally and in the main control room.

9A.2.5.2.5.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system (AS-6C) is provided for the HVAC equipment room (air handling units). Portable extinguishers and water hose stations are provided throughout the building.

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9A.2.5.2.5.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.5.6 Post-Fire Safe Shutdown Equipment:

Air handling units (1HVC*ACU2A/B) Return Air fans (1HVC*FN2A/B)

9A.2.5.2.5.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-4 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I or II powered components and system.

9A.2.5.2.6 FIRE AREA C-5 Cable Area S. of ACU

9A.2.5.2.6.1 Area Description:

Fire Area C-5 is defined as the passageway south of the ACU rooms and consists on only one zone. This area is located south of the ACU rooms on elevation 70'-0" of the Control Building.

9A.2.5.2.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as >1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.6.3 Fire Detection:

The area is provided with a zoned detection system (SD-17) arranged to alarm locally and in the main control room.

9A.2.5.2.6.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system (WS-6A) is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.6.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.6.6 Post-Fire Safe Shutdown Equipment:

Division I, II and III cable in trays

9A.2.5.2.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-5 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Pressure Control, Decay Heat Removal and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

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9A.2.5.2.7 FIRE AREA C-6 Remainder of El. 70'

9A.2.5.2.7.1 Area Description:

Fire Area C-6 is defined as the hallway area and consists of only one zone. This area is located south of area C-5 and consists of the areas not previously identified located on elevation 70'-0" of the control building.

9A.2.5.2.7.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.7.3 Fire Detection:

The area is provided with a zoned detection system (SD-19) arranged to alarm locally and in the main control room.

9A.2.5.2.7.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system (WS-6C) is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

<u>Exemptions/Deviations Summary</u>

Area wide fire suppression and detection are not provided for C-6. The NRC reviewed and acknowledged this condition under previous River Bend site audits. Specifically, the NRC staff inspected and recognized that in C-6 the following active or passive fire protection exists: area wide detection systems or thermistor detection actuating in tray, direct impingement deluge system on specific cable trays, portable extinguishers, manual hose stations, and 1 hour fire wrap on selected Division I circuits. Based on the aforementioned, a deviation was granted to GSU for the lack of area wide suppression and detection (NUREG-0989 Supplement 3, SER River Bend Facility).

9A.2.5.2.7.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.7.6 Post-Fire Safe Shutdown Equipment:

Division I, II and III cable in trays, air damper accumulator tanks (1IAS*TK5A/B)

9A.2.5.2.7.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-6 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include providing fire wrap to selected cables to preclude damage in the event of a fire. Shutdown is accomplished by using Division I powered components and system.

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9A.2.5.2.8 FIRE AREA C-7 Post-Accident Rad Monitoring

9A.2.5.2.8.1 Area Description:

Fire Area C-7 is defined as the Post Accident Radiation Monitoring Room and consists of only one zone. This area is located in the southwest quadrant of the Control Building on elevation 70'-0".

9A.2.5.2.8.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.2.8.3 Fire Detection:

The area is provided with a zoned detection system (SD-18) arranged to alarm locally and in the main control room.

9A.2.5.2.8.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system (WS-6B) is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.8.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.8.6 Post-Fire Safe Shutdown Equipment:

Division I cable in trays

9A.2.5.2.8.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-7 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, Decay Heat Removal, and Essential Mechanical/ Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.9 FIRE AREA C-9 Cable Chase III (NW)

9A.2.5.2.9.1 Area Description:

Fire Area C-9 is defined as Cable Chase III and consists of a single fire area. This area is located in the northwest quadrant of the Control Building east of the stairwell on elevations 70'-0", 98'-0" and 116'-0".

9A.2.5.2.9.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.9.3 Fire Detection:

The area is provided with zoned detection systems (SD-20, SD-50 and SD-54) arranged to alarm locally and in the main control room.

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9A.2.5.2.9.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Zoned automatic sprinkler systems (AS-6A, AS-6B, and AS-6C) are provided for cable tray areas on elevations 116'-0", 98'-0" and 70'-0", respectively. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating or ductwork. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.9.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.9.6 Post-Fire Safe Shutdown Equipment:

Division I cable in trays

9A.2.5.2.9.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-9 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.10 FIRE AREA C-10 Cable Chase IV (SW)

9A.2.5.2.10.1 Area Description:

Fire Area C-10 is defined as Cable Chase IV and consists of a single fire area. This area is located in the southwest quadrant of the Control Building on elevations 70'-0", 98'-0" and 116'-0".

9A.2.5.2.10.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.10.3 Fire Detection:

The area is provided with zoned detection systems (SD-20, SD-50 and SD-54) arranged to alarm locally and in the main control room.

9A.2.5.2.10.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Zoned automatic sprinkler systems (AS-6A, AS-6B, and AS-6C) are provided for cable tray areas on elevations 116'-0", 98'-0" and 70'-0", respectively. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduit, grating or ductwork. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Portable extinguishers and water hose stations are provided throughout the building.

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9A.2.5.2.10.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.10.6 Post-Fire Safe Shutdown Equipment:

Division I cable in trays

9A.2.5.2.10.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-10 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. No mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.11 FIRE AREA C-11 Vestibule (NW Corner)

9A.2.5.2.11.1 Area Description:

Fire Area C-11 is defined as the Vestibule and consists of only one zone. This area is located in the northwest corner of the Control Building on elevation 70'-0".

9A.2.5.2.11.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.11.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.2.11.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Alternate suppression systems are available for providing suppression. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.11.5 Fire Barrier:

Three hour rated reinforced concrete construction separate the area from adjacent areas.

9A.2.5.2.11.6 Post-Fire Safe Shutdown Equipment:

Division I cables in trays

9A.2.5.2.11.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-11 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, Decay Heat Removal, and Essential Mechanical/ Environmental Support.
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Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.12 FIRE AREA C-13E HVK Chiller East Side

9A.2.5.2.12.1 Area Description:

Fire Area C-13E is defined as the Division II Chilled Water Equipment Room and consists of only one zone. This area is located on the 98'-0" elevation of the Control Building and is the east of the two chilled water equipment rooms.

9A.2.5.2.12.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.2.12.3 Fire Detection:

The area is provided with a zoned detection system (SD-4) arranged to alarm locally and in the main control room.

9A.2.5.2.12.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system AS-6B is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.12.5 Fire Barrier:

Reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.12.6 Post-Fire Safe Shutdown Equipment:

AC water chillers (1HVK*CHL1B/D), HVAC unit (1HVC*ACU3B), pumps (1HVK*P1B/D and 1SWP*P3B/D), expansion tank for Division II (1HVK*TK1B)

9A.2.5.2.12.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-13E could potentially affect systems and components necessary to provide Essential Electrical Power, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

The area formerly designated as Fire Area C-13 was separated into two Fire Areas: C-13E and C-13W. These two new Fire Areas are separated by a one foot thick concrete wall. The penetrations traversing from east to west are sealed with fire assemblies rated for 3 hours. A rated fire door is provided. However, one 10x8 HVAC supply duct for C-13W penetrates the northern end of the dividing wall at the ceiling. The 10x8 duct has not been provided with a fire damper. Both C-13E and C-13W have fixed fire detection and suppression systems. The combustible fire loading for the former Fire Area C-13 was calculated to be insignificant.
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9A.2.5.2.13 FIRE AREA C-13W HVK Chiller West Side

9A.2.5.2.13.1 Area Description:

Fire Area C-13W is defined as the Division I Chilled Water Equipment Room and consists of only one zone. This area is located on the 98'-0" elevation of the Control Building and is the west of the two chilled water equipment rooms.

9A.2.5.2.13.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.2.13.3 Fire Detection:

The area is provided with a zoned detection system (SD-4) arranged to alarm locally and in the main control room.

9A.2.5.2.13.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic Sprinkler system AS-6B is located in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.13.5 Fire Barrier:

Reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.13.6 Post-Fire Safe Shutdown Equipment:

AC water chillers (1HVK*CHL1A/C), HVAC unit (1HVC*ACU3A), pumps (1HVK*P1A/C and 1SWP*P3A/C), expansion tank for Division I (1HVK*TK1A)

9A.2.5.2.13.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-13W could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

The area formerly designated as Fire Area C-13 was separated into two Fire Areas: C-13E and C-13W. These two new Fire Areas are separated by a one foot thick concrete wall. The penetrations traversing from east to west are sealed with fire assemblies rated for 3 hours. A rated fire door is provided. However, one 10x8 HVAC supply duct for C-13W penetrates the northern end of the dividing wall at the ceiling. The 10x8 duct has not been provided with a fire damper. Both C-13E and C-13W have fixed fire detection and suppression systems. The combustible fire loading for the former Fire Area C-13 was calculated to be insignificant.

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9A.2.5.2.14 FIRE AREA C-14 Division II Standby Switchgear Room

9A.2.5.2.14.1 Area Description:

Fire Area C-14 is defined as the Division II Standby Switchgear Room and consists of only one zone. This area is located in the southeast quadrant of elevation 98'-0" of the Control Building.

9A.2.5.2.14.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.14.3 Fire Detection:

The area is provided with zoned detection systems (SD-5 and SD-163) arranged to alarm locally and in the main control room.

9A.2.5.2.14.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Curbs are installed between fire areas C-14 and C-15 (Division I and II switchgear rooms) on el. 98'-0", to prevent the flow of water between these areas.

9A.2.5.2.14.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.14.6 Post-Fire Safe Shutdown Equipment:

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MCCs (1EHS*MCC8B and 1EHS*MCC14B), 480-V load center(1EJS*LDC1B), switchgear (1ENS*SWG1B and 1ENB*SWG01B), Remote Shutdown Panel (1RSS*PNL102), AC distribution panels (1SCV*PNL8B1 and 1SCV*PNL14B1), dry transformers (1SCV*XD8B1 and 1SCV*XD14B1), Vital Bus Inverter (ENB-INV01B1), manual transfer switch (VBS-TRS02B), and Division II cable trays

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9A.2.5.2.14.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-14 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.2.15 FIRE AREA C-15 Division I Standby Switchgear Room

9A.2.5.2.15.1 Area Description:

Fire Area C-15 is defined as the Division I Standby Switchgear Room and consists of only one zone. This area is located in the southwest quadrant of elevation 98'-0" of the Control Building.

9A.2.5.2.15.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

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9A.2.5.2.15.3 Fire Detection:

The area is provided with a zoned detection system (SD-6) arranged to alarm locally and in the main control room.

9A.2.5.2.15.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Curbs are installed between fire areas C-14 and C-15 (Division I and II Switchgear Rooms) on el. 98'-0", to prevent the flow of water between these areas.

9A.2.5.2.15.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.15.6 Post-Fire Safe Shutdown Equipment:

MCCs (1EHS*MCC8A and 1EHS*MCC14A), 480-V load center (1EJS*LDC1A), switchgear (1ENS*SWG1A and 1ENB*SWG01A), AC distribution panels (1SCV*PNL8A1 and 1SCV*PNL14A1), dry transformer (1SCV*XD8A1 and 1SCV*XD14A1), Vital Bus Inverter (ENB-INV01A1), manual transfer switch (VBS-TRS02A), and Division I cable trays.

9A.2.5.2.15.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-15 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.16 FIRE AREA C-16, Division I Remote Shutdown Room and General Area

9A.2.5.2.16.1 Area Description:

Fire Area C-16 is defined as the Division I Remote Shutdown Room and general area and consists of only one zone. The area is located on the 98'-0" elevation of the Control Building and consists of the Division I Remote Shutdown Room and the general area outside the Remote Shutdown Room.

9A.2.5.2.16.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.2.16.3 Fire Detection:

The area is provided with zoned detection systems (SD-61 and SD-162) arranged to alarm locally and in the main control room.

9A.2.5.2.16.4 Fire Suppression:
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Sprinkler systems are provided in this area in order to comply with the provisions set forth in Section III.G.2.c of Appendix R and are sufficient to protect against the hazards present. An evaluation has been performed to assess the adequacy of the partial suppression system to protect against the hazards in the area. This evaluation has been performed by a fire protection engineer and a record of the evaluation has been retained on file for audit.
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9A.2.5.2.16.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.16.6 Post-Fire Safe Shutdown Equipment:

Division I cable trays, Division II cable trays, Radiation Monitoring Cabinets (1RMS*CAB13A/B), Remote Shutdown Panels (1C61*PNLP001 and 1RSS*PNL101)

9A.2.5.2.16.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-16 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include providing fire wrap to selected cables to preclude damage in the event of a fire. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.17 FIRE AREA C-17 Control Building Ventilation Room

9A.2.5.2.17.1 Area Description:

Fire Area C-17 is defined as the Control Building Ventilation Room and consists of only one zone. This area is located on the 116'-0" elevation of the Control Building.

9A.2.5.2.17.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is charcoal.

9A.2.5.2.17.3 Fire Detection:

The area is provided with a zoned detection system (SD-1) arranged to alarm locally and in the main control room. Thermistor Detector systems FD-26 and FD-27 monitor the charcoal filter trains and alarm locally and in the main control room.

9A.2.5.2.17.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Portable extinguishers and water hose stations are provided.

The charcoal filters are provided with their own manually actuated sprinkler systems (WS-7A and WS-7B). Water flow is alarmed locally and in the main control room.

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Exemptions/Deviations Summary

Entergy requested and received an exemption from the requirements of 10 CFR 50, Appendix R, Section III.G.3 (NRC letter from David Wigginton to John McGaha, "Deviation From Technical Requirements for Fire Protection, Fire Area C-17", dated 10/04/95). The exemption was requested and granted to provide relief from the requirement for the existence of a fixed fire suppression system due to the use of alternate shutdown capability for this area. The exemption was granted based on the low combustible loading of the area and the existing fire protection features available.

9A.2.5.2.17.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.17.6 Post-Fire Safe Shutdown Equipment:

HVAC units (1HVC*ACU1A/B), Chiller units (1HVC*CH1A/B), Charcoal filters (1HVC*FLT3A/B) and fans (1HVC*FN1A/B)

9A.2.5.2.17.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-17 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I/Remote Shutdown powered components and system.

Alternate Shutdown:

Alternate shutdown (i.e., using the Remote Shutdown System) is required for a fire in this area because Main Control Room ventilation will be lost and is not recoverable since both the Division I and Division II Control Room Air Handling Units are in the area. It is anticipated that the Control Room will have to be evacuated about one hour after the loss of Control Room cooling. During this one hour period, operators should take as many actions as are feasible to place the plant in a stable shutdown condition prior to evacuation of the Control Room. The Post-Fire Safe Shutdown of the plant can then be continued from the Remote Shutdown Panel per the guidelines of AOP-31.

Alternate shutdown capability is provided due to the postulated effects of a control room fire. All Division I Post-Fire Safe Shutdown components and circuits that interface with the control room are provided with a means of isolating these circuits so that Division I components required for Post-Fire Safe Shutdown may be operated locally. Additional Division I local controls are provided, where necessary, to effect an alternate shutdown in the event of a control room fire. Emergency lighting is provided where required for ingress, egress, and operation of alternate shutdown controls.

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9A.2.5.2.18 FIRE AREA C-18 ENB A Battery & Inverter/ Charger

9A.2.5.2.18.1 Area Description:

Fire Area C-18 is defined as Standby 125V Battery Room 1A and Standby DC Equipment Room 1A and consists of only one zone. This area is located in the southwest quadrant of the 116'-0" elevation of the Control Building.

9A.2.5.2.18.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is the A Battery.

9A.2.5.2.18.3 Fire Detection:

The area is provided with a zoned detection system (SD-3) arranged to alarm locally and in the main control room.

9A.2.5.2.18.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Alternate suppression systems are available to provide suppression. Portable extinguishers and water hose stations are provided throughout the building.

Battery room ventilation fans operate continuously to prevent the buildup of hydrogen and fan/flow failure is monitored in the main control room through the use of flow sensors on the discharge ducts.

9A.2.5.2.18.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.18.6 Post-Fire Safe Shutdown Equipment:

Battery (1ENB*BAT01A) , Charger (1ENB*CHGR1A), Inverter (1ENB*INV01A)

9A.2.5.2.18.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-18 could potentially affect systems and components necessary to provide Essential Electrical Power. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

Fire Area C-18 now includes the area that was formerly identified as Fire Area C-26, in addition to former Fire Area C-18.

9A.2.5.2.19 FIRE AREA C-19 ENB B Battery & Inverter/Charger

9A.2.5.2.19.1 Area Description:

Fire Area C-19 is defined as Standby 125V Battery Room 1B and the Standby DC Equipment Room 1B and consists of only one zone. This area is located in the southeast quadrant of the 116'-0" elevation of the Control Building.

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9A.2.5.2.19.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is the B Battery.

9A.2.5.2.19.3 Fire Detection:

The area is provided with a zoned detection system (SD-3) arranged to alarm locally and in the main control room.

9A.2.5.2.19.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Alternate suppression systems are available to provide suppression. Portable extinguishers and water hose stations are provided throughout the building.

Battery room ventilation fans operate continuously to prevent the buildup of hydrogen and fan/flow failure is monitored in the main control room through the use of flow sensors on the discharge ducts.

9A.2.5.2.19.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.19.6 Post-Fire Safe Shutdown Equipment:

Battery (1ENB*BAT01B), Charger (1ENB*CHGR1B), Inverter (1ENB*INV01B)

9A.2.5.2.19.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-19 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

Fire Area C-19 now includes the area that was formerly identified as Fire Area C-23, in addition to former Fire Area C-19.

9A.2.5.2.20 FIRE AREA C-21 HPCS Battery & Charger Rooms

9A.2.5.2.20.1 Area Description:

Fire Area C-21 is defined as Standby 125V Battery Room 1C and the Standby DC Equipment Room 1C and consists of only one zone. This area is located in the eastern half of the 116'-0" elevation of the Control Building.

9A.2.5.2.20.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is the HPCS battery.

9A.2.5.2.20.3 Fire Detection:

The area is provided with a zoned detection system (SD-3) arranged to alarm locally and in the main control room.

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9A.2.5.2.20.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed suppression system. Portable extinguishers and water hose stations are provided throughout the building.

Battery room ventilation fans operate continuously to prevent the buildup of hydrogen and fan/flow failure is monitored in the main control room through the use of flow sensors on the discharge ducts.

9A.2.5.2.20.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.20.6 Post-Fire Safe Shutdown Equipment:

Battery (1E22*BATSOO1), Charger (1E22*CHGRS001)

9A.2.5.2.20.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-21 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using either Division I or II powered components and system.

Fire Area C-21 now includes the area that was formerly identified as Fire Area C-20, in addition to former Fire Area C-21.

9A.2.5.2.21 FIRE AREA C-22 HPCS Switchgear Room

9A.2.5.2.21.1 Area Description:

Fire Area C-22 is defined as the HPCS Switchgear Room and consists of only one zone. This area is located in the western half of the 116'-0" elevation of the Control Building.

9A.2.5.2.21.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.2.21.3 Fire Detection:

The area is provided with a zoned detection system (SD-2) arranged to alarm locally and in the main control room.

9A.2.5.2.21.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Fire loadings in this area do not justify a fixed suppression system. Portable extinguishers and water hose stations are located throughout.

9A.2.5.2.21.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

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9A.2.5.2.21.6 Post-Fire Safe Shutdown Equipment:

MCC transformer (1E22*S003), switchgear (1E22*S004), transfer switchgear (1E22*S002), Division III cable trays

9A.2.5.2.21.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-22 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.22 FIRE AREA C-24 Remainder of El. 116'

9A.2.5.2.22.1 Area Description:

Fire Area C-24 is defined as the general area not previously discussed on elevation 116'-0" and consists of only one zone. This area includes the general hallway outside the Battery and Charger rooms on elevation 116'-0".

9A.2.5.2.22.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is Thermo-Lag material.

9A.2.5.2.22.3 Fire Detection:

The area is provided with zoned detection systems (SD-3 and SD-60) arranged to alarm locally and in the main control room.

9A.2.5.2.22.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Fire loadings in this area do not justify a fixed suppression system. Portable extinguishers and water hose stations are located throughout the building.

9A.2.5.2.22.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.22.6 Post-Fire Safe Shutdown Equipment:

480/120 Transformer (1SCV*XDS002), Inverters (1RPS*XRC10A1, 1RPS*XRC10B1, 1SCM*XRC14A1 and 1SCM*XRC14B1)

9A.2.5.2.22.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-24 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe

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Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.2.23 FIRE AREA C-25 Control Room

Fire protection for the main control room is described in GE Topical Report NEDO-10466A. Section 4.0 of this report describes the details. The NRC accepted this report for reference in license applications on July 13, 1978. The Power Generation Control Complex (PGCC) design separates the Division I/II/III cables with fire stops and fire seals within raceways, and provides barrier in panels in those cases where separate panels are not provided. The main control room is continuously manned and access is controlled to limit the introduction of personnel and combustibles.

9A.2.5.2.23.1 Area Description:

Fire Area C-25 is defined as the Control Room and consists of only one zone. This area is the entire elevation of 136'-0" of the Control Building except for the stairwell and the pipe chase.

9A.2.5.2.23.2 In Situ/Transient Combustible Loading/Fire Severity:
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The Fire Severity for this area is provided in NEDO Document 10466A and the Combustible Loading Calculation. Carpet is installed on the surface of the Control Room floor. Carpet has been tested in accordance with NFPA 253 (ASTM E 648), "Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using Radiant Heat Energy Source" and NFPA 258 (ASTM E 662), "Standard Research Test Method for Determining Smoke Generation of Solid Materials."

Carpet test results for critical radiant flux is greater than 0.45 W/sq. cm. as determined by the test referenced. Smoke generation test results are less than 300. This carpet meets the requirements of NFPA- 101 (1997) for Class 1 interior floor finishes.

The kitchen is located approximately 10' North of 3-Line to 2-Line and between CA Line and the East wall. The stove is located above the under floor raceways, routed between panel H13-P870 and termination cabinet H13P730. The raceways are totally enclosed and are elevated above the concrete floor. Additionally, the raceways are covered by the raised floor. Spillage of hot liquid in the kitchen area can not impact any cable inside these raceways.
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9A.2.5.2.23.3 Fire Detection:

The area is provided with zoned detection systems (SD-125, SD-126, SD-127, SD-128, SD-129, SD-130, SD-131, SD-132, SD-133, SD-134, SD-135, SD-136, SD-137, SD-138, SD-139, SD-140, SD-141, SD-142, SD-143, SD-144, SD-145, SD-146, SD-150, SD-151, SD-152, SD-153, SD-154, and SD-158) arranged to alarm locally and on the Fire Protection panel in the main control room.
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9A.2.5.2.23.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. The cables in the PGCC are protected by detectors and automatically actuated Halon 1301 systems. Each PGCC module is a zone and flow is alarmed in the main control room.

A UL Listed automatic wet-chemical fire suppression system is installed in the stove vent hood. The system is actuated by fusible link, and interrupts the power to the range, as well as discharging the non-toxic wet-chemical suppression agent when actuated by a stove fire. This system is not prone to spurious actuations and the wet-chemical agent will remain localized (as opposed to dry powder) if discharged.

9A.2.5.2.23.5 Fire Barrier:

The exterior walls are three hour rated reinforced concrete construction. With the exception of lighting and communication, all cable is enclosed in PGCC modules and cabinets or is routed in conduit.

9A.2.5.2.23.6 Post-Fire Safe Shutdown Equipment:

Principal Plant Control Console (1H13*P680), RCIS Bench Board (1H13*P601), the PGCC modules and all control cabinets also included as are all back cabinets that provide indication and control functions for shutdown.

9A.2.5.2.23.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-25 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV

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Pressure Control, Decay Heat Removal, and Essential Mechanical Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown, postulating only one spurious operation for non high-low pressure interface valves, and cold shutdown repairs. The specific actions required as a result of evacuating the Control Room are discussed in AOP-0031, "Shutdown From Outside the Main Control Room". Shutdown is accomplished by using Division I/Remote Shutdown powered components and system.

Location of the kitchen has no impact on the post fire safe shutdown analysis (SSA) since the SSA assumes that the entire Main Control Room is on fire and all circuits have failed.

Alternate Shutdown:

Alternate shutdown capability is provided due to the postulated effects of a Control Room fire. All Division I Post-Fire Safe Shutdown components and circuits that interface with the Control Room are provided with a means of isolating these circuits so that Division I components required for Post-Fire Safe Shutdown may be operated locally. Additional Division I local controls are provided, where necessary, to effect an alternate shutdown in the event of a control room fire. Emergency lighting is provided where required for ingress, egress, and operation of alternate shutdown controls. An alternate Division I power supply is provided to the Division II RCIC inboard steam supply valve (E51-MOVF063) with breakers and switches in the Auxiliary Building to allow operation should Division II power be lost.

9A.2.5.2.24 FIRE AREA C-27 East Pipe Chase

9A.2.5.2.24.1 Area Description:

Fire Area C-27 is defined as the Control Building Pipe Chase and consists of only one zone. This area in located along the eastern wall of the Control Building on elevations 70'-0", 98'-0", 116'-0", and 136'-0".

9A.2.5.2.24.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.2.24.3 Fire Detection:

The area is provided with a zoned detection system (SD-20) arranged to alarm locally and in the main control room.

9A.2.5.2.24.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Portable extinguishers and water hose stations are located adjacent to the area to assist in fire suppression.

9A.2.5.2.24.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.24.6 Post-Fire Safe Shutdown Equipment:

Division II cable trays

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9A.2.5.2.24.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-27 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.2.25 FIRE AREA C-29 NW Vestibule

9A.2.5.2.25.1 Area Description:

Fire Area C-29 is defined as the North west stairwell and consists of only one zone. This area is the stairwell and surrounding vestibule in the northwest quadrant of elevations 70'-0", 98'-0" , 116'-0" and 136'-0" of the Control Building.

9A.2.5.2.25.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.2.25.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.2.25.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.2.25.5 Fire Barrier:

Reinforced concrete construction separates the area from adjacent areas.

9A.2.5.2.25.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.2.25.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area C-29 could potentially affect systems and components necessary to provide Essential Mechanical/Environmental Support. No mitigating features are required to ensure that at least one system remains available to achieve Post-Fire Safe Shutdown. All Divisions of Electrical Power are available, since only the Control Room HVAC Recirculation flow path is affected. Shutdown is accomplished by using either Division I or II powered components and system.

9A.2.5.2.26 FIRE AREA C-30 Stairwell No. 1

9A.2.5.2.26.1 Area Description:

Fire Area C-30 is defined as the Stairwell No. 1 and consists of only one zone. This area is Stairwell No. 1 and surrounding vestibule in the

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southwest quadrant of elevations 98'-0", 116'-0" and 136'-0" of the Control Building. This stairway allows access between the Control and Turbine Buildings at elevation 95'-0".

9A.2.5.2.26.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.2.26.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.2.26.4 Fire Suppression:

Sprinkler systems are provided in areas of the Control Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system. Portable extinguishers and water hose stations are located throughout the building.

9A.2.5.2.26.5 Fire Barrier:

Reinforced concrete construction and 3-hour rated elevator doors separate the area from adjacent areas.

9A.2.5.2.26.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.2.26.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.3 Diesel Generator Building

The diesel generator building contains the Division I, II, and III (HPCS) diesel generator systems on automatic start standby service. These three systems provide power to essential equipment if both normal and preferred station service power sources are lost. The building is a reinforced concrete structure with 2 ft thick reinforced concrete barrier walls provided to separate each diesel system. Fuel oil storage tanks are in sand-filled reinforced concrete vaults beneath each diesel generator room and do not expose the systems to fire. One 550-gal diesel engine fuel oil day tank is located in each diesel room.

The diesel generator building is divided into Fire Areas prefixed by "DG-". Fire wall separation of the Division I, II, and III (HPCS) diesel generator systems preclude a fire in one section from disabling both systems. The HPCS diesel generator system is located between the Division I and II systems and is also separated by minimum 3-hr, fire-rated barriers.

9A.2.5.3.1 Radioactive Release Analysis

There is no source of radioactivity in this building. Redundancy and arrangements described previously would preclude a single fire event in this building from compromising the functions required to prevent a release of radiation from sources outside the building.
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9A.2.5.3.2 FIRE AREA DG-1 Division II Fuel Storage Tank

9A.2.5.3.2.1 Area Description:

Fire Area DG-1 is defined as the Division II Fuel Storage Vault and consists of only one zone. This area is a sand filled vault. This area is located in the northern third of the 70'-0" elevation of the Diesel Generator Building.

9A.2.5.3.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. There are no combustibles in the area.

9A.2.5.3.2.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.3.2.4 Fire Suppression:

Sprinkler systems are provided in areas of the Diesel Building. Automatic sprinkler systems are not provided in this area. Fire Loadings do not justify a fixed fire suppression system.

9A.2.5.3.2.5 Fire Barrier:

Reinforced concrete barriers are provided to contain the sand and tank. Void spaces are provided between vaults.

9A.2.5.3.2.6 Post-Fire Safe Shutdown Equipment:

Fuel Oil storage tank (1EGF*TK1B) and transfer pump (1EGF*P1B)

9A.2.5.3.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-1 could potentially affect systems and components necessary to provide Essential Electrical Power. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.3.3 FIRE AREA DG-2 Division III Fuel Storage Tank

9A.2.5.3.3.1 Area Description:

Fire Area DG-2 is defined as the Division III Fuel Storage Vault and consists of only one zone. This area is a sand filled vault. This area is located on the 70'-0" elevation of the Diesel Generator Building between the Division I and Division II Fuel Oil Storage Tank Rooms

9A.2.5.3.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. There are no combustible in the area.

9A.2.5.3.3.3 Fire Detection:

The area is not provided with a zoned detection system.

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9A.2.5.3.3.4 Fire Suppression:

Sprinkler systems are provided in areas of the Diesel Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system.

9A.2.5.3.3.5 Fire Barrier:

Reinforced concrete barriers are provided to contain the sand and tank. Void spaces are provided between vaults.

9A.2.5.3.3.6 Post-Fire Safe Shutdown Equipment:

Fuel Oil storage tank (1EGF*TK1C) and transfer pump (1EGF*P1C)

9A.2.5.3.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-2 could potentially affect only the Division III Diesel Generator Fuel Storage Tank. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.3.4 FIRE AREA DG-3 Division I Fuel Storage Tank

9A.2.5.3.4.1 Area Description:

Fire Area DG-3 is defined as the Division I Fuel Storage Vault and consists of only one zone. This area is a sand filled vault. This area is located in the southern third of the 70'-0" elevation of the Diesel Generator Building.

9A.2.5.3.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. There are no combustible in the area.

9A.2.5.3.4.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.3.4.4 Fire Suppression:

Sprinkler systems are provided in areas of the Diesel Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed fire suppression system.

9A.2.5.3.4.5 Fire Barrier:

Reinforced concrete barriers are provided to contain the sand and tank. Void spaces are provided between vaults.

9A.2.5.3.4.6 Post-Fire Safe Shutdown Equipment:

Fuel Oil storage tank (1EGF*TK1A) and transfer pump (1EGF*P1A)

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9A.2.5.3.4.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-3 could potentially affect only the Division I Diesel Generator Fuel Storage Tank. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.3.5 FIRE AREA DG-4 Division II Diesel Generator Room

9A.2.5.3.5.1 Area Description:

Fire Area DG-4 is defined as the Division II Diesel Generator Room and consists of two zones. Zone one is the Diesel Generator Room on elevation 98'-0" and Zone two is the air intake and exhaust areas on elevation 126'-0". These area are located in the northern third of the 98'-0" and 126'-0" elevations of the Diesel Generator Building.

9A.2.5.3.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is oil in the Diesel Engine.

9A.2.5.3.5.3 Fire Detection:

The area is provided with zoned detection systems (FD-16 and SD-105) arranged to alarm locally and in the main control room. The diesel generator control rooms are provided with a smoke detection system arranged to alarm locally and in the main control room.

9A.2.5.3.5.4 Fire Suppression:

The diesel generator room is protected by automatically actuated preaction sprinkler system PS-2A. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduits, grating, or ductwork. Actuation is through a heat detection system which is arranged to alarm locally and in the main control room. Portable extinguishers are provided in the room. Hose coverage is possible by use of the equipment located at outside yard hydrants and hose houses. Inside hose stations are not considered to be useful for secondary suppression capability, since access to this room would be expected to be difficult in the event of a fire reaching proportions requiring hose use.

9A.2.5.3.5.5 Fire Barrier:

Three hour rated reinforced concrete construction separates each diesel generator area.

9A.2.5.3.5.6 Post-Fire Safe Shutdown Equipment:

Diesel Generator (1EGS*EG1B), Starting Air Tanks (1EGA*TK1B/1D/2B/2D), Engine Control Panel (1EGS*PNL3B), Diesel Control Panel (1EGS*EG1B), and associated equipment.

9A.2.5.3.5.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-4 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical/Environmental Support. Mitigating features are not required

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to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.3.6 FIRE AREA DG-5 Division III Diesel Generator Room

9A.2.5.3.6.1 Area Description:

Fire Area DG-5 is defined as the Division III Diesel Generator Room and consists of two zones. Zone one is the Diesel Generator Room on elevation 98'-0" and Zone two is the air intake and exhaust areas on elevation 126'-0". These areas are located on elevations 98'-0" and 126'-0" of the Diesel Generator Building between The Division I and Division II Diesel Generator Rooms.

9A.2.5.3.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is oil in the Diesel Engine.

9A.2.5.3.6.3 Fire Detection:

The area is provided with zoned detection systems (FD-17 and SD-105) arranged to alarm locally and in the main control room.

9A.2.5.3.6.4 Fire Suppression:

The diesel generator room is protected by automatically actuated preaction sprinkler system PS-2B. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduits, grating, or ductwork. Actuation is through a heat detection system which is arranged to alarm locally and in the main control room. Portable extinguishers are provided in the room. Hose coverage is possible by use of the equipment located at outside yard hydrants and hose houses. Inside hose stations are not considered to be useful for secondary suppression capability, since access to this room would be expected to be difficult in the event of a fire reaching proportions requiring hose use.

9A.2.5.3.6.5 Fire Barrier:

Three hour rated reinforced concrete construction separates each diesel generator area.

9A.2.5.3.6.6 Post-Fire Safe Shutdown Equipment:

Diesel Generator (1E22*ESS001), Engine Control Panel (1E22*PNLS001) and associated equipment.

9A.2.5.3.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-5 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control and Essential Mechanical/Electrical Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.
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9A.2.5.3.7 FIRE AREA DG-6 Division I Diesel Generator Room

9A.2.5.3.7.1 Area Description:

Fire Area DG-6 is defined as the Division I Diesel Generator Room and consists of two zones. Zone one is the Diesel Generator Room on elevation 98'-0" and Zone two is the air intake and exhaust areas on elevation 126'-0". These areas are located in the southern third of the 98'-0" and 126'-0" elevations of the Diesel Generator Building.

9A.2.5.3.7.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is oil in the Diesel Engine.

9A.2.5.3.7.3 Fire Detection:

The area is provided with zoned detection systems (FD-18 and SD-105) arranged to alarm locally and in the main control room.

9A.2.5.3.7.4 Fire Suppression:

The diesel generator room is protected by automatically actuated preaction sprinkler system PS-2C. Sprinkler heads have been installed such that spray patterns are not obstructed by cable trays, conduits, grating, or ductwork. Actuation is through a heat detection system which is arranged to alarm locally and in the main control room. Portable extinguishers are provided in the room. Hose coverage is possible by use of the equipment located at outside yard hydrants and hose houses. Inside hose stations are not considered to be useful for secondary suppression capability, since access to this room would be expected to be difficult in the event of a fire reaching proportions requiring hose use.

9A.2.5.3.7.5 Fire Barrier:

Three hour rated reinforced concrete construction separates each diesel generator area.

9A.2.5.3.7.6 Post-Fire Safe Shutdown Equipment:

Diesel Generator (1EGS*EG1A), Starting Air Tanks (1EGA*TK1A/1C/2A/2C), Engine control Panel (1EGS*PNL3A), Diesel Control Panel (1EGS*EG1A) and associated equipment.

9A.2.5.3.7.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-6 could potentially affect systems and components necessary to provide Essential Electrical Power, Decay Heat Removal and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.3.8 FIRE AREA DG-7 Division II Diesel Electrical Tunnel

9A.2.5.3.8.1 Area Description:

Fire Area DG-7 is defined as the Division II Diesel Electrical Tunnel and consists of only one zone. This area is located on elevation 70' 0' of the Diesel Generator Building between the Division II and Division III Fuel Oil storage vaults.

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9A.2.5.3.8.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. There are no combustibles in the area.

9A.2.5.3.8.3 Fire Detection:

The area is provided with a zoned detection system (SD-105) arranged to alarm locally and in the main control room.

9A.2.5.3.8.4 Fire Suppression:

Sprinkler systems are provided in areas of the Diesel Building. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed suppression system.

9A.2.5.3.8.5 Fire Barrier:

Three hour rated reinforced concrete construction separates the area from adjacent areas.

9A.2.5.3.8.6 Post-Fire Safe Shutdown Equipment:

Division II cabling in conduit.

9A.2.5.3.8.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area DG-7 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.4 Electrical Tunnels

The electrical tunnels contain Division I, II, and III, and non divisional cables. With the exception of ET-4 the electrical tunnels run along the base elevations of the building they are adjacent, most at elevation 67'-6".

The Electrical Tunnels are divided into Fire Areas prefixed by "ET-".

9A.2.5.4.1 Radioactive Release Analysis

There is no equipment within electrical tunnels capable of releasing radioactive materials. Electrical equipment within the tunnels for control and operation of safety-related systems components located in other buildings is arranged and segregated so that radioactive release from those buildings to the atmosphere is prevented.

9A.2.5.4.2 FIRE AREA ET-1 B-Tunnel East

9A.2.5.4.2.1 Area Description:

Fire Area ET-1 is defined as the B-Tunnel East and consists of only one zone. This area is located along the western wall of the Diesel and Control Buildings on elevation 67'-6".

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9A.2.5.4.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.4.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-79 and SD-81) arranged to alarm locally and in the main control room.

9A.2.5.4.2.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. Automatic Sprinkler systems (WS-8D and WS-8F) are arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

Exemptions/Deviations Summary
Area wide automatic fire suppression is not provided for this area. The NRC staff has evaluated this condition and accepted a deviation from Section C.5.b of BTP CMEB 9.5-1 for this area per NUREG-0989, Supplement No. 3.

9A.2.5.4.2.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

9A.2.5.4.2.6 Post-Fire Safe Shutdown Equipment:

Division I cables in cable trays

9A.2.5.4.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area ET-1 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include providing fire wrap to selected cables to preclude damage in the event of a fire. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.4.3 FIRE AREA ET-2 B-Tunnel West

9A.2.5.4.3.1 Area Description:

Fire Area ET-2 is defined as the B-Tunnel West and consists of only one zone. This area is located west of area ET-1 and along the Fuel Building on elevation 67'-6".

9A.2.5.4.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.4.3.3 Fire Detection:

The area is provided with zoned detection systems (SD-80 and SD-82) arranged to alarm locally and in the main control room.

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9A.2.5.4.3.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. These systems (WS-8E and WS-8G) are arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

9A.2.5.4.3.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

9A.2.5.4.3.6 Post-Fire Safe Shutdown Equipment:

Division II cables in cable trays

9A.2.5.4.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area ET-2 could potentially affect systems and components necessary to provide Essential Electrical Power, RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include manual operation of equipment required for Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.4.4 FIRE AREA ET-3 T-Tunnel West El. 67'-6"

9A.2.5.4.4.1 Area Description:

Fire Area ET-3 is defined as the T-Tunnel West elevation 67'-6" and consists of only one zone. This area is located along the western wall of the Turbine Building on elevation 67'-6".

9A.2.5.4.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.4.4.3 Fire Detection:

The area is provided with a zoned detection system (SD-84) arranged to alarm locally and in the main control room.

9A.2.5.4.4.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. This system (WS-8I) is arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

9A.2.5.4.4.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

9A.2.5.4.4.6 Post-Fire Safe Shutdown Equipment:

None

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9A.2.5.4.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.4.5 FIRE AREA ET-4 T-Tunnel West El. 95'

9A.2.5.4.5.1 Area Description:

Fire Area ET-4 is defined as the T-Tunnel West elevation 95'-0" and consists of only one zone. This area is located between the Radwaste Building and the Auxiliary Control Building on elevation 95'-0".

9A.2.5.4.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.4.5.3 Fire Detection:

The area is provided with a zoned detection system (SD-85) arranged to alarm locally and in the main control room.

9A.2.5.4.5.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. This system (WS-8J) is arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

9A.2.5.4.5.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

9A.2.5.4.5.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.4.5.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.4.6 FIRE AREA ET-5 B-Tunnel South

9A.2.5.4.6.1 Area Description:

Fire Area ET-5 is defined as the B-Tunnel South Cable Chase and consists of only one zone. This area is located at the southern end of the electrical tunnel along the southwest wall of the Control Building on elevation 67'-0".

9A.2.5.4.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 3 hours. The major contributor is cable insulation.

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9A.2.5.4.6.3 Fire Detection:

The area is provided with a zoned detection system (SD-20) arranged to alarm locally and in the main control room.

9A.2.5.4.6.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. This system (AS-6C) is arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

9A.2.5.4.6.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

9A.2.5.4.6.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.4.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area ET-5 could potentially affect systems and components necessary to RPV Level Control and RPV Pressure Control. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown, as the only components affected have their power removed during normal operation. Shutdown is accomplished by using either Division I or II powered components and system.

9A.2.5.4.7 FIRE AREA ET-6 C Tunnel

9A.2.5.4.7.1 Area Description:

Fire Area ET-6 is defined as the C-Tunnel and consists of only one zone. This area is located along the eastern wall of the Turbine Building on elevation 67'-6".

9A.2.5.4.7.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.4.7.3 Fire Detection:

The area is provided with zoned detection systems (SD-76, SD-77, SD-78, SD-160 and SD-161) arranged to alarm locally and in the main control room.

9A.2.5.4.7.4 Fire Suppression:

Zoned water spray systems are provided throughout the electrical tunnels. These systems (WS-8A, WS-8AA, WS-8B, WS-8BB and WS-8C) are arranged to actuate upon operation of zoned detectors. Operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in an adjoining building.

9A.2.5.4.7.5 Fire Barrier:

Fire rated barriers separate this area from other areas.

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9A.2.5.4.7.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.4.7.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.5 Fuel Building

The fuel building contains safety-related components including piping and cables for the following systems:

1. Fuel Pool Cooling (SFC)
2. Reactor Plant Component Cooling Water (RPCCW)
3. Fuel Handling and Storage
4. Fuel Building Ventilation (HVF)
5. Containment penetration valve of the Control Rod Drive
6. Fuel Transfer (FTS)
7. Termination Cabinets

The building is a reinforced concrete structure, including exterior and interior walls and roof.

The Fuel Building is identified as Fire Area FB-1. Area FB-1 contains equipment, instrumentation, and cables for both Division I and II systems.

This area contains cabling for instrumentation of reactor level and pressure and drywell pressure.

9A.2.5.5.1 Radioactive Release Analysis

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The fuel building ventilation system consists of a supply air subsystem, unit coolers subsystem, exhaust air subsystem, and charcoal filtration subsystem, with their associated fans, filters, ductwork, dampers, and controls. Cooling is provided by air conditioning unit and fan coil unit coolers for various cubicles. During normal operation, ventilation air is exhausted directly to the atmosphere through the roof of the building by exhaust fans. Upon detection of high airborne radioactivity concentration exceeding set point, air is automatically diverted through redundant charcoal filtration units (alarming the main control room operator simultaneously), thereby preventing an unacceptable release of radioactivity to the environment. During fuel handling operation, all ventilation air is routed through charcoal filtration units before exhausting to atmosphere. The fuel building is maintained at a negative pressure of 1/4 in W.G. relative to outdoor atmosphere during movement of recently irradiated fuel, which further reduces possible radiation releases. Each filter unit is sized to provide adequate filtration and reduce radioactive releases. Redundant radiation monitors are provided in the exhaust duct near the roof to detect release of radioactivity to the environment and alarm the main control room operators.

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9A.2.5.5.2 FIRE AREA FB-1 Fuel Building

9A.2.5.5.2.1 Area Description:

Fire Area FB-1 is defined as the entire Fuel Building and consists of two zones; FB-1/Z-1 and FB-1/Z-2. Zone FB-1/Z1 is the Fuel Building

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except for what is contained in zone FB-1/Z-2. Zone FB-1/Z-2 is the Division II Spent Fuel Pool Pump room on elevation 70'-0" and 95'-0".

9A.2.5.5.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.5.2.3 Fire Detection:

The building is provided with zoned detection systems (SD-33, SD-44, SD-51, SD-59, SD-91, SD-94, SD-110, SD-111, SD-121, SD-123, SD-124 and SD-155) arranged to alarm locally and in the main control room. Thermistor detectors FD-35 and FD-36 in the charcoal filters provide alarm functions at and through the local fire alarm panel to the main control room.

9A.2.5.5.2.4 Fire Suppression:

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Automatic Sprinkler system AS-5 is provided for the new fuel receiving area (el. 95'-0"), for the spent fuel pool cooling pump 1SFC*P1A cubicle (el. 70'-0"), and for the crescent areas at elevations 70'-0" and 113'-0". Manual dry pipe sprinklers are installed in the spent fuel cask handling area located exterior and north of the Fuel Building. Charcoal filters have individual water spray systems (WS-5A and WS-5B) manually actuated by the opening of local valves. Water flow is alarmed locally and in the main control room by means of the building fire alarm panel. Fire loadings do not justify fixed fire suppression systems in remaining areas of the building. Portable extinguishers and water hose stations are provided throughout the building.

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9A.2.5.5.2.5 Fire Barrier:

The Fuel Building is a single fire area, provided with a measure of separation by the reinforced concrete floors and walls.

9A.2.5.5.2.6 Post-Fire Safe Shutdown Equipment:

There are no HVF or SFC components required for Post-Fire Safe Shutdown. |

9A.2.5.5.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area FB-1 could potentially affect systems and components necessary to provide Decay Heat Removal and Essential Mechanical Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using either Division I or II powered components and system.

9A.2.5.6 Standby Cooling Tower

The Standby Cooling Tower utilizes twenty safety-related service water cooling fans.

The pump house contains the following safety-related equipment:

1. Four standby service water pumps

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2. Two motor control centers
3. Ventilation system.

The remote air intake room contains the following safety-related equipment:

1. Remote air intake system
2. Radiation monitoring system
3. Ventilation system.

The standby cooling tower, including the standby service water pump house and remote air intake room, is constructed of reinforced concrete.

The Standby Service Water Cooling Tower, Pump House, and Control Room Remote Air Intake Building are divided into Fire Areas prefixed by "PH-". Redundancy is provided for components required for safe plant shutdown. Each Fire Area is separated by 3-hr rated fire barriers.

9A.2.5.6.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.6.2 FIRE AREA PH-1 Standby Cooling Tower (Division I)

9A.2.5.6.2.1 Area Description:

Fire Area PH-1 is defined as the Division I portion of the Standby Cooling Tower and consists of two zones. Zone one is the area on elevation 118'-4" and Zone 2 is the areas on elevations 137'-10" and 154'-2" of the Standby Cooling Tower. These zones are located on the northeast portions of these elevations.

9A.2.5.6.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.6.2.3 Fire Detection:

The area is provided with a zoned detection system (SD-72) arranged to alarm locally and in the main control room.

9A.2.5.6.2.4 Fire Suppression:

Portable extinguishers are provided. Hose coverage is possible by use of equipment located at an outside yard hydrant and hose houses. Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.6.2.5 Fire Barrier:

Two and half-foot thick reinforced concrete wall separate PH-1 from PH-2.

9A.2.5.6.2.6 Post-Fire Safe Shutdown Equipment:

Standby Service Water pumps (1SWP*P2A/C), vent fans (1HVY*FN1A/2A), Division I cable

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9A.2.5.6.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area PH-1 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division II powered components and system.

9A.2.5.6.3 FIRE AREA PH-2 Standby Cooling Tower (Division II)

9A.2.5.6.3.1 Area Description:

Fire Area PH-2 is defined as the Division II portion of the Standby Cooling Tower and consists of two zones. Zone one is the area on elevation 118'-4" and Zone 2 is the areas on elevations 137'-10" and 154'-2" of the Standby Cooling Tower. These zones are located on the southwest portions of these elevations.

9A.2.5.6.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.6.3.3 Fire Detection:

The area is provided with a zoned detection system (SD-73) arranged to alarm locally and in the main control room.

9A.2.5.6.3.4 Fire Suppression:

Portable extinguishers are provided. Hose coverage is possible by use of equipment located at an outside yard hydrant and hose houses. Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.6.3.5 Fire Barrier:

Two and half-foot thick reinforced concrete wall separate PH-2 from PH-1.

9A.2.5.6.3.6 Post-Fire Safe Shutdown Equipment:

Standby Service Water pumps (1SWP*P2B/D), vent fans (1HVY*FN1B/2B), Division II cable

9A.2.5.6.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area PH-2 could potentially affect systems and components necessary to provide Essential Electrical Power and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using Division I powered components and system.

9A.2.5.6.4 FIRE AREA PH-3 Remote Air Intake Room

9A.2.5.6.4.1 Area Description:

Fire Area PH-3 is defined as the Remote Air intake Room and consists of only one zone. This area is located on the northwest corner of the Standby Cooling Tower between elevations 118'-4" and 161'-10".

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9A.2.5.6.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.6.4.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.6.4.4 Fire Suppression:

Portable extinguishers are provided. Hose coverage is possible by use of equipment located at an outside yard hydrant and hose houses. Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.6.4.5 Fire Barrier:

Two and half-foot thick reinforced concrete walls.

9A.2.5.6.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.6.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.6.5 FIRE AREA PH-4 Division II SCT Fans

9A.2.5.6.5.1 Area Description:

Fire Area PH-4 is defined as the Division II SCT Fan area and consists of only one zone. This area is located on the south and west side of the Standby Cooling Tower.

9A.2.5.6.5.2 In Situ/Transient Combustible Loading/Fire Severity:

This area is internal to the Standby Service Water Cooling Tower and is accessible only by crane. There is no direct communication to fire areas PH-1, PH-2 or PH-3. Cooling tower fill material is ceramic. The only combustible materials in the area are fan motors and cables in conduit. With negligible combustibles in the area, and no exposure to other areas, combustible load and equivalent fire severity calculations are not required.

9A.2.5.6.5.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.6.5.4 Fire Suppression:

Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.6.5.5 Fire Barrier:

Two and half-foot thick reinforced concrete walls.

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9A.2.5.6.5.6 Post-Fire Safe Shutdown Equipment:

Division II fans (1SWP*FN1B, 1D, 1F, 1H, 1K, 1M, 1P, 1R, 1T, 1V)

9A.2.5.6.5.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area PH-4 could potentially affect systems and components necessary to provide Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using either Division I or II powered components and system.

9A.2.5.6.6 FIRE AREA PH-5 Division I SCT Fans

9A.2.5.6.6.1 Area Description:

Fire Area PH-5 is defined as the Division I SCT Fan area and consists of only one zone. This area is located on the north and east side of the Standby Cooling Tower.

9A.2.5.6.6.2 In Situ/Transient Combustible Loading/Fire Severity:

This area is internal to the Standby Service Water Cooling Tower and is accessible only by crane. There is no direct communication to fire areas PH-1, PH-2 or PH-3. Cooling tower fill material is ceramic. The only combustible materials in the area are fan motors and cables in conduit. With negligible combustibles in the area, and no exposure to other areas, combustible load and equivalent fire severity calculations are not required.

9A.2.5.6.6.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.6.6.4 Fire Suppression:

Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.6.6.5 Fire Barrier:

Two and half-foot thick reinforced concrete walls.

9A.2.5.6.6.6 Post-Fire Safe Shutdown Equipment:

Division I fans (1SWP*FN1A, 1C, 1E, 1G, 1J, 1L, 1N, 1Q, 1S, 1U)

9A.2.5.6.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area PH-5 could potentially affect systems and components necessary to provide Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. Shutdown is accomplished by using either Division I or II powered components and system.

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9A.2.5.7 Pipe Tunnels

These tunnels contain piping associated with the following systems:

1. Service Water
2. Reactor Plant Component Cooling Water
3. Condensate Makeup and Draw-off
4. Makeup Water
5. Control Rod Drive
6. Fuel Pool Cooling and Cleanup
7. Radioactive Liquid Waste
8. Service Air
9. Instrument Air
10. Turbine Plant Equipment Drains
11. Reactor Water Cleanup
12. High Pressure Core Spray
13. Turbine Building Floor Drains
14. Reactor Building Equipment Drains
15. Reactor Building Floor Drains
16. Auxiliary Steam
17. Auxiliary Boiler Steam

Division I, II, and III, and non divisional cable trays are also located in these tunnels. Trays are installed in accordance with Regulatory Guide 1.75.

The Pipe Tunnels are divided into Fire Areas prefixed by "PT-". Only PT-1 contains Post-Fire Safe Shutdown Equipment. Equipment in the area includes Division I and II Standby Service Water cables and components, as well as cables for equipment supporting Standby Service Water. The Division I Control Building Chilled Recirculation Pumps are also affected.

9A.2.5.7.1 Radioactive Release Analysis

The pipe tunnels are not considered susceptible to uncontrolled radioactive releases. No system components within the tunnels can in themselves cause such a release in other areas which cannot be controlled by equipment within those areas.

9A.2.5.7.2 FIRE AREA PT-1 E, F, & G Tunnels

9A.2.5.7.2.1 Area Description:

Fire Area PT-1 is defined as the E, F, & G Tunnels and consists of only one zone. These tunnels are located along the north and west walls of the Fuel Building, along the western wall of PT-2, and from the Fuel Building to the Standby Service Water Cooling Tower on elevation 70'-0". This area also includes the Standby Service Water Cooling Tower Cable chases.

9A.2.5.7.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.7.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-86, SD-87, SD-88 and SD-89) arranged to alarm locally and in the main control room.

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9A.2.5.7.2.4 Fire Suppression:

Zoned water spray systems (WS-8K, WS-8L, WS-8M and WS-8N) are provided for protection of cable trays and motor operated valves located in these tunnels. These systems are designed to actuate upon operation of zoned detectors. System operation is indicated in the main control room. Tunnel areas can be reached by manual hose stations located either in a tunnel area or in adjoining building.

9A.2.5.7.2.5 Fire Barrier:

Reinforced concrete fire barriers separate the tunnels from the adjacent areas.

9A.2.5.7.2.6 Post-Fire Safe Shutdown Equipment:

Division I and II cable in trays, level transmitters, MOVs

9A.2.5.7.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area PT-1 could potentially affect systems and components necessary to provide Essential Mechanical/Environmental Support. Mitigating features are required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown. The required mitigating features include providing fire wrap to selected cables to preclude damage in the event of a fire. Shutdown is accomplished by using Division I powered components and system.

Since neither division of Standby Service Water will be available, an analysis was performed to determine if Normal Service Water, including its required power supplies and support systems , would remain available and be unaffected by a fire in PT-1. Results of this analysis indicate that Normal Service Water will remain available, as documented in Entergy Calculation G13.18.3.6*12, "10CFR50 Appendix R Analysis of Fire Area PT-1." All other Division II Post-Fire Safe Shutdown systems and components are available.

9A.2.5.7.3 FIRE AREA PT-2 E-Tunnel (SWP/CCP)

9A.2.5.7.3.1 Area Description:

Fire Area PT-2 is defined as the E Tunnel and consists of only one zone. This area is located along the western wall of the Auxiliary Building on elevation 70'-0".

9A.2.5.7.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.7.3.3 Fire Detection:

The area is provided with zoned detection systems (SD-86) arranged to alarm locally and in the main control room.

9A.2.5.7.3.4 Fire Suppression:

Tunnel areas can be reached by manual hose stations located either in a tunnel area or in adjoining building.

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9A.2.5.7.3.5 Fire Barrier:

Reinforced concrete fire barriers separate the tunnels from the adjacent areas.

9A.2.5.7.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.7.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.8 Reactor Building

The reactor building contains safety-related components including piping and cables of the following systems:

1. Residual Heat Removal (RHR)
2. Control Rod Drive (CRD) Scram Components
3. High Pressure Core Spray (HPCS)
4. Fuel Pool Cooling (SFC)
5. Standby Liquid Control (SLC)
6. Standby Service Water (SWP)
7. Low Pressure Core Spray (LPCS)
8. Reactor Water Cleanup (RWCU)
9. Reactor Recirculation (RCS)
10. Reactor Building Ventilation (HVR)
11. Hydrogen Recombiners
12. Reactor Pressure Vessel
13. Reactor Core Isolation Cooling (RCIC)
14. Main Steam
15. Feedwater (FWS)
16. Main Steam Drain
17. Containment Hydrogen Mixing (CPM)
18. Main Steam Safety and Relief Valves
19. Containment Isolation Valves for the following systems not listed previously:
    a. Containment Hydrogen Purge
    b. Reactor Plant Floor Drains
    c. Reactor Building Equipment Drains (DER)
    d. Service Air (SAS)
    e. Instrument Air (IAS)
    f. Condensate Makeup and Draw-off (CNS)
    g. Ventilation Chilled Water
    h. Fire Protection - Water
    I. Inclined Fuel Transfer Tube
    j. Containment and Drywell Purge
    k. Reactor Plant Component Cooling Water (RPCCW)
20. Leakage Monitoring (LMS)

The reactor building consists of a circular reinforced concrete superstructure (shield building), a steel containment, reinforced concrete drywell structure, and the steel reactor pressure vessel. The 5-ft space between the shield building and the steel containment is defined as the annulus. The working area of the containment is approximately 20 ft wide.

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The Reactor Building is divided into Fire Areas prefixed by "RC-" outside of the Drywell and "RDW-" inside the Drywell. The Reactor Building Fire Areas also extend into the Main Steam Tunnel in the Auxiliary Building out to the Jet Impingement Wall.

9A.2.5.8.1 Radioactive Release Analysis

The portions of the reactor plant ventilation system (which includes the auxiliary building) which are provided to mitigate a possible release of radiation to the atmosphere are the continuous containment/drywell purge system, and the annulus pressure control system as described below.

The purge system is designed to either purge the containment or recirculate air during periods of testing the containment. The system has the capability of being operated at two different capacities. The normal system operating capacity is 7,000 cfm. This system consists of a centrifugal supply fan, ductwork, dampers, and an iodine filter unit with a centrifugal exhaust fan. A second system is provided to operate in the event of either a mechanical failure of the normal operating system or to purge the containment at a faster rate for pre-entry. This system has a capacity of 25,000 cfm and consists of a vaneaxial supply and exhaust fan, ductwork, piping, and dampers. The 25,000 cfm is passed through the standby gas treatment system (SGTS) using both filter trains before being exhausted to the atmosphere. Containment space cooling is provided by recirculation unit coolers. The purge system is classified as non-nuclear safety, with the exception of the containment and drywell isolation valves. During a LOCA, the containment and drywell are automatically isolated.

The annulus pressure control system is provided to maintain a sub-atmospheric pressure in the annulus during normal reactor operation. The system contains two 100 percent exhaust fans with associated dampers and takes suction from the annulus and exhausts directly to the plant exhaust stack. Classified as non-nuclear safety, the system is automatically isolated in the event of a LOCA. In the event of a LOCA or high radiation within the annulus, the exhaust is diverted to the standby gas treatment system. In the event of a LOCA, fission products from the containment are released into the annulus, diluted, and discharged to the atmosphere after filtration by SGTS.

The annulus mixing system is disabled.

Components of all systems are well separated and not subject to damage in the event of a single fire event.

9A.2.5.8.2 FIRE AREA RC-2 MS Tunnel North of Impingement Wall

9A.2.5.8.2.1 Area Description:

Fire Area RC-2 is defined as the Main Steam Tunnel north of the impingement wall and consists of two zones. Zone one is located inside the containment between the drywell wall and containment wall on
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elevation 114'-0" of the Reactor Building. Zone two is located outside the containment north of the impingement wall on elevation 114'-0" of the Auxiliary Building.

9A.2.5.8.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.8.2.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.8.2.4 Fire Suppression:

Sprinkler systems are not provided in the Reactor Building. Portable extinguishers and water hose stations are provided in the containment. Administrative controls are established to limit the introduction of combustibles and to provide fire protection equipment and manpower during shutdown.

9A.2.5.8.2.5 Fire Barrier:

This is the steam tunnel separated by reinforced concrete walls from adjacent areas. The Jet Impingement Wall, a structural steel composite assembly, serves to separate Fire Area RC-2 from Fire Area AB-10. The construction of this wall is not consistent with that of typical 3-hour rated fire barrier wall assemblies. This wall, however, has been qualified to be acceptable for the intended fire protection service and will not affect the redundant post fire Post-Fire Safe Shutdown capability. An evaluation determined that the existing configuration is acceptable for the intended fire protection service.

9A.2.5.8.2.6 Post-Fire Safe Shutdown Equipment:

Outboard MSIVs (1B21*AOVF028A/B/C/D), MSIV accumulators (1B21*TKA002A/B/C/D), MS guard pipes, RCIC Steam Feedwater, turbine plant. misc. drains, RHR suction line, RWCU piping, isolation valves

9A.2.5.8.2.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area RC-2 could potentially affect systems and components necessary to provide RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown.

The Main Steam Tunnel, outside the Steel Containment and north of the Jet Impingement Wall, contains Division I equipment, instrumentation, and cables only. Therefore in the event of a fire in this area, shutdown will be achieved using Division II. For the Main Steam Tunnel, inside the Reactor Building, between the Drywell and the Steel Containment, there is no Post-Fire Safe Shutdown related equipment. Because of the divisional equipment located in the Main Steam Tunnel outside Containment, Division II powered components and system will be used for Post-Fire Safe Shutdown.

9A.2.5.8.3 FIRE AREA RC-3 Reactor Building (82', 95', 114', 141', 162', 186') East

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9A.2.5.8.3.1 Area Description:

Fire Area RC-3 is defined as the East half of the Reactor Building from elevations 82' 0" through 186'-0" and consists of six zones, RC-3/Z-1, RC-3/Z-2, RC-3/Z-3, RC-3/Z-4, RC-3/Z-5 and RC-3/Z-6. Zone RC-3/Z-1 is located in the eastern half of the 82'-0" elevation of the Reactor Building. Zone RC-3/Z-2 is located in the eastern half of the 95'-0" elevation of the Reactor Building. Zone RC-3/Z-3 is located in the eastern half of the 114'-0" elevation of the Reactor Building. Zone RC-3/Z-4 is located in the eastern half of the 141'-0" elevation of the Reactor Building. Zone RC-3/Z-5 is located in the eastern half of the 162'-0" elevation of the Reactor Building. Zone RC-3/Z-6 is located in the eastern half of the 186'-0" elevation of the Reactor Building. Excluded from these zones is the Main Steam Tunnel area.

9A.2.5.8.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.8.3.3 Fire Detection:

The area is partially provided with zoned detection systems (SD-57, SD-104, SD-117, SD-119) arranged to alarm locally and in the main control room.

9A.2.5.8.3.4 Fire Suppression:

Sprinkler systems are not provided in the Reactor Building. Portable extinguishers and water hose stations are provided in the containment.

9A.2.5.8.3.5 Fire Barrier:

Reinforced concrete walls separate this area from surrounding areas and the drywell and steam tunnel.

9A.2.5.8.3.6 Post-Fire Safe Shutdown Equipment:

Hydraulic Control Units (HCU), electrical panels piping and valves for: HPCS, RHR, RPCCW, LPCS, CPM, CNS, SSW, DER, electrical termination cabinets.

9A.2.5.8.3.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area RC-3 could potentially affect systems and components necessary to provide RPV Level Control, RPV Pressure Control, Decay Heat Removal and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve safe shutdown.

<u>Separations Analysis</u>
RC-3 primarily contains Division II equipment and cables for monitoring RPV level and pressure, Suppression Pool temperature and level, and operational interlocks for RHR valves.

Zones Z-1, Z-2 and Z-3 contain three (3) Division I and four (4) Division II RTDs and associated cables for monitoring Suppression Pool temperature. Division I RTDs are separated from Division II RTDs by
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more than twenty (20) feet, and the divisional cables are routed in conduit. Only one RTD is required to supply Suppression Pool temperature indication.

The only combustible in Zone Z-2 is the Pernali Neutron shielding on the Drywell Equipment Hatch. This shielding is installed on the inside of the equipment hatch, between the hatch and the interior drywell door. The shielding is thus completely encased between two steel doors. Therefore the shielding is not included in the combustible loading calculation.

Zone Z-3 contains instrumentation and cables for monitoring Suppression Pool level, RPV level and pressure, and non-divisional cable trays 1TC512N, 1TK512N, 1TX512N, and 1TX530N. These trays are filled with USG Fire Code CT gypsum cement to provide a fire break between RC-3/Z-3 and RC-4/Z-3. This fire break is located approximately at azimuth 200°. For a fire occurring in Z-3, Division I instrumentation will be credited. Division I components which may be affected by a fire in Z-3 and the Division I components which will remain available are as follows:

Affected Component	Component Available
1CMS*RTD24G/J	1CMS*RTD24A/C/E
1CMS*RTD40C	1CMS*RTD40A

Based on the separation between the Division I and II components and the minimal potential effects of a fire from the in-situ combustibles, safe shutdown can be achieved. For a fire occurring in RC-3, Division I equipment in RC-4 will be available. All other safe shutdown equipment and systems will remain available.

System Auto Initiation Summary

This area contains cables for instrumentation which could generate fire induced spurious signals and inadvertently initiate the following systems. This signal is not credited for Appendix R safe shutdown and the signal will not adversely affect the ability to achieve safe shutdown.

SRV High Pressure Auto Initiation

Fire related cable damage to more than one instrument is required to induce a spurious Reactor Pressure Vessel high pressure signal which is not postulated for non-High/Low pressure interface components. However, should this spurious signal occur, adequate control of the Safety Relief Valves remains available from the Control Room to support safe shutdown. Additionally, Low Pressure Coolant Injection, RHR Trains A/B/C, Low Pressure Core Spray and High Pressure Core Spray are available to provide Reactor Pressure Vessel makeup and level control to mitigate the effects of the spurious SRV actuations.

RHR/LPCS/RCIC/HPCS Auto Initiation

Fire related cable damage to more than one instrument is required to induce a spurious Division I RHR, Division II RHR, LPCS, RCIC, and HPCS Initiation signal, which is postulated for High/Low pressure interface components only. However, should this spurious signal occur, adequate control of the affected systems remains available from the Control Room to support safe shutdown.
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Multiple SRV Spurious Actuation

Spurious opening of more than one SRV due to multiple fire induced cable-to-cable hot shorts is not postulated. In the unlikely event one or more SRVs spuriously open, Low Pressure Coolant Injection, RHR Train C, Low Pressure Core Spray, High Pressure Core Spray and RCIC are available to provide Reactor Pressure Vessel makeup and level control to mitigate the effects of the spurious SRV actuations.

The accident analysis design basis of the plant supports rapid RPV depressurization initiated at RPV Level 1 utilizing 7 SRVs in the ADS mode to achieve RPV injection with a low pressure injection system (LPCS, RHR-LPCI). The Appendix R scenario is conservatively assumed to initiate with RPV level at the low end of the normal operating band. This level represents more than 14 feet of RPV inventory above the accident analysis design basis RPV inventory. The amount of RPV inventory expended to reduce RPV pressure (i.e., stored energy removal) is essentially unchanged regardless of the number of SRVs which open. In the unlikely event more than 7 SRVs spuriously open due to fire related cable damage, the time to reach the low pressure injection system (LPCS, RHR) operating pressure is reduced and RPV makeup and level control will be initiated sooner. Therefore, multiple fire induced spurious SRV actuations postulated for the Appendix R safe shutdown scenario is bounded by the accident analysis design basis event.

If one or more SRVs spuriously open and can not be closed, the available RHR Train will be used in the Alternate Shutdown Cooling mode to achieve cold shutdown decay heat removal. A minimum of three SRVs is required to remain open to support this RHR mode.

9A.2.5.8.4 FIRE AREA RC-4 Reactor Building (82', 95', 114', 141', 162', 186') West

9A.2.5.8.4.1 Area Description:

Fire Area RC-4 is defined as the west half of Reactor Building from elevations 82'-0" through 162'-0" and consists of six zones, RC-4/Z-1, RC-4/Z-2, RC-4/Z-3, RC-4/Z-4, RC-4/Z-5 and RC-4/Z-6. Zone RC-4/Z-1 is located in the western half of the 82'-0" elevation of the Reactor Building. Zone RC-4/Z-2 is located in the western half of the 95'-0" elevation of the Reactor Building. Zone RC-4/Z-3 is located in the western half of the 114'-0" elevation of the Reactor Building. Zone RC-4/Z-4 is located in the western half of the 141'-0" elevation of the Reactor Building. Zone RC-4/Z-5 is located in the western half of the 162'-0" elevation of the Reactor Building. Zone RC-4/Z-6 is located in the western half of the 186'-0" elevation of the Reactor Building. Excluded from these zones is the Main Steam Tunnel area.

9A.2.5.8.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.8.4.3 Fire Detection:

The area is partially provided with zoned detection systems (SD-57, SD-104, SD-117, SD-119) arranged to alarm locally and in the main control room.
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9A.2.5.8.4.4 Fire Suppression:

Sprinkler systems are not provided in the Reactor Building. Portable extinguishers and water hose stations are provided in the containment.

9A.2.5.8.4.5 Fire Barrier:

Reinforced concrete walls separate this area from the drywell and adjacent areas (shield wall).

9A.2.5.8.4.6 Post-Fire Safe Shutdown Equipment:

RWCU piping, valves and heat exchangers (regenerative and nonregenerative); SSW piping and valves; RWCU backwash receiving tank, piping and valves; electrical termination cabinets; rad monitor cabinets; SSW, RHR, SFC, CCP CPM, and HVN piping and valves; SLC tank and pumps; RCS piping and valves

9A.2.5.8.4.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area RC-4 could potentially affect systems and components necessary to provide RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure that at least one system remains available to achieve safe shutdown.

Separations Analysis

RC-4 contains primarily Division I equipment and cables for monitoring Reactor Vessel level and pressure, Suppression Pool temperature and level, and operational interlocks for RHR valves.

Zones Z-1, Z-2 and Z-3 contain four (4) Division I and three (3) Division II RTDs and associated cables for monitoring Suppression Pool temperature. Division I equipment is separated from Division II equipment by more than twenty (20) feet, and the divisional cables are routed in conduit. Only one RTD is required to supply Suppression Pool temperature indication.

Zone Z-3 contains instrumentation and cables for monitoring Suppression Pool level and RPV level and pressure. For a fire in Z-3, Division II instrumentation will be credited. A fire in Z-3 will affect the following Division II instrumentation with the listed instrumentation remaining available:

Affected Component	Component Available
1CMS*RTD24B/D	1CMS*RTD24F/H/K
1CMS*RTD40D	1CMS*RTD40B
1B21*LTN081D	1B21*LTN081B
1C71*PTN050D	1C71*PTN050B

Zone Z-4 contains primarily Division I cables. If a fire occurs in this zone, Division II systems in RC-3 may be used to shut down the plant.

Zone Z-6 contains only cable.

Based on the separation between the Division I and II components and the minimal potential effects of a fire from the in-situ combustibles, safe shutdown can be achieved. For a fire occurring in RC-4, Division II equipment in RC-3 will be available. All other safe shutdown equipment and systems will remain available.

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System Auto Initiation Summary

This area contains cables and tubing for instrumentation which could generate fire induced spurious signals and inadvertently initiate the following systems. This signal is not credited for Appendix R safe shutdown and the signal will not adversely affect the ability to achieve safe shutdown.

SRV High Pressure Auto Initiation

Fire related cable damage to more than one instrument is required to induce a spurious Reactor Pressure Vessel high pressure signal which is not postulated for non-High/Low pressure interface components. However, should this spurious signal occur, adequate control of the Safety Relief Valves remains available from the Control Room to support safe shutdown. Additionally, Low Pressure Coolant Injection, RHR Train C, Low Pressure Core Spray, High Pressure Core Spray and RCIC are available to provide Reactor Pressure Vessel makeup and level control to mitigate the effects of the spurious SRV actuations.

RHR/LPCS/RCIC/HPCS Auto Initiation

Fire related cable damage to more than one instrument is required to induce a spurious RHR, LPCS, RCIC or HPCS Initiation signal, which is postulated for High/Low pressure interface components only. However, should this spurious signal occur, adequate control of the credited system remains available from the Control Room to support safe shutdown.

Multiple SRV Spurious Actuation

Spurious opening of more than one SRV due to multiple fire induced cable-to-cable hot shorts is not postulated. In the unlikely event one or more SRVs spuriously open, Low Pressure Coolant Injection, RHR Train C, Low Pressure Core Spray, High Pressure Core Spray and RCIC are available to provide Reactor Pressure Vessel makeup and level control to mitigate the effects of the spurious SRV actuations.

The accident analysis design basis of the plant supports rapid RPV depressurization initiated at RPV Level 1 utilizing 7 SRVs in the ADS mode to achieve RPV injection with a low pressure injection system (LPCS, RHR-LPCI). The Appendix R scenario is conservatively assumed to initiate with RPV level at the low end of the normal operating band. This level represents more than 14 feet of RPV inventory above the accident analysis design basis RPV inventory. The amount of RPV inventory expended to reduce RPV pressure (i.e., stored energy removal) is essentially unchanged regardless of the number of SRVs which open. In the unlikely event more than 7 SRVs spuriously open due to fire related cable damage, the time to reach the low pressure injection system (LPCS, RHR) operating pressure is reduced and RPV makeup and level control will be initiated sooner. Therefore, multiple fire induced spurious SRV actuations postulated for the Appendix R safe shutdown scenario is bounded by the accident analysis design basis event.

If one or more SRVs spuriously open and can not be closed, the available RHR Train will be used in the Alternate Shutdown Cooling mode to achieve cold shutdown decay heat removal. A minimum of three SRVs is required to remain open to support this RHR mode.

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9A.2.5.8.5 FIRE AREA RC-6 Annulus Area

9A.2.5.8.5.1 Area Description:

Fire Area RC-6 is defined as the Annulus Area of the Reactor Building and consists of only one zone. This area is located at all elevations of the Reactor Building between the free standing containment steel shell and the Shield Wall.

9A.2.5.8.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.8.5.3 Fire Detection:

Fire detection zone SD-102B is comprised of in-duct detectors installed in the Annulus HVAC system ductwork. Under normal operating condition for Annulus Pressure Control, the detectors will not sense the presence of smoke in the Annulus because of insufficient air flow velocities. As a result of the absence of combustible materials, the restricted and infrequent personnel access and the lack of ignition sources in the area, there is no fire exposure risk in the Annulus to safety related equipment. Based on the low to nonexistent fire potential in the Annulus, a fire detection system is not mandatory for the area.

9A.2.5.8.5.4 Fire Suppression:

Sprinkler systems are not provided in the Reactor Building. Portable extinguishers and water hose stations are provided in the containment. Administrative controls are established to limit the introduction of combustibles and to provide fire protection equipment and manpower during shutdown.

9A.2.5.8.5.5 Fire Barrier:

The Annulus is separated from surrounding areas by reinforced concrete shield building wall and from the containment by the free standing containment steel shell.

9A.2.5.8.5.6 Post-Fire Safe Shutdown Equipment:

Piping and electrical penetrations, containment air lock

9A.2.5.8.5.7 Post-Fire Safe Shutdown Analysis:

Post-Fire Safe Shutdown Divisions I and II electrical cables are adequately separated. The Division II-blue (east side of the Annulus) is separated from the west side by the fuel transfer tube area on the north and by an area free of combustibles on the south. Additionally, between elevations 110'-0" and 137'-0" on the south side, the Annulus is separated by the Main Steam Tunnel which is RC-2. If the fire is located on the east side, Division I is used; if the fire is on the west side, Division II is used.

9A.2.5.8.6 FIRE AREA RDW-1 Drywell East and West

9A.2.5.8.6.1 Area Description:

Fire Area RDW-1 is defined as the Drywell all elevations and includes only one zone. This area is located inside the drywell at all elevations.

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9A.2.5.8.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is oil in the Recirc pumps.

9A.2.5.8.6.3 Fire Detection:

The Reactor Recirculation Pumps are provided with a zoned detection system (FD-13) arranged to alarm locally and in the main control room. These detectors are Thermistor wire detectors.

9A.2.5.8.6.4 Fire Suppression:

The drywell is inaccessible during normal operation and has no fixed or portable suppression equipment. Administrative controls are established to limit the introduction of combustibles and to provide fire protection equipment and manpower during shutdown.

9A.2.5.8.6.5 Fire Barrier:

The Drywell is separated from the containment by a reinforced concrete wall. The Drywell is a 5'-0" thick concrete wall with a steel liner on the inside surface. The Drywell on the west side (Az 0° to 180°) from elevation 95'-0" to 157'-3" is a "boundary fire barrier" separating Fire Area RDW-1 (Drywell) from Fire Areas RC-3 and RC-4 (Containment Building). All of the penetrations, including the Drywell Personnel Airlock Door, are either sealed by a 3-hour rated configuration of have been evaluated for adequacy to withstand the fire hazards associated with the area in which they are installed.

9A.2.5.8.6.6 Post-Fire Safe Shutdown Equipment:

RPV (1B13*REVD003), MSIVs (1B21*AOVF022A/B/C/D), MS safety and relief valves and blowdown piping: equipment hatch and personnel air lock, MSIV accumulators, RCS, CRD, HPCS, LPCS, RHR, FWS, RWCU, SLC, SWP piping pumps and valves.

9A.2.5.8.6.7 Post-Fire Safe Shutdown Analysis:

A fire in Fire Area RDW-1 could potentially affect systems and components necessary to provide RPV Level Control, RPV Pressure Control, Decay Heat Removal, and Essential Mechanical/Environmental Support. Mitigating features are not required to ensure at least one system remains available to achieve Post-Fire Safe Shutdown.

Within the Drywell there is more than 20 feet of separation between each group of eight SRV's. Therefore, the location of the fire determines which group of SRV's is used for Post-Fire Safe Shutdown.

The principal potential fire hazard in the drywell is the lubricating oil for the two reactor recirculation pump motors. Each motor utilizes oil-lubricating bearings. The lubricating oil is cooled by cooling coils installed within the reservoirs.

This design minimizes piping connections to the oil reservoir. The heavy construction and nonpressurized design of this lubricating oil is not credible and additional fire protection measures for the recirculation pumps are not required.

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Substantially all cables in the drywell are installed within conduit raceway. Contradictorily, diagnostic instrumentation cables for vibration monitoring on the recirculation pumps are installed totally external to conduit in the drywell. Low energy instrument cables for main steam line strain gauges are installed both external to conduit and in stainless steel flexible conduit in the drywell. The amount of exposed combustible is negligible. The drywell is inaccessible during operation and when opened, stringent administrative controls and procedures are implemented to monitor personnel and equipment ingress and egress.

The drywell contains valves, instrument tubing, and raceways for Division I and Division II powered components. In the event of a fire in this area, plant shutdown would be achieved by depressurizing the reactor pressure vessel using combinations of safety relief valves that are not affected by the fire in the Drywell.

Separations Analysis

The sixteen Main Steam Safety Relief Valves (SRVs) are located in the Drywell. They are separated such that there is more than twenty (20) feet of separation between each group of eight (8) SRVs. Therefore, at least one set of eight SRVs will be available to control reactor pressure.

Instrument tubing for Reactor Vessel Pressure monitoring components 1B21*PTN062A and 1B21*PTN062B are also separated by more than twenty feet, so one of the two will be available.

9A.2.5.9 Auxiliary Boiler and Water Treatment Building

The Auxiliary Boiler and Water Treatment Building houses equipment for the processing of water and the Auxiliary Boiler which produces steam for plant start-up.

The Auxiliary Boiler and Water Treatment Building is divided into Fire Areas prefixed by "A-".

9A.2.5.9.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.9.2 FIRE AREA A-1 Demineralizer Room

9A.2.5.9.2.1 Area Description:

Fire Area A-1 is defined as the Demineralizer Room of the Auxiliary Boiler and Water Treatment Building and consists of only one zone. This area is located in the western half of the Auxiliary Boiler and Water Treatment Building on elevation 95'-0".

9A.2.5.9.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.9.2.3 Fire Detection:

The area is provided with a zoned detection system (SD-42) arranged to alarm locally and in the main control room.

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9A.2.5.9.2.4 Fire Suppression:

Portable extinguishers and water hose stations provide complete building coverage. Fire loadings do not justify fixed fire suppression systems in the building.

9A.2.5.9.2.5 Fire Barrier:

Reinforced concrete construction separates the area from the Condensate Demineralizer Regeneration and Offgas Building.

9A.2.5.9.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.9.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.9.3 FIRE AREA A-2 Auxiliary Boiler Room

9A.2.5.9.3.1 Area Description:

Fire Area A-2 is defined as the Auxiliary Boiler Room of the Auxiliary Boiler and Water Treatment Building and consists of only one zone. This area is located in the southeastern quadrant of the Auxiliary Boiler and Water Treatment Building on elevation 95'-0".

9A.2.5.9.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.9.3.3 Fire Detection:

The building is provided with a zoned detection system (SD-41) arranged to alarm locally and in the main control room.

9A.2.5.9.3.4 Fire Suppression:

Portable extinguishers and water hose stations provide complete building coverage. Fire loadings do not justify fixed fire suppression systems in the building.

9A.2.5.9.3.5 Fire Barrier:

The area is not provided with fire barriers.

9A.2.5.9.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.9.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.
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9A.2.5.9.4 FIRE AREA A-3 Switchgear Room

9A.2.5.9.4.1 Area Description:

Fire Area A-3 is defined as the Switchgear Room of the Auxiliary Boiler and Water Treatment Building and consists of only one zone. This area is located in the northeastern quadrant of the Auxiliary Boiler and Water Treatment Building on elevation 95'-0".

9A.2.5.9.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.9.4.3 Fire Detection:

The building is provided with a zoned detection system (SD-41) arranged to alarm locally and in the main control room.

9A.2.5.9.4.4 Fire Suppression:

Portable extinguishers and water hose stations provide complete building coverage.

9A.2.5.9.4.5 Fire Barrier:

Reinforced concrete construction separates the area from the Turbine Building.

9A.2.5.9.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.9.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.10 Auxiliary Control Building

The Auxiliary Control Building houses a mechanical equipment room, offices, a passage way which connects the Auxiliary Control and Turbine Buildings, and an Auxiliary Control Room. The Auxiliary Control Room contains controls for balance of plant (BOP).

The Auxiliary Control Building is divided into Fire Areas prefixed by "AX-".

9A.2.5.10.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.10.2 FIRE AREA AX-1 Hot Machine Shop

9A.2.5.10.2.1 Area Description:

Fire Area AX-1 is defined as the Hot Machine Shop and consists of only one zone. This area is located on elevation 95'-0" of the Auxiliary Control Building.

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9A.2.5.10.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.10.2.3 Fire Detection:

The area is provided with a zoned detection system (SD-113) arranged to alarm locally and in the main control room.

9A.2.5.10.2.4 Fire Suppression:

Portable extinguishers and water hose stations provide complete building coverage. Fuel loadings do not justify fixed fire suppression system in the area.

9A.2.5.10.2.5 Fire Barrier:

The area is provided with a 3-hour fire rated ceiling.

9A.2.5.10.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.10.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.10.3 FIRE AREA AX-2 Auxiliary Control Room

9A.2.5.10.3.1 Area Description:

Fire Area AX-2 is defined as the Auxiliary Control Room and consists of only one zone. This area is located on the southern half of elevation 123'-6" of the Auxiliary Control Building.

9A.2.5.10.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.10.3.3 Fire Detection:

The area is provided with zoned detection systems (SD-112, SD-114 and SD-115) arranged to alarm locally and in the main control room.

9A.2.5.10.3.4 Fire Suppression:

A Halon 1301 fire suppression system is provided for protection of the room and under floor cable space of the Auxiliary Control Room. Fire suppression system flow alarms sound locally and in the main control room.

9A.2.5.10.3.5 Fire Barrier:

The area is provided with a 3-hour fire rated floor.

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9A.2.5.10.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.10.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.10.4 FIRE AREA AX-3 T-Tunnel West End

9A.2.5.10.4.1 Area Description:

Fire Area AX-3 is defined as the T-Tunnel west end and consists of only one zone. This area is located in the northern half of elevation 123'-6" of the Auxiliary Control Building.

9A.2.5.10.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is plastic hoses.

9A.2.5.10.4.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.10.4.4 Fire Suppression:

Portable extinguishers and water hose stations provide complete building coverage. Fire loadings do not justify fixed fire suppression system in the area.

9A.2.5.10.4.5 Fire Barrier:

Reinforced concrete construction separates the area from adjacent areas.

9A.2.5.10.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.10.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.11 Normal Cooling Towers

Normal Cooling Towers consists of multicelled cooling towers, 480-V Switchgear Houses, Circulating Water Pump Structure, and 4,160-V Switchgear House, Service Water Cooling Pump Structure, heat exchanger slab and Service Water Cooling (SWC) 4,160V Switchgear House.

The Normal Cooling Towers are divided into Fire Areas prefixed by "CT-".

9A.2.5.11.1 Radioactive Release Analysis

There is no equipment in this area capable of releasing radioactivity to the atmosphere.

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9A.2.5.11.2 FIRE AREA CT-1 Normal Cooling Towers

9A.2.5.11.2.1 Area Description:

Fire Area CT-1 is defined as the Normal Cooling Towers and consists of only one zone. This area is the Switchgear Rooms at the Cooling Towers on elevation 105'-6".

9A.2.5.11.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.11.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-63, SD-64, SD-69 and SD-70) arranged to alarm locally and in the main control room. The 480 V switchgear houses and 4160 V switchgear houses are provided with a zoned detection system arranged to alarm locally and in the main control room.

9A.2.5.11.2.4 Fire Suppression:

Cooling towers are essentially noncombustible construction and have been accepted by the American Nuclear Insurers without fixed fire suppression systems. Portable extinguishers are provided inside the switchgear houses and the circulating water pump structure. Fire loading in the switchgear houses does not justify fixed protection systems.

9A.2.5.11.2.5 Fire Barrier:

Block walls separate the area from oil filled transformers outdoors.

9A.2.5.11.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.11.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.11.3 FIRE AREA CT-2 CWP Switchgear Room

9A.2.5.11.3.1 Area Description:

Fire Area CT-2 is defined as the CWP Switchgear Room and consists of only one zone. This area is located in the CWP Structure Switchgear House next to the CWP structure on elevation 105'-6".

9A.2.5.11.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.11.3.3 Fire Detection:

The area is provided with a zoned detection system (SD-92) arranged to alarm locally and in the main control room.

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9A.2.5.11.3.4 Fire Suppression:

Cooling towers are essentially noncombustible construction and have been accepted by the American Nuclear Insurers without fixed fire suppression systems. Portable extinguishers are provided inside the switchgear houses and the circulating water pump structure.

9A.2.5.11.3.5 Fire Barrier:

Block walls separate area from oil filled transformers outdoors.

9A.2.5.11.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.11.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.11.4 FIRE AREA CT-3 Service Water Cooling Switchgear House

9A.2.5.11.4.1 Area Description:

Fire Area CT-3 is defined as the Service Water Cooling Switchgear House and consists of only one zone. This area is located near the cooling towers on elevation 150'-6".

9A.2.5.11.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.11.4.3 Fire Detection:

The area is provided with a zoned detection system (SD-62) arranged to alarm locally and in the main control room. The 480 V switchgear houses and 4160 V switchgear houses are provided with a zoned detection system arranged to alarm locally and in the main control room

9A.2.5.11.4.4 Fire Suppression:

Cooling towers are of essentially noncombustible construction and have been accepted by the American Nuclear Insurers without fixed fire suppression systems. Portable extinguishers are provided inside the switchgear houses and the circulating water pump structure. Fire loading in the switchgear houses does not justify fixed protection systems.

9A.2.5.11.4.5 Fire Barrier:

Block walls separate area from oil filled transformers outdoors.

9A.2.5.11.4.6 Post-Fire Safe Shutdown Equipment:

None

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9A.2.5.11.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.12 Fire Pump House

The Fire Pump House contains equipment required to be activated in case of fire in the plant area. Fire pumps are separated by fire-rated barriers.

The Fire Pump House is divided into Fire Areas prefixed by "FP-".

9A.2.5.12.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.12.2 FIRE AREA FP-1 Diesel Fire Pump 1A

9A.2.5.12.2.1 Area Description:

Fire Area FP-1 is defined as the Diesel Fire Pump Room 1A and consists of only one zone. This area is located on the east side of the Fire Pump House on elevation 95'-0".

9A.2.5.12.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is Fuel Oil.

9A.2.5.12.2.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.12.2.4 Fire Suppression:

Automatic Sprinkler system AS-11A is provided in this area. Hose coverage is possible by use of equipment located at an outside yard hydrant and/or hose houses.

9A.2.5.12.2.5 Fire Barrier:

A block wall separates the area from FP-2.

9A.2.5.12.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.12.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

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9A.2.5.12.3 FIRE AREA FP-2 Electrical Fire Pump

9A.2.5.12.3.1 Area Description:

Fire Area FP-2 is defined as the Electrical Fire Pump Room and consists of only one zone. This area is located between the two Diesel Fire Pump Rooms in the Fire Pump House on elevation 95'-0".

9A.2.5.12.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.12.3.3 Fire Detection:

The area is provided with a zoned detection system (SD-120) arranged to alarm locally and in the main control room.

9A.2.5.12.3.4 Fire Suppression:

Sprinkler systems are provided in areas of the Fire Pump House. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed suppression system. Hose coverage is possible by use of equipment located at an outside yard hydrant and/or hose houses.

9A.2.5.12.3.5 Fire Barrier:

Block walls separate the area from FP-1 and FP-3.

9A.2.5.12.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.12.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.12.4 FIRE AREA FP-3 Diesel Fire Pump 1B

9A.2.5.12.4.1 Area Description:

Fire Area FP-3 is defined as Diesel Fire Pump Room 1B and consists of only one zone. This area is located in the Fire Pump House on elevation 95'-0".

9A.2.5.12.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is Fuel Oil.

9A.2.5.12.4.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.12.4.4 Fire Suppression:

Automatic Sprinkler system AS-11B is provided in this area. Hose coverage is possible by use of equipment located at an outside yard hydrant and/or hose houses.

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9A.2.5.12.4.5 Fire Barrier:

Block walls separate the area from FP-3 and FP-4.

9A.2.5.12.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.12.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.12.5 FIRE AREA FP-4 Domestic Water Pump Area

9A.2.5.12.5.1 Area Description:

Fire Area FP-4 is defined as the Domestic Water Pump Room and consists of only one zone. This area is located in the western portion of the Fire Pump House on elevation 95'-0".

9A.2.5.12.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.12.5.3 Fire Detection:

The area is provided with a zoned detection system (SD-122) arranged to alarm locally and in the main control room.

9A.2.5.12.5.4 Fire Suppression:

Sprinkler systems are provided in areas of the Fire Pump House. Automatic sprinkler systems are not provided in this area. Fire loadings do not justify a fixed suppression system. Hose coverage is possible by use of equipment located at an outside yard hydrant and/or hose houses.

9A.2.5.12.5.5 Fire Barrier:

A block wall separates the area from FP-3.

9A.2.5.12.5.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.12.5.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.13 Makeup Water Building

The Makeup Water Building houses the equipment that provides water to the plant. This makeup supply is to the Normal Cooling Towers.

The Makeup Water building houses 4,160-V switchgear and three 1,500 hp cooling tower makeup water pumps.

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The Makeup Water Building is divided into Fire Areas prefixed by "IS-".

9A.2.5.13.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.13.2 FIRE AREA IS-1 Makeup Water Building El -15'-0", 4'-0" and 10'-2"

9A.2.5.13.2.1 Area Description:

Fire Area IS-1 is defined as the Makeup Water Building El. -15'-0", through 10' 2" and consists of only one zone. This area is the bottom three floors of the Intake Structure.

9A.2.5.13.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.13.2.3 Fire Detection:

The area is provided with a zoned detection system (SD-71) arranged to alarm locally and in the main control room.

9A.2.5.13.2.4 Fire Suppression:

Fire loading in the structure does not justify a fixed protection system. Portable extinguishers are provided throughout the building.

9A.2.5.13.2.5 Fire Barrier:

There are no fire barriers constructed to protect this area.

9A.2.5.13.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.13.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.13.3 FIRE AREA IS-2 Makeup Water Treatment Building Elevation 35' 4 1/4" and 51'-6"

9A.2.5.13.3.1 Area Description:

Fire Area IS-2 is defined as the Makeup Water Building El. 35' 4 1/4", through 51'-6" and consists of only one zone. This area is the top two floors of the Intake Structure.

9A.2.5.13.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.
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9A.2.5.13.3.3 Fire Detection:

The area is provided with a zoned detection system (SD-71) arranged to alarm locally and in the main control room. The two switchgear on the roof of the structure are provided with detection systems (FD-38 and FD-39).

9A.2.5.13.3.4 Fire Suppression:

Fire loading in the structure does not justify a fixed protection system. Portable extinguisher are provided throughout the building.

9A.2.5.13.3.5 Fire Barrier:

Reinforced concrete ceiling separates this area from oil filled transformers outdoors.

9A.2.5.13.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.13.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.14 Low Level Radwaste Storage Building

The Low Level Radwaste Storage Building was constructed to be an onsite storage facility for low level radwaste pending offsite shipment and disposal. The building contains mostly storage containers.

The Low Level Radwaste Storage Building is a Fire Areas prefixed by "LL-".

9A.2.5.14.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.14.2 FIRE AREA LL-1 Low Level Radwaste Storage Building

9A.2.5.14.2.1 Area Description:

LL-1 is defined as the Low Level Radwaste Storage Building. The entire building is one fire area.

9A.2.5.14.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as <1 hr. There are no combustibles in the area.

9A.2.5.14.2.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.14.2.4 Fire Suppression:

Suppression of a fire can be performed using an outside yard hydrant and/or hose house.

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9A.2.5.14.2.5 Fire Barrier:

None

9A.2.5.14.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.14.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.15 Motor-Generator Building

The Motor-Generator building houses two 200-kVA motor-generator sets, with 250-hp motors and two motor-generator control panels used for operating the reactor recirculation pump at slow speed.

The Motor Generator Building is a Fire Areas prefixed by "MG-".

9A.2.5.15.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.15.2 FIRE AREA MG-1 LFMG Building

9A.2.5.15.2.1 Area Description:

Fire Area MG-1 is defined as the Motor Generator Set Building and consists of only one zone. This area is located along the outside of the western wall of the Reactor Building on elevation 98'-0".

9A.2.5.15.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.15.2.3 Fire Detection:

The building is provided with a zoned detection system (SD-56) arranged to alarm locally and in the main control room.

9A.2.5.15.2.4 Fire Suppression:

Portable extinguishers are provided. Hose coverage is possible by use of equipment located at an outside yard hydrant and hose houses. Fire loading in the building does not justify fixed fire suppression systems.

9A.2.5.15.2.5 Fire Barrier:

This area is not provided with fire barriers.

9A.2.5.15.2.6 Post-Fire Safe Shutdown Equipment:

None

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9A.2.5.15.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16 Normal Switchgear Building

The Normal Switchgear Building is provided with a cable spreading area in the basement and enclosures for electrical switchgear batteries, inverters, and related equipment, including central alarm station (CAS), in the two floors above grade. The passage way which connects the Turbine and Services Buildings on elevation 123'-6" is considered part of the Normal Switchgear Building.

The Normal Switchgear Building is divided into Fire Areas prefixed by "NS-".

9A.2.5.16.1 Radioactive Release Analysis

There is no equipment in this building capable of releasing radioactivity to the atmosphere.

9A.2.5.16.2 FIRE AREA NS-1 Normal Switchgear Building El 67'-6"

9A.2.5.16.2.1 Area Description:

Fire Area NS-1 is defined as the Normal Switchgear Building Elevation 67'-6" and consists of only one zone. This area is the entire bottom floor of the Normal Switchgear Building at elevation 67'-6".

9A.2.5.16.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 3 hours. The major contributor is cable insulation.

9A.2.5.16.2.3 Fire Detection:

The area is provided with zoned detection systems (SD-21 and SD-22) arranged to alarm locally and in the main control room.

9A.2.5.16.2.4 Fire Suppression:

Zoned water spray systems (WS-14A and WS-14B) are provided for protection of cables in trays in the basement spreading room.

9A.2.5.16.2.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

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9A.2.5.16.3 FIRE AREA NS-2 Normal Switchgear Room 1C

9A.2.5.16.3.1 Area Description:

Fire Area NS-2 is defined as the Normal Switchgear Room 1C and consists of only one zone. This area is located in the northern third of elevation 98'-0" of the Normal Switchgear Building.

9A.2.5.16.3.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.16.3.3 Fire Detection:

The area is provided with a zoned detection system (SD-7) arranged to alarm locally and in the main control room.

9A.2.5.16.3.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.3.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.4 FIRE AREA NS-3 Normal Switchgear Room 1B

9A.2.5.16.4.1 Area Description:

Fire Area NS-3 is defined as the Normal Switchgear Room 1B and consists of only one zone. This area is located in the Normal Switchgear Building on elevation 98'-0" between areas NS-2 and NS-4.

9A.2.5.16.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.16.4.3 Fire Detection:

The area is provided with a zoned detection system (SD-8) arranged to alarm locally and in the main control room.

9A.2.5.16.4.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

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9A.2.5.16.4.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.4.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.5 FIRE AREA NS-4 Normal Switchgear Room 1A

9A.2.5.16.5.1 Area Description:

Fire Area NS-4 is defined as the Normal Switchgear Room 1A and consists of only one zone. This area is located on the southern third of elevation 98'-0" of the Normal Switchgear Building.

9A.2.5.16.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.16.5.3 Fire Detection:

The area is provided with a zoned detection system (SD-9) arranged to alarm locally and in the main control room.

9A.2.5.16.5.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.5.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.5.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.5.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.6 FIRE AREA NS-5 NS Battery Room A

9A.2.5.16.6.1 Area Description:

Fire Area NS-5 is defined as the Normal Switchgear Battery Room A and consists of only one zone. This area is located in the northeast area of the 123'-6" elevation of the Normal Switchgear Building.

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9A.2.5.16.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is the batteries.

9A.2.5.16.6.3 Fire Detection:

The area is provided with a zoned detection system (SD-10) arranged to alarm locally and in the main control room.

9A.2.5.16.6.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.6.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.6.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.6.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.7 FIRE AREA NS-6 NS Battery Room B

9A.2.5.16.7.1 Area Description:

Fire Area NS-6 is defined as the Normal Switchgear Battery Room B and consists of only one zone. This area is located in the northeast quadrant of the 123'-6" of the Normal Switchgear Building.

9A.2.5.16.7.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is the batteries

9A.2.5.16.7.3 Fire Detection:

The area is provided with a zoned detection system (SD-11) arranged to alarm locally and in the main control room.

9A.2.5.16.7.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.7.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.7.6 Post-Fire Safe Shutdown Equipment:

None

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9A.2.5.16.7.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.8 FIRE AREA NS-7 NS Battery Charger Room

9A.2.5.16.8.1 Area Description:

Fire Area NS-7 is defined as the Normal Switchgear Battery Charger Room and consists of only one zone. This area is located next to NS Battery Room B on the 123'-6" elevation of the Normal Switchgear Building.

9A.2.5.16.8.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is the Inverter insulation.

9A.2.5.16.8.3 Fire Detection:

The area is provided with zoned detection systems (SD-12 and SD-159) arranged to alarm locally and in the main control room.

9A.2.5.16.8.4 Fire Suppression:

A Halon 1301 system is provided for protection of the underfloor cables in the CAS room. Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system in the rest of the area.

9A.2.5.16.8.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.8.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.8.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.9 FIRE AREA NS-8 IHS Battery Room

9A.2.5.16.9.1 Area Description:

Fire Area NS-8 is defined as the IHS Battery Room and consists of only one zone. This area is located on the 123'-6" elevation of the Normal Switchgear Building.

9A.2.5.16.9.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is the battery.

9A.2.5.16.9.3 Fire Detection:

The area is provided with a zoned detection system (SD-13) arranged to alarm locally and in the main control room.

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9A.2.5.16.9.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.9.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.9.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.9.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.16.10 FIRE AREA NS-9 General Area El 123'-6"

9A.2.5.16.10.1 Area Description:

Fire Area NS-9 is defined as the General Area Elevation 123'-6" and consists of only one zone. This area is located in the southern and western portion of elevation 123'-6" of the Normal Switchgear Building.

9A.2.5.16.10.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 1 but ≤ 3 hours. The major contributor is cable insulation.

9A.2.5.16.10.3 Fire Detection:

The building is provided with a zoned detection system (SD-14) arranged to alarm locally and in the main control room.

9A.2.5.16.10.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.10.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.10.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.10.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

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9A.2.5.16.11 FIRE AREA NS-10 Passageway

9A.2.5.16.11.1 Area Description:

Fire Area NS-10 is defined as the passageway and consists of only one zone. This area is located along the Control Building southern wall on elevation 123'-6" of the Normal Switchgear Building.

9A.2.5.16.11.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

9A.2.5.16.11.3 Fire Detection:

The area is not provided with a zoned detection system

9A.2.5.16.11.4 Fire Suppression:

Portable extinguishers and water hose stations are provided throughout the building. Fire loading in the area does not justify a fixed fire suppression system.

9A.2.5.16.11.5 Fire Barrier:

Reinforced concrete walls separate the area from adjacent areas.

9A.2.5.16.11.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.16.11.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.17 Radwaste Building

The equipment housed in the Radwaste Building is dedicated to the collection and processing of liquid and solid radioactive waste material.

The Radwaste Building is a Fire Area prefixed by "RB-".

9A.2.5.17.1 Radioactive Release Analysis

The radwaste building ventilation and cooling system for general areas and cubicles consists of five supply air unit coolers and three 50 percent exhaust fans. Exhaust from the tank area is through redundant charcoal filters. Ventilation and cooling in the sampling room, and solidification area consist of redundant unit coolers. Normal building exhaust is through ducts in the exhaust penthouse on the building roof. A radiation monitor is provided in the exhaust penthouse to alert operating personnel in the auxiliary control room of high radiation levels. The operator has the ability to shut down all supply and exhaust systems in the building to prevent radioactive release to the atmosphere. The building essentially becomes closed up at this time.

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9A.2.5.17.2 FIRE AREA RB-1 Radwaste Building

9A.2.5.17.2.1 Area Description:

Fire Area RB-1 is defined as the Radwaste Building and consists of five zones; RB-1/Z-1, RB-1/Z-2 RB-1/Z-3, RB-1/Z-4 and RB-1/Z-5. Zone RB-1/Z-1 is the entire 63'-0" elevation, Zone RB-1/Z-2 the entire 106'-0" elevation, Zone RB-1/Z-3 the entire 136'-0" elevation, Zone RB-1/Z-4 the entire 166'-0" elevation, Zone RB-1/Z-5 the entire 90'-0" elevation of the Radwaste Building.

9A.2.5.17.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.17.2.3 Fire Detection:

The building is provided with zoned detection systems (SD-34, SD-95 and SD-116) arranged to alarm locally and in the main control room. Thermistor detectors (FD-29 and FD-30) in the charcoal filters provide alarm functions at and through the local fire alarm panel to the main control room.

9A.2.5.17.2.4 Fire Suppression:

Automatic sprinkler AS-4 is provided for the bailing area, drum storage area and truck pit. Charcoal filters have individual water spray systems (WS-13A and WS-13B) manually actuated by opening of local valves. Water flow is alarmed locally and in the main control room. Fire loadings do not justify fixed fire suppression systems in remaining areas of the building. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.17.2.5 Fire Barrier:

The Radwaste Building is a single fire are. A measure of separation is provided between floors (zones) by the reinforced concrete floors although un-enclosed openings exist in these floors. These openings prevent allocation of separate fire areas for each floor. The building is separated from adjacent buildings by reinforced concrete walls.

9A.2.5.17.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.17.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18 Turbine Building

The Turbine Building does not contain safety-related equipment with the exception of nuclear boiler system pressure transmitters. It consists of five main areas: the heater bay, condensate demineralizer area, off-gas area, fire protection equipment room, and the passage way to the control and normal switchgear buildings.

The Turbine Building is divided into Fire Areas prefixed by "T-".

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9A.2.5.18.1 Radioactive Release Analysis

The turbine building ventilation and cooling system consists of one supply air handling unit and five exhaust fans. Cooling is by unit coolers. The air ejector off-gas treatment system reduces the activity level of the non-condensable fission gases removed from the main condenser prior to their release to the atmosphere. Non-condensable gas removed from the main condenser, including air inleakage, is diluted with steam to give less than 4 percent (by volume) hydrogen in the last stage non-condensing jet of the air ejector assembly. The diluted off gas is superheated and then passed through a catalytic recombiner to remove the hydrogen and oxygen by combining them into water. The off-gas effluent from the recombiner, containing only traces of hydrogen, is passed through a condenser cooled by plant condensate.

An enlarged pipe volume provides a 10 min holdup for decay of the N-13, N-16, 0-19, and source krypton and xenon isotopes. During this decay period, daughter products are removed through condensation on the wall of the pipe.

The charcoal absorbers provide the final delay for the radioactive gases, reducing the release rate to within the specified range. Two parallel trains of charcoal absorbers are used to minimize back pressure. Heat is removed from the vault which houses the absorbers to maintain the charcoal beds at an operating temperature of 0°F. The off-gas effluent from the absorbers is passed through another high-efficiency filter prior to discharge.

The normal building exhaust, the charcoal filter exhaust, and the off-gas system discharge are all through the plant exhaust duct.

Main control room personnel are alerted to high radiation levels. The operator has the ability to shut down supply and exhaust systems in the building to prevent unacceptable radioactive release to the atmosphere.

Automatic heat actuated unit vents are provided in the building roof. Fusible links are set to release at about 350°F. These vents are provided to prevent roof collapse in the event of a fire at the turbine generator on the operating level.

9A.2.5.18.2 FIRE AREA T-1 Turbine Lube Oil Tank Storage Room

9A.2.5.18.2.1 Area Description:

Fire Area T-1 is defined as the Turbine Lube Oil Tank Storage Room and consists of only one zone. This area is located on the 67'-6" elevation of the Turbine Building.

9A.2.5.18.2.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 3 hours. The major contributor is Lube Oil.

9A.2.5.18.2.3 Fire Detection:

The area is provided with a zoned detection system (FD-1) arranged to alarm locally and in the main control room.

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9A.2.5.18.2.4 Fire Suppression:

Sprinkler systems are provided in areas of the Turbine Building. Automatic Sprinkler system WS-1 is provided in this area.

9A.2.5.18.2.5 Fire Barrier:

One foot, two and a half foot, and four foot thick reinforced concrete walls separate the area from adjacent areas.

9A.2.5.18.2.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.18.2.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18.3 FIRE AREA T-2 Turbine Building Elevation 67'-6"

9A.2.5.18.3.1 Area Description:

Fire Area T-2 is defined as the Turbine Building General Area elevation 67'-6" and consists of six zones; T-2/Z-1, T-2/Z-2, T-2/Z-3, T-2/Z-4, T-2/Z-5, T-2/Z-6. Zone T-2/Z-1 is located south of the Turbine Lube Oil Storage Room on elevation 67'-6" of the Turbine Building. Zone T-2/Z-2 is the General Area on elevation 67'-6" of the Turbine Building. Zone T-2/Z-3 is the Sample Room located in the north east quadrant of the 67'-6" of the Turbine Building. Zone T-2/Z-4 is the Regeneration Area on elevation 67'-6" of the Turbine Building. Zone T-2/Z-5 is the Division I Heater Room and zone T-2/Z-6 is the Division II heater room.

9A.2.5.18.3.2 In Situ/Transient Combustible Loading/Fire Severity:

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The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation. Piping containing H_2 for the Hydrogen Water Chemistry system is routed in this area.

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9A.2.5.18.3.3 Fire Detection:

The area is provided with zoned detection systems (FD-2, SD-23, SD-24, SD-25, SD-26, SD-27, SD-107, SD-108 and SD-109) arranged to alarm locally and in the main control room.

9A.2.5.18.3.4 Fire Suppression:

Automatic Sprinkler systems (AS-2A and AS-2B) are provided for protection of general areas of the Turbine Building elevation 67'-6". Automatic Sprinkler systems (AS-3 and WS-17) are provided for protection of the condenser pit and the hydrogen seal oil unit. Exceptions for protection of the general area are the remainder of the heater bay, heater drain rooms, regeneration areas, and other small enclosed areas which do not contain combustibles. Fire loadings do not justify fixed fire suppression systems in remaining rooms in the area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.18.3.5 Fire Barrier:

There are no fire barriers constructed to protect this area.

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9A.2.5.18.3.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.18.3.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18.4 FIRE AREA T-3 Turbine Building Elevation 95'

9A.2.5.18.4.1 Area Description:

Fire Area T-3 is defined as the General Area Turbine Building Elevation 95'-0" and consists of seven zones; T-3/Z-7, T-3/Z-8, T-3/Z-9, T-3/Z-10, T-3/Z-11, T-3/Z-13 and T-3/Z-14. Zone T-3/Z-7 is located in the southeast quadrant of the 95'-0" elevation of the Turbine Building. Zone T-3/Z-8 is the general area west of the condenser on elevation 95'-0" of the Turbine Building. Zone T-3/Z-9 is the Division I heater room, and zone T-3/Z-10 is the Division II heater room on the 95' 0' elevation of the Turbine Building. Zone T-3/Z-11 is the Regenerator/ Offgas Area on elevation 95'-0". Zone T-3/Z-13 is the general areas along the west and north sides of the Turbine Building on elevation 95'-0". Zone T-3/Z-14 is the passage between the Turbine Building proper and the outside between the Control Building and the Normal Switchgear Building.

9A.2.5.18.4.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.18.4.3 Fire Detection:

The area is provided with zoned detection systems (SD-36, SD-37, SD-38, SD-39, SD-40, SD-59 and SD-93) arranged to alarm locally and in the main control room.

9A.2.5.18.4.4 Fire Suppression:

Automatic sprinkler systems (AS-1A and AS-1B) are provided on the mezzanine level for general areas. Sprinkler systems are not provide in the heater rooms nor in the main steam line area. Fire loadings do not justify fixed fire suppression system in these areas.

Fire loadings do not justify fixed fire suppression systems in remaining rooms in the area.

Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.18.4.5 Fire Barrier:

There are no fire barriers constructed to protect this area.

9A.2.5.18.4.6 Post-Fire Safe Shutdown Equipment:

None

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9A.2.5.18.4.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18.5 FIRE AREA T-4 Lube Oil Room

9A.2.5.18.5.1 Area Description:

Fire Area T-4 is defined as the Lube Oil Room and consists of only one zone. This area is located on elevation 95'-0" above the Lube Oil Storage Room.

9A.2.5.18.5.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as > 3 hours. The major contributor is Lube Oil.

9A.2.5.18.5.3 Fire Detection:

The building is provided with a zoned detection system (FD-3) arranged to alarm locally and in the main control room.

9A.2.5.18.5.4 Fire Suppression:

An automatic water spray system (WS-2) is provided for the lube oil system.

9A.2.5.18.5.5 Fire Barrier:

One foot and four foot thick reinforced concrete walls separate the area from adjacent areas.

9A.2.5.18.5.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.18.5.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18.6 FIRE AREA T-5 Turbine Building Elevation 123'-6"

9A.2.5.18.6.1 Area Description:

Fire Area T-5 is defined as General Area Turbine Building Elevation 123'-6" and consists of eight zones; T-5/Z-14, T-5/Z-15, T-5/Z-16, T-5/Z-17, T-5/Z-18, T-5/Z-19, T-5/Z-20 and T-5/Z-21. Zone T-5/Z-14 is the Regenerator /Offgas Building. Zone T-5/Z-15 is the South General Area around the generator on elevation 123'-6". Zone T-5/Z-16 is the North General Area around the turbine on elevation 123'-6". Zone T-5/Z-17 is the Steam Seal Evaporator room. Zone T-5/Z-18 is the Radwaste Boiler Room, Zone T-5/Z-19 is the Turbine Building Filter Room, Zone T-5/Z-20 is the Hallway of the north side of the floor. Zone T-5/Z-21 is the general area on the west and north on the floor outside of the previously discussed areas.

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9A.2.5.18.6.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is cable insulation.

9A.2.5.18.6.3 Fire Detection:

The area is provided with zoned detection systems (SD-46, SD-47, SD-48 and SD-118) for local areas. The detection systems are arranged to alarm locally and in the main control room. Thermal detectors (FD-21, FD-22, FD-23, FD-24) for the turbine bearings, (FD-25) for the exciter, and (FD-37) for the charcoal filter are arranged to alarm locally and in the main control room.

9A.2.5.18.6.4 Fire Suppression:

Automatic high-pressure carbon dioxide systems are provided for the turbine generator bearings and oil lines at the bearings. The high pressure carbon dioxide cylinders are stored on elevation 67'-6". The main generator exciter is provided with an automatic total-flooding, high-pressure carbon dioxide system. The charcoal filter has an individual water spray system (WS-15) manually actuated by opening of local valves. The turbine generator bearings and oil lines are also protected by automatically actuated preaction sprinkler systems (PS-3A, PS-3B, PS-3C and PS-3D). Flow for all suppression systems is alarmed locally and in the main control room by means of the building fire alarm panel. Fire loadings do not justify fixed fire suppression systems in remaining areas of the building. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.18.6.5 Fire Barrier:

There are no fire barriers constructed to protect zones T-5/Z-14 through T-5/Z-19 and T-5/Z-21. One foot thick reinforced concrete walls separate area T-5/Z-20 from adjacent areas.

9A.2.5.18.6.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.18.6.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

9A.2.5.18.7 FIRE AREA T-6 Fire Protection Room

9A.2.5.18.7.1 Area Description:

Fire Area T-6 is the Fire Protection Equipment Room and consists of only one zone. This area is located in the southeast quadrant of the 95'-0" elevation of the Turbine Building.

9A.2.5.18.7.2 In Situ/Transient Combustible Loading/Fire Severity:

The Fire Severity for this area is classified as ≤ 1 hour. The major contributor is baseline (ancillary equipment).

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9A.2.5.18.7.3 Fire Detection:

The area is not provided with a zoned detection system.

9A.2.5.18.7.4 Fire Suppression:

Fire loadings do not justify fixed fire suppression systems in this area. Portable extinguishers and water hose stations are provided throughout the building.

9A.2.5.18.7.5 Fire Barrier:

None

9A.2.5.18.7.6 Post-Fire Safe Shutdown Equipment:

None

9A.2.5.18.7.7 Post-Fire Safe Shutdown Analysis:

There is no Post-Fire Safe Shutdown Equipment contained in this area. Shutdown is accomplished by using either Division I or Division II powered components and systems.

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9A.2.6 References

NONE

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TABLE 9A.2-0

TRANSIENT FIRE HAZARD EVALUATION

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TABLE 9A.2-1

REACTOR BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-2

REACTOR BUILDING FIRE LOADING DATA

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TABLE 9A.2-3

FUEL BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-4

FUEL BUILDING FIRE LOADING DATA

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TABLE 9A.2-5

AUXILIARY BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-6

AUXILIARY BUILDING FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-7

CONTROL BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-8

CONTROL BUILDING FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-9

DIESEL GENERATOR BUILDING FIRE HAZARDS ANALYSIS

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-10

DIESEL GENERATOR BUILDING FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-11

TURBINE BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-12

TURBINE BUILDING FIRE LOADING DATA

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TABLE 9A.2-13

MAKEUP WATER INTAKE STRUCTURE FIRE HAZARDS ANALYSIS

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TABLE 9A.2-14

MAKEUP WATER INTAKE STRUCTURE FIRE LOADING DATA

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TABLE 9A.2-15

RADWASTE BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-16

RADWASTE BUILDING FIRE LOADING DATA

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TABLE 9A.2-17

NORMAL SWITCHGEAR BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-18

NORMAL SWITCHGEAR BUILDING FIRE LOADING DATA

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TABLE 9A.2-19

AUXILIARY CONTROL BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-20

AUXILIARY CONTROL BUILDING FIRE LOADING DATA

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TABLE 9A.2-21

AUXILIARY BOILER AND WATER TREATMENT BUILDING FIRE HAZARDS ANALYSIS

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TABLE 9A.2-22

AUXILIARY BOILER AND WATER TREATMENT BUILDING FIRE LOADING DATA

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TABLE 9A.2-23

STANDBY SERVICE WATER PUMP HOUSE FIRE HAZARDS ANALYSIS

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TABLE 9A.2-24

STANDBY SERVICE WATER PUMP HOUSE FIRE LOADING DATA

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TABLE 9A.2-25

MOTOR-GENERATOR BUILDING FIRE HAZARDS ANALYSIS

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-26

MOTOR-GENERATOR BUILDING FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-27

PIPE TUNNEL FIRE HAZARDS ANALYSIS

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TABLE 9A.2-28

PIPE TUNNEL FIRE LOADING DATA

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TABLE 9A.2-29

ELECTRICAL TUNNELS FIRE HAZARDS ANALYSIS

RIVER BEND STATION

UPDATED SAFETY ANALYSIS REPORT

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TABLE 9A.2-30

ELECTRICAL TUNNELS FIRE LOADING DATA

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TABLE 9A.2-31

FIRE PUMP HOUSE FIRE HAZARDS ANALYSIS

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TABLE 9A.2-32

FIRE PUMP HOUSE FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-33

NORMAL COOLING TOWERS (SWITCHGEAR HOUSE) FIRE HAZARDS ANALYSIS

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-34

NORMAL COOLING TOWERS (SWITCHGEAR HOUSE) FIRE LOADING DATA

THIS TABLE HAS BEEN DELETED

TABLE 9A.2-35

FIRE HAZARDS ANALYSIS RESULTS

TABLE 9A.2-36

IAS & SAS AIR COMPRESSOR BUILDING FIRE HAZARDS ANALYSIS

	Enclosure 2 Reference Paragraph	FIRE AREA / ZONE
Plan & Elevation	1	The IAS & SAS air compressors and related equipment are located under an open canopy adjacent the west exterior wall of the Turbine Building and south of the Auxiliary Control Building.
Safety-Related Equipment		
Description	1(b)	None
Safe Shutdown Analysis	2	Not Applicable
Non-safety-related Equipment	1	Six air Compressors Six after-coolers Six moisture separators One air receiver tank Four pre-filters Two after-filters Two dryers
Area Suppression/Detection	1(b) 1(e)	None
Electrical Cable		
Description	1(b)	Non-divisional cables in conduit
Safe Shutdown Analysis	2	Not Applicable
Suppression/Detection	1(b), 1(e), 2	None
Fire Barrier Description	1(e)	None. Open structure

TABLE 9A.2-36

IAS & SAS AIR COMPRESSOR BUILDING FIRE HAZARDS ANALYSIS

	Enclosure 2 Reference Paragraph	FIRE AREA / ZONE
Combustible Loading	1(d), 1(c)	Negligible
Design Basis Fire	1(a)	
Radioactive Release Analysis	1	The IAS & SAS air compressor area contains no radioactive materials; consequently, no radioactive release is possible.

TABLE 9A.2-37

DIESEL AIR COMPRESSOR AREA FIRE HAZARDS ANALYSIS

	Enclosure 2 Reference Paragraph	FIRE AREA / ZONE
Plan & Elevation	1	The Diesel Air Compressor Area is located outside south of the Auxiliary Control Building and west of the Turbine Building.
Safety-Related Equipment		
Description	1(b)	None
Safe Shutdown Analysis	2	Not Applicable
Nonsafety-related Equipment	1	One diesel air compressor One air dryer One air receiver tank
Area Suppression/Detection	1(b) 1(e)	None
Electrical Cable		
Description	1(b)	Non-divisional cables in conduit
Safe Shutdown Analysis	2	Not Applicable
Suppression/Detection	1(b), 1(e), 2	None
Fire Barrier Description	1(e)	None. Open structure with curb surrounding diesel engine skid
Combustible Loading	1(d), 1(c)	244 gallons diesel fuel

TABLE 9A.2-37

DIESEL AIR COMPRESSOR AREA FIRE HAZARDS ANALYSIS

	Enclosure 2 Reference Paragraph	FIRE AREA / ZONE
Design Basis Fire	1(a)	In skid mount tank
Radioactive Release Analysis	1	The Diesel Air Compressor Area contains no radioactive materials; consequently, no radioactive release is possible.

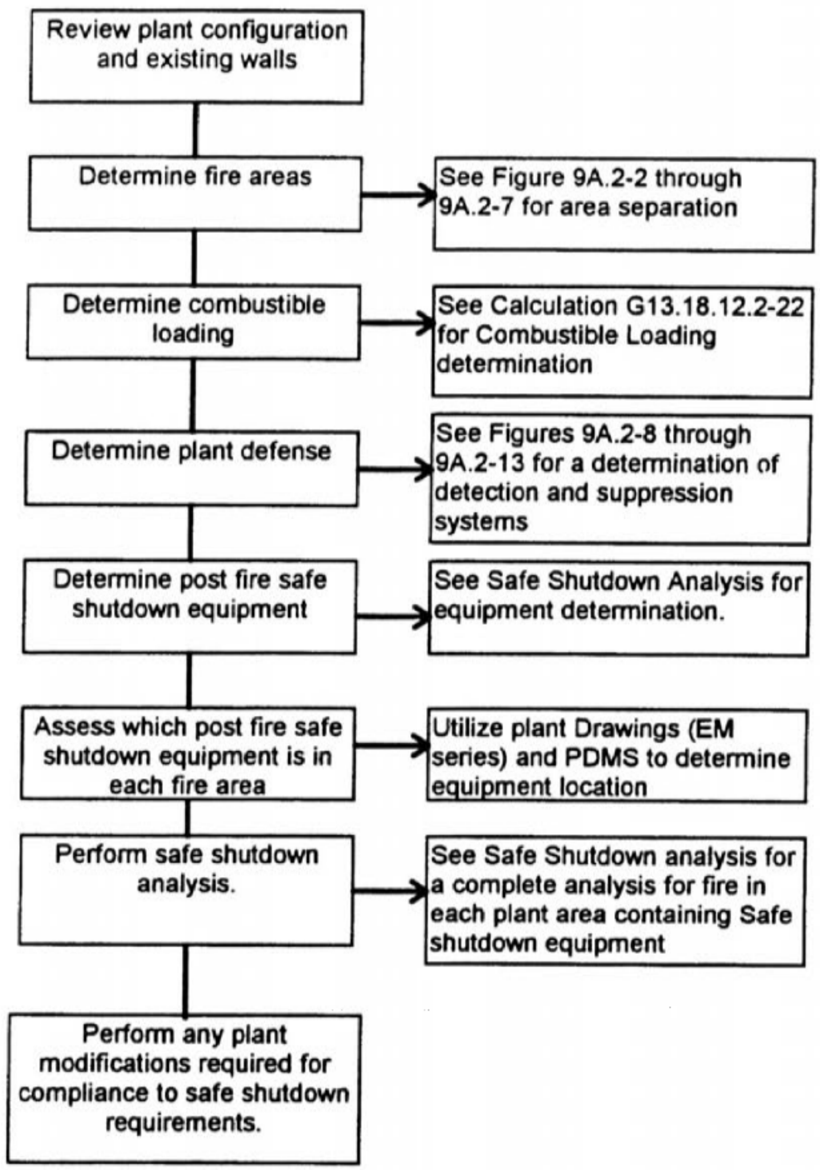

FIGURE 9A.2-1

Fire Hazards Methodology

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Security-Related Information
Figure Withheld Under 10 CFR 2.390

SOURCE DOCUMENT: EB-003AB Rev 3

FIGURE 9A.2-2
FIRE AREA BOUNDARIES PLANT PLAN VIEW-ELEVATIONS 65'-0" TO 90'-0"
RIVER BEND STATION UPDATED SAFETY ANALYSIS REPORT REVISION 13 SEPTEMBER 2000

Security-Related Information
Figure Withheld Under 10 CFR 2.390

SOURCE DOCUMENT: EB-003AC, REV 4

FIGURE 9A.2-3

FIRE AREA BOUNDARIES
PLANT PLAN VIEW-ELEVATIONS
83'-0" TO 106'-0"

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Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-4

F RE AREA BOUNDARIES
PLANT PLAN V EW-ELEVATIONS
109'-0" TO 148'-0"

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Security-Related Information
Figure Withheld Under 10 CFR 2.390

SOURCE DOCUMENT: EB-003AE, REV 3

FIGURE 9A.2-5

FIRE AREA BOUNDARIES
PLANT PLAN VIEW-ELEVATIONS
113'-0" THROUGH 186'-3"

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Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-6

FIRE AREA BOUNDARIES
STANDBY SERVICE WATER PUMP HOUSE
AND COOLING TOWER

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Figure Withheld Under 10 CFR 2.390

SOURCE DOCUMENT: EB-003AJ

FIGURE 9A.2-7

F RE AREA BOUNDARIES
NORMAL COOL NG TOWERS,
MAKEUP WATER INTAKE STRUCTURE,
AND F RE PUMP HOUSE

Security-Related Information
Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-8

FIRE PROTECTION FEATURES
PLANT PLAN VIEW-ELEVATIONS
65'-0" TO 90'-0"

Security-Related Information
Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-9

FIRE PROTECTION FEATURES
PLANT PLAN VIEW – ELEVATIONS
83'-0" TO 106'-0"

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Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-10

F RE PROTECTION FEATURES
PLANT PLAN V EW-ELEVATIONS
109'-9" TO 148'-0"

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Figure Withheld Under 10 CFR 2.390

SOURCE DOCUMENT: EB-003BE REV 3

FIGURE 9A.2-11

FIRE PROTECTION FEATURES
PLANT PLAN VIEW-ELEVATIONS
113'-0" THROUGH 186'-3"

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Security-Related Information
Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-12

FIRE PROTECTION FEATURES
STANDBY SERVICE WATER PUMP HOUSE
AND COOLING TOWER

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Security-Related Information
Figure Withheld Under 10 CFR 2.390

FIGURE 9A.2-13

FIRE PROTECTION FEATURES
NORMAL COOLING TOWERS,
MAKEUP WATER INTAKE STRUCTURE,
AND FIRE PUMP HOUSE

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SMOKE DETECTION SYSTEM SCHEDULE

ITEM NO.	SYSTEM NO.	EQUIPMENT OR AREA	REMARKS
1	SD-1	CONTROL BLDG EL 115'-0" & 116'-0", HVAC ROOM	
2	SD-2	CONTROL BLDG EL 115'-0" & 116'-0", HPCS SWGR 1E22*S004	
3	SD-3	CONTROL BLDG EL 115'-0" & 116'-0", THREE BATTERY ROOMS & DC EQUIP ROOMS	
4	SD-4	CONTROL BLDG EL 98'-0", HVAC ROOM	
5	SD-5	CONTROL BLDG EL 98'-0", STANDBY SWGR ROOM	
6	SD-6	CONTROL BLDG EL 98'-0", STANDBY SWGR ROOM	
7	SD-7	NORMAL SWGR BLDG EL 98'-0", SWGR ROOM 1A	
8	SD-8	NORMAL SWGR BLDG EL 98'-0", SWGR ROOM 1B	
9	SD-9	NORMAL SWGR BLDG EL 98'-0", SWGR ROOM 1C	
10	SD-10	NORMAL SWGR BLDG EL 123'-6", BATTERY ROOM A	
11	SD-11	NORMAL SWGR BLDG EL 123'-6", BATTERY ROOM B	
12	SD-12	NORMAL SWGR BLDG EL 123'-6", SECURITY EQUIP ROOM	
13	SD-13	NORMAL SWGR BLDG EL 123'-6", SECURITY BATTERY ROOM	
14	SD-14	NORMAL SWGR BLDG EL 123'-6", GENERAL AREA	
15	SD-15	CONTROL BLDG EL 70'-0", HVAC ROOM 1A	
16	SD-16	CONTROL BLDG EL 70'-0", HVAC ROOM 1B	
17	SD-17	CONTROL BLDG EL 70'-0", WS-6A	
18	SD-18	CONTROL BLDG EL 70'-0", WS-6B	
19	SD-19	CONTROL BLDG EL 70'-0", WS-6C	
20	SD-20	CONTROL BLDG EL 70'-0", AS-6C	
21	SD-21	NORMAL SWGR BLDG EL 67'-6", WS-14A	
22	SD-22	NORMAL SWGR BLDG EL 67'-6", WS-14B	
23	SD-23	TURBINE BLDG EL 67'-6", 1NHS-MCC1G & 1H	
24	SD-24	TURBINE BLDG EL 67'-6", 1NHS-MCC1C & 1D	
25	SD-25	TURBINE BLDG EL 67'-6", 1NHS-MCC1N	
26	SD-26	TURBINE BLDG EL 67'-6", 1NHS-MCC1P	
27	SD-27	TURBINE BLDG EL 67'-6", 1NHS-MCC1E & 1F	
28	SD-28	AUX BLDG EL 70'-0", HPCS PUMP E22-PC001	
29	SD-29	AUX BLDG EL 70'-0", RHR PUMP E12-PC002B	
30	SD-30	AUX BLDG EL 70'-0", RHR PUMP E12-PC002C	
31	SD-31	AUX BLDG EL 70'-0", RHR PUMP E12-PC002A	
32	SD-32	AUX BLDG EL 70'-0", LPCS PUMP E21-PC002	
33	SD-33	FUEL BLDG EL 70'-0", FUEL POOL COOLING PUMPS 1SFC*P1A & 1B	
34	SD-34	RADWASTE BLDG EL 65'-0"	
35	SD-35	TURBINE BLDG EL 95'-0", GEN & STATION SERVICE RELAY BOARD	
36	SD-36	TURBINE BLDG EL 95'-0", SWGR 1NJS-LDC1EF	
37	SD-37	TURBINE BLDG EL 95'-0", 1NHS-MCC1A & 1B	
38	SD-38	TURBINE BLDG EL 95'-0",1NHS-MCC101, 1NHS-MCC1LL1 & L2	
39	SD-39	TURBINE BLDG EL 95'-0", 1NJS-LDC1GH HEATER BAY	
40	SD-40	TURBINE BLDG EL 95'-0", 1NHS-MCC4A & 4B OFF-GAS AREA	
41	SD-41	AUX BOILER & WATER TREATMENT BLDG EL 95'-0", 1NJS-LDC1JK & 1NHS-MCC6A & 6B & AUX BOILER AREA	
42	SD-42	AUX BOILER & WATER TREATMENT BLDG EL 95'-0"	
43	SD-43	AUX BLDG EL 95'-0", WEST	
44	SD-44	FUEL BLDG EL 95'-0", 1ENS*SWG3A & 4A, 1NHS-MCC8L1 & L2, 1NHS-SWG5A, 1NHS-MCC8A & 8B	
45		SPARE	
46	SD-46	TURBINE BUILDING HEATER BAY EL 123'-6", 1NHS-MCC1L	
47	SD-47	TURBINE BUILDING HEATER BAY EL 123'-6", 1NHS-MCC1M	
48	SD-48	OFF-GAS BLDG EL 123'-6", 1NHS-MCC4C & 4D LOCAL PANELS	
49	SD-49	AUX BLDG EL 141'-0"	
50	SD-50	CONTROL BLDG EL 98'-0", CABLE CHASES AS-6B	
51	SD-51	FUEL BLDG EL 148'-0", 480V LOAD CENTER 1NJS-LDC1LM, 1NHS-MCC8C & 8D	
52	SD-52	AUX BLDG EL 114'-0", EAST	
53	SD-53	AUX BLDG EL 114'-0", WEST	
54	SD-54	CONTROL BLDG EL 116'-0", CABLE CHASES AS-6A	
55	SD-55	AUX BLDG EL 114'-0", P.A.S.S. ROOM	
56	SD-56	MG BLDG EL 98'-0"	
57	SD-57	REACTOR BLDG EL 114'-0", CONTAINMENT AREA	
58		SPARE	
59	SD-59	FUEL BLDG EL 113'-0", GENERAL AREA	
60	SD-60	CONTROL BLDG EL 115'-0" & 116'-0", 1ENB*CHGR1D, 1BYS-1NV02, 1ENB*SWG01D, 1NHS-MCC10A & B	
61	SD-61	CONTROL BLDG EL 98'-0", GENERAL AREA	
62	SD-62	SWC SWGR HOUSE EL 105'-6"	
63	SD-63	SWGR HOUSE NORMAL COOLING TOWERS	
64	SD-64	SWGR HOUSE NORMAL COOLING TOWERS	
65		SPARE	
66		SPARE	
67		SPARE	
68		SPARE	
69	SD-69	SWGR HOUSE NORMAL COOLING TOWERS	
70	SD-70	SWGR HOUSE NORMAL COOLING TOWERS	
71	SD-71	SWGR HOUSE INTAKE STRUCTURE	
72	SD-72	STANDBY COOLING TOWER NO. 1 PUMP ROOM EL 118'-4", SWITCHGEAR & TRANSFORMER AREA EL 137'-10"	
73	SD-73	STANDBY COOLING TOWER NO. 1 PUMP ROOM EL 118'-4", SWITCHGEAR & TRANSFORMER AREA EL 137'-10"	
74		SPARE	
75		SPARE	
76	SD-76	CABLE TUNNEL EL 67'-6", WS-8A	
77	SD-77	CABLE TUNNEL EL 67'-6", WS-8B	
78	SD-78	CABLE TUNNEL EL 67'-6", WS-8C	
79	SD-79	CABLE TUNNEL EL 67'-6", WS-8D	
80	SD-80	CABLE TUNNEL EL 67'-6", WS-8E	
81	SD-81	CABLE TUNNEL EL 67'-6", WS-8F	
82	SD-82	CABLE TUNNEL EL 67'-6", WS-8G	
83	SD-83	CABLE TUNNEL EL 70'-0", WS-8H	
84	SD-84	CABLE TUNNEL EL 67'-6", WS-8I	
85	SD-85	CABLE TUNNEL EL 95'-0", WS-8J	
86	SD-86	PIPE TUNNEL EL 70'-0", WS-8K	
87	SD-87	PIPE TUNNEL EL 67'-6", WS-8L	
88	SD-88	PIPE TUNNEL EL 67'-6", WS-8M	
89	SD-89	PIPE TUNNEL EL 67'-6", WS-8N	
90		SPARE	
91	SD-91	FUEL BLDG EL 70'-0", GENERAL AREA AS-5	
92	SD-92	4160 V SWGR HOUSE NORMAL COOLING TOWERS	
93	SD-93	TURBINE BUILDING HEATER BAY EL 95'-0", 1NHS-MCC1J & 1K	
94	SD-94	FUEL BLDG EL 95'-0", NEW FUEL RECEIVING AS-5	
95	SD-95	RADWASTE BLDG. EL 166'-0"	
96	SD-96	AUX BLDG EL 70'-0", ICS PUMP 1E51*PC001, PS-1 (REACTOR CORE ISOLATION COOLING PUMP)	
97	SD-97	AUX BLDG EL 70'-0"	
98	SD-98	AUX BLDG EL 95'-9", EAST	
99	SD-99	AUX BLDG EL 95'-9",EAST	
100	SD-100	AUX BLDG EL 95'-9", WEST	
101	SD-101	AUX BLDG EL 141'-0", FILTER AREA	
102	SD-102	REACTOR BLDG EL 186'-3", ANNULUS AREA	DUCT DETECTION
103	SD-103	AUX BLDG EL 141'-0", FILTER AREA	
104	SD-104	REACTOR BLDG EL 186'-3"	
105	SD-105	DIESEL GENERATOR BLDG EL 98'-0", WEST	
106	SD-106	AUX BLDG EL 171'-0", 1HVR*FN11A & 11B, 1RMS*CAB11A	
107	SD-107	TURBINE BUILDING HEATER BAY EL 67'-6"	
108	SD-108	TURBINE BUILDING HEATER BAY EL 67'-6"	
109	SD-109	CONDENSATE DEMINERALIZER, REGENERATION, & OFF-GAS BLDG EL 67'-6"	
110	SD-110	FUEL BLDG EL 70'-0", 1SFC*P2A & 2B, 1SFC*P3A & 3B	
111	SD-111	FUEL BLDG EL 95'-0", 1SFC*E1A & 1B	
112	SD-112	AUX CONTROL ROOM EL 123'-6", H-4A & BELOW FLOOR H-4	
113	SD-113	AUX CONTROL BLDG HOT MACHINE SHOPS EL 95'-0"	
114	SD-114	AUX CONTROL ROOM EL 123'-6", ABOVE SUSPENDED CEILING	
115	SD-115	AUX CONTROL ROOM EL 123'-6", MECH EQUIP ROOM	
116	SD-116	RADWASTE BLDG EL 106'-0", 1LWS-P8A & 8B, 1LWS-P10A & 10B, 1LWS-P12A & 12B & DECONTAMINATION AREA	
117	SD-117	REACTOR BLDG EL 162'-3"	
118	SD-118	TURBINE BLDG EL 123'-6", FILTER AREA	
119	SD-119	REACTOR BLDG EL 141'-0", CONTAINMENT AREA	
120	SD-120	FIRE PUMP HOUSE EL 95'-0", 1FPW-P2	
121	SD-121	FUEL BLDG EL 148'-0", FILTER AREA	
122	SD-122	FIRE PUMP HOUSE EL 95'-0", 1DWS-P1A, 1B, & 1C, 1MWS-P2A, 2B & 2C	
123	SD-123	FUEL BLDG EL 148'-0", FILTER AREA	
124	SD-124	FUEL BLDG EL 148'-0", 1SCA*PNL8B1, FUTURE MCC, 1RMS*CAB101	
125-151	SD-125 THRU SD-151	CONTROL BLDG EL 136'-0", PGCC FLOOR PANELS	
152&153	SD-152 & SD-153	CONTROL BLDG EL 135'-0", NORTH, NON PANEL MODULE AREA CONTROL BLDG EL 135'-0", SOUTH, NON PANEL MODULE AREA	
154	SD-154	CONTROL BLDG EL 136'-0", GENERAL AREA	
155	SD-155	FUEL BLDG EL 113'-0", GENERAL AREA AS-5	

NOTES:
1. SCALE: NONE
2. FOR GENERAL NOTES AND LEGEND SEE FIGURE 9A.2-2

SOURCE DOCUMENT: EB-3M

FIGURE 9A.2-14

DETECTION SYSTEM IDENTIFICATION LEGEND SHEET 1 OF 2

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FIRE SUPPRESSION SYSTEM SCHEDULE

ITEM NO.	SYSTEM NO.	EQUIPMENT OR AREA	TYPE OF SYSTEM	REMARKS
1	AS-1A	TURBINE BLDG-MEZZANINE-NORTH EL 95'-0"	AUTO SPRINKLER	
2	AS-1B	TURBINE BLDG-MEZZANINE-SOUTH EL 95'-0"	AUTO SPRINKLER	
3	AS-2A	TURBINE BLDG-BASEMENT-NORTH EL 67'-6"	AUTO SPRINKLER	
4	AS-2B	TURBINE BLDG-BASEMENT-SOUTH EL 67'-6"	AUTO SPRINKLER	
5	WS-1	TURBINE BLDG EL 67'-6", TURBINE OIL STORAGE ROOM	WATER SPRAY	
6	WS-2	TURBINE BLDG EL 95'-0", TURBINE LUBE OIL SYSTEM ROOM	WATER SPRAY	
7	AS-3	TURBINE BLDG EL 67'-6", CONDENSER PIT	AUTO SPRINKLER	
8	PS-3A	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARINGS NO. 1, 2 & 3 AND OIL PIPING	WATER SPRAY	
9	PS-3B	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARINGS NO. 4 & 5 AND OIL PIPING	WATER SPRAY	
10	PS-3C	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARINGS NO. 6 & 7 AND OIL PIPING	WATER SPRAY	
11	PS-3D	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARINGS NO. 8 AND OIL PIPING	WATER SPRAY	
12	AS-4	RADWASTE BLDG BALING AREA, TRUCK PIT & DRUM STORAGE AREA EL 106'-0" & 136'-0"	AUTO SPRINKLER	
13	PS-1	AUXILIARY BLDG EL 70'-0", RCIC PUMP ROOM	PREACTION SPRINKLERS	
14	WS-4A	AUXILIARY BLDG EL 141'-0", STANDBY GAS TREATMENT FILTER (1GTS*FLT1A)	WATER SPRAY	
15	WS-4B	AUXILIARY BLDG EL 141'-0", STANDBY GAS TREATMENT FILTER (1GTS*FLT1B)	WATER SPRAY	
16	AS-5	FUEL BLDG-NEW FUEL RECEIVING AREA EL 95'-0", GENERAL AREA EL 70'-0" & 113'-0"	AUTO SPRINKLER	
17	WS-5A	FUEL BLDG EL 148'-0", CHARCOAL FILTER (1HVF*FLT2A)	WATER SPRAY	
18	WS-5B	FUEL BLDG EL 148'-0", CHARCOAL FILTER (1HVF*FLT2B)	WATER SPRAY	
19	WS-6A	CONTROL BLDG EL 70'-0", CABLE VAULT	WATER SPRAY	
20	WS-6B	CONTROL BLDG EL 70'-0", CABLE VAULT	WATER SPRAY	
21	WS-6C	CONTROL BLDG EL 70'-0", CABLE VAULT	WATER SPRAY	
22	WS-7A	CONTROL BLDG EL 115'-0", CHARCOAL FILTER (1HVC*FLT3A)	WATER SPRAY	
23	WS-7B	CONTROL BLDG EL 115'-0", CHARCOAL FILTER (1HVC*FLT3B)	WATER SPRAY	
24	AS-6A	CONTROL BLDG EL 116'-0", CABLE CHASES	AUTO SPRINKLER	
25	AS-6B	CONTROL BLDG EL 98'-0", CABLE CHASES & HVAC ROOMS GENERAL AREA	AUTO SPRINKLER	
26	AS-6C	CONTROL BLDG EL 70'-0", CABLE CHASES & HVAC ROOMS	AUTO SPRINKLER	
27	AS-7	WAREHOUSE EL 95'-0"	AUTO SPRINKLER	
28	AS-8	WAREHOUSE	AUTO SPRINKLER	
29		SPARE		
30	PS-2A	DIESEL GENERATOR BLDG EL 98'-0"	PREACTION SPRINKLERS	
31	PS-2B	DIESEL GENERATOR BLDG EL 98'-0"	PREACTION SPRINKLERS	
32	PS-2C	DIESEL GENERATOR BLDG EL 98'-0"	PREACTION SPRINKLERS	
33	WS-8A	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
34	WS-8B	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
35	WS-8C	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
36	WS-8D	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
37	WS-8E	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
38	WS-8F	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
39	WS-8G	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
40	WS-8H	CABLE TUNNELS EL 70'-0"	WATER SPRAY	
41	WS-8I	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
42	WS-9A	MAIN TRANSFORMER-YARD AREA (1MTX-XM1)	WATER SPRAY	
43	WS-9B	MAIN TRANSFORMER-YARD AREA (1MTX-XM2)	WATER SPRAY	
44	WS-10A	PREFERRED STATION SERVICE TRANSFORMER-YARD AREA (1RTX-XSR1E)	WATER SPRAY	
45	WS-10B	PREFERRED STATION SERVICE TRANSFORMER-YARD AREA (1RTX-XSR1F)	WATER SPRAY	

ITEM NO.	SYSTEM NO.	EQUIPMENT OR AREA	TYPE OF SYSTEM	REMARKS
46	WS-11A	NORMAL STATION SERVICE TRANSFORMER-YARD AREA (1STX-XNS1A)	WATER SPRAY	
47	WS-11B	NORMAL STATION SERVICE TRANSFORMER-YARD AREA (1STX-XNS1B)	WATER SPRAY	
48		SPARE		
49		SPARE		
50	WS-13A	RADWASTE BLDE EL 166'-0", IODINE FILTER (1HVW-FLT1A)	WATER SPRAY	
51	WS-13B	RADWASTE BLDE EL 166'-0", IODINE FILTER (1HVW-FLT1B)	WATER SPRAY	
52	WS-14A	CABLE VAULT-NORM SWGR EL 67'-6"	WATER SPRAY	
53	WS-14B	CABLE VAULT-NORM SWGR EL 67'-6"	WATER SPRAY	
54	WS-8J	CABLE TUNNELS EL 95'-0"	WATER SPRAY	
55	WS-8K	PIPE TUNNELS EL 70'-0"	WATER SPRAY	
56	WS-8L	PIPE TUNNELS EL 67'-6"	WATER SPRAY	
57	WS-8M	PIPE TUNNELS EL 67'-6"	WATER SPRAY	
58	WS-8N	PIPE TUNNELS EL 67'-6"	PREACTION & WATER SPRAY	
59		SPARE		
60	WS-15	TURBINE BLDG EL 123'-6", CHARCOAL FILTER (1HVT-FLT1A)	WATER SPRAY	
61	WS-17	TURBINE BLDG-HYDROGEN SEAL OIL UNIT EL 67'-6"	WATER SPRAY	
62	DPS-1	FUEL BLDG EL 95'-0", EXTERIOR SPENT FUEL HANDLING AREA	MANUAL DRY PIPE SPRINKLER	
63		SPARE		
64	CO2-1	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARING NO. 1	CARBON DIOXIDE	
65	CO2-2	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARING NO. 2 & 3	CARBON DIOXIDE	
66	CO2-3	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARING NO. 4 & 5	CARBON DIOXIDE	
67	CO2-4	TURBINE BLDG EL 123'-6", TURBINE GENERATOR BEARING NO. 6, 7 & 8	CARBON DIOXIDE	
68	CO2-5	TURBINE BLDG EL 123'-6", EXCITER	CARBON DIOXIDE	
69		SPARE		
70		SPARE		
71		SPARE		
72		SPARE		
73	H-4 H-4A	AUX CONTROL BLDG EL 123'-6", CONTROL RM (BELOW FLOOR) AUX CONTROL BLDG EL 123'-6", CONTROL RM	HALON 1301	
74	AS-11A	FIRE PUMP HOUSE-DIESEL DRIVEN FIRE PUMP (1FPW-P1A)	AUTO SPRINKLER	
75	AS-11B	FIRE PUMP HOUSE-DIESEL DRIVEN FIRE PUMP (1FPW-P1B)	AUTO SPRINKLER	
76	WS-10D	PREFERRED STATION SERVICE TRANSFORMER-YARD AREA (1RTX-XSR1D)	WATER SPRAY	
77	WS-11C	NORMAL STATION SERVICE TRANSFORMER - YARD AREA (1STX-XNS1C)	WATER SPRAY	
78	WS-18A	RECIRC PUMP TRANSFORMER-YARD AREA (1RCS-X1A)	WATER SPRAY	
79	WS-18B	RECIRC PUMP TRANSFORMER-YARD AREA (1RCS-X1B)	WATER SPRAY	
80	WS-10C	PREFERRED STATION SERVICE TRANSFORMER-YARD AREA (1RTX-XSR1C)	WATER SPRAY	
81	WS-16	AUXILIARY BLDG EL 171'-0", CONTAINMENT CONTINUOUS PURGE FILTER (1HVR-FLT6)	WATER SPRAY	
82	WS-8AA	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
83	WS-8BB	CABLE TUNNELS EL 67'-6"	WATER SPRAY	
84	H-5	NORMAL SWGR BLDG EL 123'-6", CENTRAL ALARM STATION (BELOW FLOOR)	HALON 1301	
85	H-6	SERVICES BUILDING EL 109'-3", PBX ROOM	HALON 1301	
86	H-7	SERVICES BUILDING EL 109'-3", COMPUTER ROOM & RECORDS STORAGE	HALON 1301	
87	H-8 H-8A	SERVICES BLDG EL 123'-6", COMPUTER ROOM (BELOW FLOOR) SERVICES BLDG EL 123'-6", COMPUTER ROOM	HALON 1301	
88	WS-19	AUX BLDG EL 70'-0", (WATER CURTAIN)	WATER SPRAY	
89	WS-20	AUX BLDG EL 141'-0", (WATER CURTAIN)	WATER SPRAY	
90	AS-12	AUX BLDG EL 95'-9", 114'-0" & 141'-0", CABLE TRAYS (7 DEEP OR MORE)	AUTO SPRINKLER	
91	H-9	SERVICES BLDG EL 123'-6", RECORDS ROOM	HALON 1301	

ITEM NO.	SYSTEM NO.	EQUIPMENT OR AREA	TYPE OF SYSTEM	REMARKS
92	H-10	SERVICES BLDG EL 123'-6", SAFETY PARAMETER DISPLAY AREA (ROOM & BELOW FLOOR)	HALON 1301	
93	H-11	PAP BUILDING SECONDARY ALARM STATION (BELOW FLOOR)	HALON 1301	
94	H-12	METEOROLOGICAL BUILDING, UTILITY SECTION	HALON 1301	SYSTEM ABANDONED IN PLACE
95	H-13	METEOROLOGICAL BUILDING, INSTRUMENT SECTION	HALON 1301	SYSTEM ABANDONED IN PLACE
96	WS-21A	SERVICES BLDG EL 138'-1 1/2" CHARCOAL FILTER (1HVL-FLU1)	WATER SPRAY	
97	WS-21B	SERVICES BLDG EL 138'-1 1/2" CHARCOAL FILTER (1HVL-FLU2)	WATER SPRAY	

NOTES
1. SCALE NONE
2. GENERAL NOTES, LEGEND & REFERENCES EB-3A

SOURCE DOCUMENT: EB-003N

FIGURE 9A.2-15

FIRE SUPPRESSION SYSTEM IDENTIFICATION LEGEND

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT
REVISION 22

SMOKE DETECTION SYSTEM SCHEDULE

ITEM NO	SYSTEM NO	EQUIPMENT OR AREA	REMARKS
156		SPARE	
157		SPARE	
158	SD 158	CONTROL BLDG EL 136' 0", PGCC PANEL	
159	SD 159	NORMAL SWGR BLDG EL 123' 6", CAS UNDERFLOOR, H 5	
160	SD 160	CABLE TUNNEL EL 67' 6", WS 8AA	
161	SD 161	CABLE TUNNEL EL 67' 6", WS 8BB	
162	SD 162	CONTROL BLDG EL 98' 0", REMOTE SHUTDOWN ROOM DIV I	
163	SD 163	CONTROL BLDG EL 98' 0", REMOTE SHUTDOWN ROOM DIV II	
164	SD 164	AUX BLDG EL 70' 0", WS 19	
165	SD 165	AUX BLDG EL 141' 0", WS 20	
166		SPARE	
167		SPARE	
168		SPARE	
169	SD 169	PAP BUILDING, H 11	
170	SD 170	SERVICES BLDG EL 123' 6", COMPUTER ROOM, H 8 & H 8A	
171	SD 171	SERVICES BLDG EL 123' 6", SAFETY PARAMETER DISPLAY AREA, H 10	
172	SD 172	SERVICES BLDG EL 123' 6", RECORDS ROOM, H 9	
173	SD 173	SERVICES BLDG EL 109' 3", PBX ROOM, H 6	
174	SD 174	SERVICES BLDG EL 109' 3", COMPUTER ROOM & RECORDS STORAGE, H 7	
175	SD 175	METEOROLOGICAL BLDG, UTILITY SECTION, H 12	
176	SD 176	METEOROLOGICAL BLDG, INSTRUMENT SECTION, H 13	

FIRE DETECTION SYSTEM SCHEDULE

ITEM NO	SYSTEM NO	EQUIPMENT OR AREA	REMARKS
1	FD 1	TURBINE BLDG EL 67' 6", TURBINE OIL STORAGE RM, WS 1	
2	FD 2	TURBINE BLDG EL 67' 6", H_2 SEAL OIL UNIT, WS 17	
3	FD 3	TURBINE BLDG EL 95' 0", LUBE OIL SYSTEM ROOM, WS 2	
4	FD 4	NORMAL STATION SERVICE TRANSFORMER YARD AREA (1STX XNS1C), WS 11C	
5	FD 5	NORMAL STATION SERVICE TRANSFORMER YARD AREA (1STX XNS1B), WS 11B	
6	FD 6	NORMAL STATION SERVICE TRANSFORMER YARD AREA (1STX XNS1A), WS 11A	
7	FD 7	PREFERRED STATION SERVICE TRANSFORMER YARD AREA (1RTX XSR1C), WS 10C	
8	FD 8	PREFERRED STATION SERVICE TRANSFORMER YARD AREA (1RTX XSR1E), WS 10A	
9		SPARE	
10		SPARE	
11	FD 11	MAIN TRANSFORMER YARD AREA (1MTX XM1), WS 9A	
12	FD 12	MAIN TRANSFORMER YARD AREA (1MTX XM2), WS 9B	
13	FD 13	REACTOR BLDG EL 70' 0" & 98' 0", RECIRC PUMP 1B33*PC001A & 1B	
14	FD 14	RECIRC PUMP TRANSFORMER YARD AREA (1RCS X1A), WS 18A	
15	FD 15	RECIRC PUMP TRANSFORMER YARD AREA (1RCS X1B), WS 18B	
16	FD 16	DIESEL GENERATOR BLDG EL 98' 0", PS 2A	
17	FD 17	DIESEL GENERATOR BLDG EL 98' 0", PS 2B	
18	FD 18	DIESEL GENERATOR BLDG EL 98' 0", PS 2C	
19	FD 19	PREFERRED STATION SERVICE TRANSFORMER YARD AREA (1RTX XSR1D), WS 10D	
20	FD 20	PREFERRED STATION SERVICE TRANSFORMER YARD AREA (1RTX XSR1F), WS 10B	
21	FD 21	TURBINE BLDG EL 123' 6", TURBINE BEARING NO 1, CO_2 1	
22	FD 22	TURBINE BLDG EL 123' 6", TURBINE BEARINGS NO 2 & 3, CO_2 2	
23	FD 23	TURBINE BLDG EL 123' 6", TURBINE BEARINGS NO 4 & 5, CO_2 3	
24	FD 24	TURBINE BLDG EL 123' 6", TURBINE BEARINGS NO 6, 7 & 8, CO_2 4	
25	FD 25	TURBINE BLDG EL 123' 6", EXCITER, CO_2 5	
26	FD 26	CONTROL BLDG EL 115' 0", CHARCOAL FILTER 1HVC*FLT3B, WS 7B	
27	FD 27	CONTROL BLDG EL 115' 0", CHARCOAL FILTER 1HVC*FLT3A, WS 7A	
28	FD 28	AUX BLDG EL 171' 0", CONTAINMENT CONTINUOUS PURGE FILTER (1HVR FLT6), WS 16	
29	FD 29	RADWASTE BLDG EL 166' 0", CHARCOAL FILTER (1HVW FLT1B), WS 13B	
30	FD 30	RADWASTE BLDG EL 166' 0", CHARCOAL FILTER (1HVW FLT1A), WS 13A	
31		SPARE	
32		SPARE	
33	FD 33	AUX BLDG EL 141' 0", SGTS FILTER (1GTS*FLT1B), WS 4B	
34	FD 34	AUX BLDG EL 141' 0", SGTS FILTER (1GTS*FLT1A), WS 4A	
35	FD 35	FUEL BLDG EL 148' 0", IODINE FILTER (1HVF*FLT2A), WS 5A	
36	FD 36	FUEL BLDG EL 148' 0", IODINE FILTER (1HVF*FLT2B), WS 5B	
37	FD 37	TURBINE BLDG EL 123' 6", CHARCOAL FILTER (1HVT FLT1), WS 15	
38	FD 38	MAKEUP WATER INTAKE STRUCTURE EL 70' 6", TRANSFORMER (1STX XS3B)	
39	FD 39	MAKEUP WATER INTAKE STRUCTURE EL 70' 6", TRANSFORMER (1STX XS3A)	
40		SPARE	
41	FD 41	METEOROLOGICAL BLDG UTILITY SECTION, H 12	
42	FD 42	METEOROLOGICAL BLDG INSTRUMENT SECTION, H 13	
43	FD 43	SERVICES BLDG EL 138' 1 1/2", CHARCOAL FILTER (1HVL FLU1), WS 21A	
44	FD 44	SERVICES BLDG EL 138' 1 1/2", CHARCOAL FILTER (1HVL FLU2), WS 21B	

NOTES
1 SCALE NONE
2 FOR GENERAL NOTES AND LEGEND SEE FIGURE 9A 2 2

SOURCE DOCUMENT: EB-3P

FIGURE 9A.2-16

DETECTION SYSTEM IDENTIFICATION
LEGEND SHEET 2 OF 2

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT
REVISION 22

SECTION 9A.3

DEGREE OF COMPLIANCE WITH APPENDIX A TO BRANCH TECHNICAL POSITION APCSB 9.5-1

9A.3.1 INTRODUCTION

This section is organized based on the portions of Appendix A to BTP APCSB 9.5-1 applicable to plants docketed, but Construction Permit not received as of July 1, 1976. The various sections of Appendix A have been repeated and are immediately followed by the River Bend Station position.

Prior to issuance of Appendix A, the River Bend Station design was based upon the various available regulatory requirements and industry and insurance standards. As design progressed, efforts were made to incorporate changes in these requirements and standards. The Branch Technical Position guidelines have similarly been reviewed, and design changes incorporated where feasible. Where full compliance is not possible, descriptions of the existing design are provided. Reference to the detailed fire hazards analysis is made to support the River Bend Station position.

The River Bend Station fire protection program is described in Section 9.5.1.

9A.3.2 OVERALL REQUIREMENTS OF NUCLEAR PLANT FIRE PROTECTION PROGRAM

9A.3.2.1 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 of authority should be to staff personnel 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 firefighting 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 the competence of the station firefighting and operating crew, including personnel responsible for maintaining and inspecting the fire protection equipment.

The fire protection staff should be responsible for:

1. Coordination of building layout and systems design with fire area requirements, including consideration of potential hazards associated with postulated design basis fires
2. Design and maintenance of fire detection, suppression, and extinguishing systems
3. Fire prevention activities
4. 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.

RIVER BEND STATION POSITION

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Responsibility for the overall fire protection program is assigned to the Site Vice-President, who retains the ultimate responsibility, even though formulation and assurance of program implementation is delegated. Personnel to whom authority for implementation and formulation is delegated are trained commensurate with the level within the program with which they deal. The Fire Protection Staff is responsible for the formulation of the fire protection program including:

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- Coordination of building layout and systems design with the fire area requirements, including consideration of the potential hazards associated with postulated design basis fires.
- Design of fire detection and suppression systems.
- Fire prevention activities.
- Assisting in the development of the fire protection related training program and development of the maintenance, inspecting and testing of all fire protection equipment.

The Fire Protection Staff reports to the Director - Engineering through the Manager - Design and Program Engineering. Implementation of the fire protection program and manual fire fighting activities as formulated by the fire protection staff is the responsibility of the General Manager through various staff positions.

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The Manager - Training is responsible for the development and implementation of the fire protection related training programs. Section 13.2.3 provides complete details regarding the staffing, training and maintaining the competence of the Station's fire fighting and operating crews.

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9A.3.2.2 Design Bases

The overall fire protection program should be 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.

RIVER BEND STATION POSITION

The fire hazards analysis of all plant areas is provided in Section 9A.2. The analysis includes the evaluation of postulated design basis fires involving both permanent and/or transient combustibles on systems and equipment required for safe plant shutdown and to minimize potential radioactive releases to the environment.

9A.3.2.3 Backup

Total reliance should not be placed on a single automatic fire suppression system. Appropriate backup fire suppression capability should be provided.

RIVER BEND STATION POSITION

Backup fire protection capability by means of manual fire hose stations and portable extinguishers is provided throughout the plant. Where automatic suppression is not required by the hazard analysis, these manual systems support and supplement each other.

9A.3.2.4 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 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 or aircraft crashes which have a reasonable probability of occurring at the specific plant site. The effects of lightning strikes should be included in the overall plant fire protection program.

RIVER BEND STATION POSITION

The redundancy provided for the station fire protection system is described in Section 9A.3.6.2 of this response.

As a result of the total evaluation of the plant's fire protection program including the fire hazards analysis, it has been concluded that the requirements for safe shutdown of the reactor and mitigation of radioactive release to the environment are retained under postulated fire events. In the event of an SSE, the plant's engineered safety systems respond to shut the reactor down. Other systems including the appropriate ventilation equipment respond to mitigate radioactive releases. All of these systems are seismically qualified and would retain their intended functions upon an occurrence of the SSE. Also, in the event of the most severe earthquake (SSE), or earthquakes of less intensity which are characteristic of the region, Seismic Category I standby service water supply is available to manual hose stations located in the auxiliary, control, fuel, and reactor buildings. Piping for these hose stations are analyzed for the SSE loading and provided with supports to assure system pressure integrity.

Fire protection systems retain their original design capability for potential man-created, site-related events and natural phenomena (except earthquake) which are characteristic (once in 10 yr) of the site geographic region. Natural phenomena are described in Section 2.3.

A building lightning protection system with grounding is provided to permit the dissipation of a direct stroke of lightning without stroke current passing through the nonconducting parts of the building, thus preventing damage caused by the heat and mechanical forces generated in such nonconductive parts by the discharge.

9A.3.2.5 Fire Suppression Systems

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."

RIVER BEND STATION POSITION

Fire protection systems are classified as nonnuclear safety class. Where safety-related components are located, the hangers and supports for the fire suppression lines in the vicinity of this equipment are seismically designed. The plant design includes features such as physical separation of safety-related systems and components, and curbs and drains that prevent the failure or inadvertent operation of the fire suppression systems from incapacitating both redundant systems or components. Water level design is described in Section 3.4.

9A.3.2.6 Fuel Storage Areas

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.

RIVER BEND STATION POSITION

A fire protection program (plans, personnel, equipment) will be fully operational for the fuel storage zone and for adjacent fire zones which could affect the fuel storage zone prior to storing fuel in that zone. In the event that portions of the fire protection equipment are incomplete, a fire patrol will be provided for the fuel storage zone and adjacent fire zones that could affect the fuel storage zone. This fire patrol will have communications with the control room.

9A.3.2.7 Fuel Loading

The fire protection program for an entire reactor unit should be fully operational prior to initial fuel loading in that reactor unit.

RIVER BEND STATION POSITION

A fire protection program for the operating unit will be fully operational prior to fuel loading.

9A.3.2.8 Multiple Reactor Sites

On multiple reactor sites where there are operating reactors and construction of remaining units is being completed, the fire protection program should provide continuing evaluation and include additional fire barriers fire protection capability, and administrative 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.

RIVER BEND STATION POSITION

Not applicable, only one unit provided.

9A.3.2.9 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.

RIVER BEND STATION POSITION

Not applicable, only one unit provided.

9A.3.3 ADMINISTRATIVE PROCEDURES, CONTROLS, AND FIRE BRIGADE

9A.3.3.1 NFPA Standards

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

RIVER BEND STATION POSITION

Administrative procedures consistent with the need for maintaining the performance of the fire protection system and personnel are described in Section 9.5.1.5.

9A.3.3.2 Administrative Measures

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 Guide 1.39, "Housekeeping Requirements for Water-Cooled Nuclear Power Plants," provides guidance on housekeeping, including the disposal of combustible materials.

RIVER BEND STATION POSITION

Administrative measures are implemented to ensure that bulk storage of combustible materials in or near safety-related buildings and systems is controlled. Housekeeping requirements including the disposal of combustible materials comply with Regulatory Guide 1.39.

9A.3.3.3 Normal and Abnormal Conditions

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:

1. 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.

2. Leak testing, and similar procedures such as airflow determination, should use one of the commercially available aerosol techniques. Open

flames or combustion-generated smoke should not be permitted.

3. 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-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.

RIVER BEND STATION POSITION

Procedures for administrative control of ignition sources, leak testing, and combustible materials are described in Section 9.5.1.5.

9A.3.3.4 Public Fire Department

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 firefighting activities and rely on the public response only for supplemental or backup capability.

RIVER BEND STATION POSITION

River Bend Station is designed to avert and control all reasonably postulated fires as discussed in Sections 9A.3.5 and 9A.3.6. The station firefighting crews are organized and trained to be self-sufficient. Procedures are provided so that the public fire departments could assist, if required.

The St. Francisville Volunteer Fire Department has sufficient equipment and facilities to back up the station firefighting crews. Agreements for this backup have been attained as discussed in Section 13.3.

9A.3.3.5 Fire Training

The need for good organization, training, and equipping of fire brigades at nuclear power plant sites requires that 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.

9A.3.3.5.1 Testing Fire Equipment

Successful firefighting 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.

9A.3.3.5.2 Training Fire Brigade

Basic training is a necessary element in effective firefighting 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 and 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 postcritiqued 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.

9A.3.3.6 Training Shift Crews

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 special hazards associated with a nuclear power plant site.

9A.3.3.7 NFPA 27, "Private Fire Brigade"

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 the 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 Couplings," 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.

RIVER BEND STATION POSITION (For Sections 9A.3.3.5 Through 9A.3.3.7)

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Procedures for testing and maintenance of fire protection equipment, including detection and suppression systems, hydrants and interim hose stations, emergency lighting and communication facilities, are included in those discussed in Section 9.5.1.5. All aspects of organization and training associated with the plant fire brigade are discussed in Section 13.2.3. Retraining and drills associated with the plant fire brigade are discussed in Section 13.2.5.4.

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9A.3.4 QUALITY ASSURANCE PROGRAM

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 controls 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.

9A.3.4.1 Design Control and Procurement Document Control

Measures 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.

RIVER BEND STATION POSITION

Procedures are established whereby design and procurement requirements are included in applicable documents and that deviations therefrom are controlled. This system is designated as QA Category III. See Chapter 17 for a further discussion of QA.

9A.3.4.2 Instructions, 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.

RIVER BEND STATION POSITION

Inspections, tests, administrative control, fire drills, and training procedures are provided as discussed in Section 9.5.1.5.

9A.3.4.3 Control of Purchased Material, Equipment, and Services

Measures should be established to assure that purchased material, equipment, and services conform to the procurement documents.

RIVER BEND STATION POSITION

Procedures currently exist concerning the review and approval of supplier designs and material, the surveillance inspection during the procurement process, and inspection of material received and work installed at the jobsite.

9A.3.4.4 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.

RIVER BEND STATION POSITION

The independent inspection of fire protection systems and equipment is executed by the fire insurance underwriter. Test procedures are a part of the plant operating procedures.

9A.3.4.5 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; test results should be properly evaluated and acted on.

RIVER BEND STATION POSITION

The test program which provides testing procedure, appropriate forms for recording results, testing periods, inspection, audit, evaluation of test results, and follow-up action after test has been established.

9A.3.4.6 Inspection, Test, and Operating Status

Measures should be established to provide for the identification of items that have satisfactorily passed required tests and inspections.

RIVER BEND STATION POSITION

Startup test procedures require identification of those systems considered satisfactorily operational. Construction methods procedures establish the necessary measures to monitor initial tests and inspections.

9A.3.4.7 Nonconforming Items

Measures should be established to control items that do not conform to specified requirements to prevent inadvertent use of installation.

RIVER BEND STATION POSITION

Materials received which do not comply with specifications, and equipment found not operating satisfactorily during testing, are segregated and identified as nonconforming items in accordance with current procedures.

9A.3.4.8 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.

RIVER BEND STATION POSITION

Measures are 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.

9A.3.4.9 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.

RIVER BEND STATION POSITION

Appropriate records are prepared and maintained to furnish evidence that the criteria previously enumerated are being met for activities affecting the fire protection program.

9A.3.4.10 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.

RIVER BEND STATION POSITION

Regular audits are conducted and documented as required to verify compliance with the fire protection program, including design and procurement documents; instructions; procedures and drawings; and inspection and test activities.

9A.3.5 GENERAL GUIDELINES FOR PLANT PROTECTION

9A.3.5.1 Building Design

9A.3.5.1.1 Plant Layout

Plant layouts should be arranged to:

1. Isolate safety-related systems 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.

RIVER BEND STATION POSITION

Physical separation is provided for safety-related systems needed for plant shutdown. In electrical cable tunnels and the chases in the control building, 3-hr fire-rated barriers are provided. In other areas, Regulatory Guide 1.75 and transient fire considerations are implemented. For redundant safety-related equipment, physical separation or fire-rated barriers are provided so that a single accident or failure does not compromise plant shutdown. In addition, cable tray locations are reviewed as a source of combustibles, with ignition from either the equipment fire or a cable tray fire. In this evaluation, qualitative credit is given to the fire retardancy of River Bend Station cable, fire loadings within a fire area, and distance separation. It was determined that there is no compromise to plant shutdown.

9A.3.5.1.2 Safety-Related Systems

In order to accomplish plant layout, safety-related systems and fire hazards should be identified throughout the plant. Therefore, a detailed fire hazard analysis should be made. The fire hazards analysis should be reviewed and updated as necessary.

RIVER BEND STATION POSITION

An updated, detailed fire hazard analysis is presented in Section 9A.2. This analysis identifies safety- and nonsafety-related systems, fire loadings, fire areas, fire barriers, detections, and extinguishing systems.

9A.3.5.1.3 Multiple Reactor Sites

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 3 hr. Cabling for redundant safety divisions should be separated by walls having 3-hr fire barriers.

RIVER BEND STATION POSITION

There is only one reactor unit at this location. Cable spreading rooms are separated from adjacent areas by 3-hr walls. Cables for redundant safety divisions do not all require separation by 3-hr fire-rated walls. Positions regarding separation of cable divisions are provided in the discussions of individual buildings and areas.

9A.3.5.1.4 Structural Components

Interior wall and structural components, thermal insulation materials, 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 (FM) or Underwriters' Laboratory, Inc. (UL), for flame spread, and smoke and fuel contribution factors of 25 or less in its use configuration (ASTM E84 Test, "Surface Burning Characteristics of Building Materials").

RIVER BEND STATION POSITION

Noncombustible building materials are used throughout the plant where practicable. Interior finishes have flame spread, and smoke and fuel contribution factors of 25 or less except resilient floor coverings.

9A.3.5.1.5 Roof Construction

Metal deck roof construction should be noncombustible (see the building materials directory of the UL), or listed as Class I by Factory Mutual System Approval Guide.

RIVER BEND STATION POSITION

All metal deck roof construction is FM Class I construction or listed by UL as "classified as to fire."

9A.3.5.1.6 Suspended Ceiling

Suspended ceilings and their supports should be of noncombustible construction. Concealed spaces should be devoid of combustibles.

RIVER BEND STATION POSITION

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Suspended ceilings and their supports are noncombustible with the exception of the concealed space above the suspended ceiling in the CRD maintenance area. The concealed airspace above the CRD maintenance area in the Auxiliary Building contains electrical cables in open cable trays and risers. Automatic sprinkler protection is provided over the cable trays and early warning is provided by ionization type detection both above and below the suspended ceiling. This early warning detection and automatic suppression over the exposed combustibles provides adequate protection of this hazard. Concealed spaces are devoid of combustibles except for cables for lighting fixtures. The combustible cable loads are negligible.

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9A.3.5.1.7 High Voltage Transformers

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.

RIVER BEND STATION POSITION

All transformers inside buildings containing safety-related equipment are of the dry type.

9A.3.5.1.8 Oil-Filled Transformers

Buildings containing safety-related systems should be protected from exposure or spill fires involving oil-filled transformers by:

1. Locating such transformers at least 50 ft distant or

2. Ensuring that such building walls within 50 ft of oil-filled transformers are without openings and have a fire resistance rating of at least 3 hr.

RIVER BEND STATION POSITION

The fuel building wall is located within 50 ft of oil-filled transformers. This wall is 3-hr fire-rated with an opening closed by a missile-protected door. The turbine building contains safety-related RPS inputs for turbine trip. These are not required for safe shutdown.

9A.3.5.1.9 Floor Drains

Floor drains, sized to remove expected firefighting 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 firefighting 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, "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 which may contain radioactivity should be sampled and analyzed before discharge to the environment.

RIVER BEND STATION POSITION

Floor drains are available in those areas where fixed water fire suppression systems are installed. The drainage system is designed to prevent the spread of fire through drainage piping. Potentially radioactive area drainage is diverted to the radwaste building prior to discharging to the environment. Fire area flooding resulting from an inadvertent actuation of a sprinkler system and an assumed loss of floor drainage system in one fire area does not cause a loss of redundant trains of safety-related equipment.

9A.3.5.1.10 Fire Area Enclosures

Floors, walls, and ceilings enclosing separate fire areas should have minimum fire rating of 3 hr. 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.")

RIVER BEND STATION POSITION

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Separate fire areas are enclosed with minimum 3-hr rated fire walls and floors, or the walls and floors have been evaluated to be adequate using the guidance contained in NRC Generic Letter 86-10. The walls and floor/ceiling

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assemblies are constructed of a minimum of 8 inches thick reinforced concrete. Concrete, in addition to its capability to support various loads, also possesses insulating and fire resistive properties. The nationally known and recognized Uniform Building Code (herein called UBC) lists the required minimum thicknesses of various insulating materials for fire-resistive periods of 1 hour through 4 hours in the tables 43A and 43B. Based on these tables it can be concluded that all fire assemblies provide a minimum of 3 hours of fire resistance rating. The reinforcing steel, with a minimum of 1 inch concrete cover, also provides 3 hours of fire resistance rating.

American Concrete Institute (ACI) codes and quality assurance requirements of ANSI N45.2.5, as invoked by NRC Regulatory Guides 1.55 and 1.94, respectively, are used in the design, procurement, and construction of these assemblies.

Comparisons of River Bend Station fire barrier designs with UL-rated sections are shown in Tables 9A.3-1, 9A.3-2, and 9A.3-3 for a typical floor system, steel beam, and wall section, respectively. The details of UL-rated sections are obtained from The Fire Resistance Directory published by Underwriters' Laboratories, Inc., dated January 1979.

Testing of fire barriers in accordance with ASTM E119 has not been performed. However, the required 3-hour fire resistance is provided as described above.

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Electrical and mechanical (pipe, cable tray, conduit, etc.) penetrations through fire related barriers are sealed with fire tested designs. Penetration seal designs are compared to representative (similar) configurations that have been fire tested in accordance with accepted industry standards for determining the fire endurance rating of through-penetration firestops (i.e. ASTM E814, UL 1479, IEEE 634, ANI). All of the fire test standards follow the standard fire exposure time-temperature curve described by ASTM E119. Penetration seal configurations are considered acceptable when the representative fire test specimens meet the following acceptance requirements:

1. The fire test specimen shall have withstood the fire test for the rating period without permitting the passage of flame through openings, or the occurrence of flaming on any element of the unexposed side of the test specimen.

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2. No individual thermocouple on the unexposed surface of the fire stop (field) shall exceed 325 degrees F above its initial (ambient) temperature.

3. During the hose stream test, the fire stop shall not develop any opening that would permit a projection of water from the stream beyond the unexposed side of the test specimen.

Penetration seals are typically qualified in accordance with the acceptance criteria enumerated above for a fire exposure duration of 3 hours or an evaluation is on file providing justification for the adequacy of the penetration seal.

Openings inside conduits are also sealed or closed where necessary to prevent the passage of fire, hot gases and smoke. Fire tests of conduit configurations have shown that fire and smoke propagation through conduits is influenced by conduit size (diameter) and extension distance beyond the fire barrier. Therefore, conduit seal requirements may be determined based upon conduit size and extension distance beyond the fire barrier.

Ductwork penetrations are sealed with fire dampers. Door openings are similarly closed to retain the integrity of the enclosure.

River Bend Station has combustible compressible material located in seismic shake spaces/rattle joints between certain buildings. In those areas where the gap is exposed to a plant fire area, the gap is sealed with a Dymeric joint sealant. This design seals off the combustible material from ignition sources. The areas also have automatic suppression and/or detection systems, inside fire hose connections, and fire extinguishers.

For those areas with the double wall/shake space configuration, acceptance criteria to establish a three hour fire separation-was developed. All areas were reviewed for compliance with this criteria and were found to be acceptable. The compressible material allowed to remain in Shake Spaces is Rodofoam II.

The areas where compressible materials remain between double walls are as follows:

a. 3” shake space between Diesel Generator Building south wall and Control Building north wall.

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b. 3″ shake space between Auxiliary Building east wall and west wall of Electric Tunnels.

c. 3″ shake space between Auxiliary Building west wall and east wall of Pipe Tunnels.

d. 3″ shake space between Radwaste Building east wall and west wall of Pipe Tunnels.

e. 3″ shake space between Turbine Generator Heater Bay north wall and south wall of Pipe Tunnels.

Safe Shutdown components traverse these double wall configurations through penetrations. Intersecting walls and/or floors on both sides of the double wall configuration could cause a situation where redundant Safe Shutdown components, while in compliance with the licensing basis on either side of the double wall, are in close proximity to each other in the shake space between the walls, thus creating a potential concern.

Due to the unique configuration of this shake space, compliance requirements can be achieved only by providing a 3-hour separation or alternate shutdown capability. All of the penetrations, in both walls of the double wall configuration are either sealed with 3-hour rated configuration or have been evaluated to be adequate to withstand the fire hazards associated with the area in which they are installed. This design provides an adequate fire separation between the 311 shake space and either side of the double wall. A 3-hour separation within the shake space for redundant safe shutdown components has been established as follows:

a. Redundant safe shutdown components are separated by a minimum distance of 8′ with no intervening penetrations.

b. Where intervening penetrations are present, a minimum distance of 8′ is required between redundant safe shutdown components and a minimum distance of 8′ is required between the intervening penetration and at least one of the redundant safe shutdown components.

Safe shutdown analyses have been completed for all areas of concern. No redundant safe shutdown components are closer than the minimum distances specified above, therefore compliance has been maintained.

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9A.3.5.2 Control of Combustibles

9A.3.5.2.1 Safety-Related Systems

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 automatic fire suppression, and construction 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
2. Turbine-generator oil and hydraulic control fluid systems
3. Reactor coolant pump lube oil system.

RIVER BEND STATION POSITION

In the design of the River Bend Station, there are a number of systems which include combustible materials which are integral with the systems and for which isolation is neither practical nor warranted. Retention of safety shutdown functions in these systems is accomplished by required redundancy. By means of the fire hazards analysis, it has been determined that the design basis fire in any one division of equipment would not expose the redundant division to damage. For the identified hazards the following is noted.

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The emergency diesel-generator fuel oil day tanks are 612-gal capacity and are mounted adjacent to the diesel engines. This installation meets the requirements of NFPA Standard No. 37. The generator rooms are separated from one another by 3-ft thick concrete walls and are fully equipped with sprinklers using automatic preaction systems. A postulated fire in one of the generator rooms does not affect its redundant system located in an adjacent room.

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The turbine-generator oil and hydraulic fluid systems are not safety related. Although lubricating oil storage and conditioning equipment are located in separate fire-rated enclosures and piping to the machine is generally in guarded pipe, the interface at the turbine bearings is exposed and cannot be isolated. Hydraulic fluids are high flash point materials. Manual water spray systems are provided to protect bearings. Automatic sprinkler systems are installed under the operating and mezzanine levels and water hose stations are located throughout. Automatic carbon dioxide protection is also provided at machine bearings.

The safety-related (passive) reactor recirculation pumps are electric motor-driven with oil-cooled and lubricated bearings. These pumps are located about 180 deg apart inside the drywell, and therefore both pumps would not be exposed to a single fire event. These pumps are not required to operate to mitigate the consequences of an accident. Therefore, the loss of either or both pumps' operability due to a fire does not diminish overall plant capability to mitigate the consequences of an accident.

Each of the two reactor recirculation loops contains a hydraulically operated flow control valve. Each valve has its own hydraulic system. The hydraulic system contains about 60 gal of hydraulic fluid. The hydraulic fluid used In this system has a high flash point. These valves are located adjacent to the recirculation pumps and thus have the same 180 degree physical separation. Additionally, they are passive components, and loss of their operability does not diminish overall plant capability to mitigate the consequences of an accident.

Permali JN, the material used for radiation shielding in the reactor building, is combustible. The material is used in eight locations as follows:

1. The containment side of the drywell equipment hatch (Az 225° El 95'-9")

2. In a removable plug inside a drywell wall sleeve (Az 40° El 95'-9")

3. To shield drywell penetration Z57B (inside drywell Az 312° El 125'-6")

4. To shield-drywell penetration Z32 (inside drywell Az 62° El 143'-2")

5. To shield drywell penetration Z107 (outside drywell Az 48° El 132'-0")

6. To shield drywell penetration Z57A (outside drywell Az 170° El 115'-6")

7. To shield drywell penetration Z112 (outside drywell Az 293° El 134'-6")

8. To shield drywell penetration Z34 (outside drywell Az 322° El 135'-10")

Item 1. Material is located within the drywell hatch opening between the equipment hatch and the drywell shield door.

Item 2. Material is encased within a steel wall sleeve with cover panels at each end.

Items 3. through 8. Material is completely encased in steel box containers.

Due to its application in isolated instances and the negligible combustible loading within the area, the use of Permali JN is considered acceptable.

9A.3.5.2.2 Bulk Gas Storage

Bulk gas storage (either compressed or cryogenic) should not be permitted inside structures housing safety-related equipment. Storage of flammable gassuch as hydrogen should be located outdoors or in separatedetached buildings so that a fire or explosion will notadversely 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) inside buildings should be controlled (refer to NFPA 6, "Industrial Fire Loss Prevention").

RIVER BEND STATION POSITION

Bulk hydrogen and carbon dioxide storage is located outdoors south of the turbine building and in the yard storage area and is not exposed to safety-related equipment. Also bulk storage of carbon dioxide cylinders is located in the turbine building, which does not house any safety-related equipment. Air tanks associated with the emergency diesel-generator air start systems are located integral with the diesel-generator rooms and would not cause redundant systems in adjacent rooms to be affected by a single fire hazard or other failure event.

Halon 1301 containers are provided in the main control room. This does not affect safety-related equipment because individual containers are small and are located within the metal cabinets which are seismically qualified; effect of leakage from individual containers is negligible.

Halon 1301 storage containers are also provided in conjunction with installed Halon fire suppression systems that may be installed in various areas of the plant that do not house any safety-related equipment.

9A.3.5.2.3 Plastic Materials

The use of plastic materials should be minimized. In particular, halogenated 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 with 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 halogenated plastics also release free chlorine and hydrogen chloride when burning which are toxic to humans and corrosive to equipment.

RIVER BEND STATION POSITION

Plastic materials in limited amounts are used in some exposed roof drainage piping in nonsafety-related buildings, buried sanitary system piping, buried electrical Outlines and in liquid-tight flexible conduit in short lengths throughout the plant. The materials do not offer a compromise to safe plant shutdown.

9A.3.5.2.4 Flammable Liquids

Storage of flammable liquids should, as a minimum, comply with the requirements of NFPA 30, "Flammable and Combustible Liquids Code."

RIVER BEND STATION POSITION

Flammable liquids are stored according to the existing GSU safety practices.

9A.3.5.3 Electric Cable Construction, Cable Trays, and Cable Penetrations

9A.3.5.3.1 Cable Tray

Only noncombustible materials should be used for cable tray construction.

RIVER BEND STATION POSITION

All cable trays are fabricated of noncombustible materials.

9A.3.5.3.2 Cable Spreading Rooms

See Section 9A.3.7.3 for fire protection guidelines for cable spreading rooms.

RIVER BEND STATION POSITION

The River Bend Station uses the General Electric Power Generation Control Complex (PGCC) concept for routing, separating, and installing cables for the main control room. This concept is fully described in the Licensing Topical Report, NEDO-10466-A, dated February 1979. As described in this report, termination cabinets provide the interface between the field- and factory-installed cables in the PGCC floor sections. The field-installed cables enter the termination cabinets from the top of 3-hr fire-rated cable chases which extend from the basement to the control room level of the control building. Intermediate levels within the control building, which contain the standby switchgear rooms, batteries, uninteruptible power supply and battery charger rooms, ventilation and air conditioning rooms, and cable areas, are similarly divided with 3-hr rated walls in order to maintain separation and isolation between safety divisions. Cables enter the west side of the control building basement from electrical tunnels and are routed throughout the plant through a series of tunnels as shown on Fig. 9A.2-1. Protection of these areas is described in Section 9A.3.7.3.

9A.3.5.3.3 Water Spray Outside Cable Spreading Room

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 sprinkler water discharge, should be protected from sprinkler system operation or malfunction.

RIVER BEND STATION POSITION

Cable trays in tunnels and in the basement of the normal switchgear building are protected by fixed, automatic, zoned water spray systems designed the same as described in Section 9A.3.7.3 for the cable areas in the control building basement. Cable trays in the turbine building are in areas protected by ceiling-level automatic sprinkler systems. Cable trays in other safety-related areas are protected by ceiling level sprinklers if the tray stacks exceed 6 trays deep and the highest tray is 15 ft or more above the floor. If the highest tray is less than 15 ft above the floor these trays are considered accessible for manual fire fighting using water hose stations. Tray stacks of 6 trays or less are protected using water hose stations. The analysis of fire loading of these trays, the exposure to other trays and equipment, and the effects on safe plant shutdown do not justify fixed, automatic, fire suppression systems. Smoke detectors are provided for warning of potential fires at these locations, which allows personnel to respond and take appropriate action.

9A.3.5.3.4 Cable and Cable Tray Penetration

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 horizontal and vertical cable trays should, as a minimum, meet the requirements of ASTM E119, Fire Test of Building Construction and Materials, including the hose stream test.

RIVER BEND STATION POSITION

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See Section 9A.3.5.1.10

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9A.3.5.3.5 Fire Breaks

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Fire breaks should be provided as deemed necessary by the fire hazards analysis. Flame or fire-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.)

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RIVER BEND STATION POSITION

Fire breaks are provided at fire barrier walls and floors for all horizontal and vertical cable and cable tray penetrations. Additional fire breaks within cable trays at locations other than the fire-rated walls and floors are not required based on the fire hazards analysis.

9A.3.5.3.6 Electric Cable Construction

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.)

RIVER BEND STATION POSITION

Cables installed in the cable trays are subjected to the vertical cable tray flame test for Class 1E electrical cable for nuclear power generating stations as required by IEEE 383-1974. Cables not meeting the above requirements are installed in metallic conduits inside the plant, with the exception of lighting fixture cords. The River Bend Station cable specifications require that testing be done on production runs of the actual cable supplied.

9A.3.5.3.7 Corrosive Gases

To the extent practical, cable construction that does not give off corrosive gases while burning should be used.

RIVER BEND STATION POSITION

No alternative materials superior to those used at the River Bend Station exist with respect to overall flame spread and gas generation.

9A.3.5.3.8 Cable Trays

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.

RIVER BEND STATION POSITION

Cable trays, raceways, conduits, and trenches are used only for cables.

9A.3.5.3.9 Cable Tunnels

The design of cable tunnels, culverts, and spreading rooms should provide for automatic or manual smoke venting as required to facilitate manual firefighting capability.

RIVER BEND STATION POSITION

Smoke removal is discussed in Section 9A.3.5.4.

9A.3-5.3.10 Control Room Cables

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.

RIVER BEND STATION POSITION

River Bend Station uses the General Electric PGCC which utilizes floor modules for access to the control panels.

9A.3-5.4 Ventilation

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9A.3.5.4.1 Products of Combustion

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/Requirements.

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RIVER BEND STATION POSITION

River Bend Station does not have dedicated smoke venting systems except in the control building. In event of fire, all air handling systems have the capability to be used for smoke removal. However, normal ventilation systems and the control building smoke removal system are not designed to handle high temperature gases. In buildings which use once-through ventilation, smoke removal is accomplished manually by running the exhaust equipment, while shutting the supply air. The control building has three major systems: one for the control room, one for the cable areas in the basement, switchgear, and battery rooms, and the third for the chiller equipment room. These systems normally are in a 10 percent fresh air, 90 percent recirculated air mode of operation. Manual capability is provided so that the 90 percent recirculated air can be diverted to the smoke removal system. All areas in which radioactive materials are located are provided with radiation monitors.

For safety-related buildings, contaminated air is automatically diverted through redundant charcoal filter units in the event of high radiation in the exhaust air. Smoke removal and main control room habitability are described in Sections 9.4 and 6.4.

9A.3.5.4.2 Smoke or Corrosive Cases

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.

RIVER BEND STATION POSITION

Normal operation of the ventilation systems is not to exhaust smoke or corrosive gases. Changing to the purge mode of operation or otherwise taking action to accommodate smoke removal does not violate controlled areas of the plant. Radiation monitor alarms also provide a means to indicate that unacceptable conditions exist and alert the operator prior to actuation for smoke removal.

9A.3.5.4.3 Power Supply and Controls

The power supply and controls for mechanical ventilation systems should be run outside the fire area served by the system.

RIVER BEND STATION POSITION

The nature of mechanical ventilation systems at this plant in many cases includes the use of fans and other air handling devices located in the areas served. Power supply and control cables for ventilation systems are located in accordance with Regulatory Guide 1.75. Adequacy of separation is analyzed for transient fire consideration. Also, safety-related systems have redundant components. For safety-related systems, control is from the main control room. Nonsafety-related equipment is locally controlled.

9A.3.5.4.4 Fire Suppression Systems

Fire suppression systems should be installed to protect charcoal filters in accordance with Regulatory Guide 1.52, Design, Testing, and Maintenance Criteria for Post Accident Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants.

RIVER BEND STATION POSITION

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Manually actuated water spray systems are provided for all charcoal filters. Continuous thermistor detection is provided to alarm and annunciate in the main control room. Actuation of the system is by means of manually operated valves located near the filters. Decay heat removal fans are also provided for each filter.

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9A.3.5.4.5 Fresh Air Supply Intakes

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.

RIVER BEND STATION POSITION

Fresh air intakes are located so as not to be compromised by exhaust air outlets. Unit smoke vents in the turbine building roof do not contaminate any fresh air intake.

9A.3.5.4.6 Stairwells

Stairwells should be designed to minimize smoke infiltration during a fire. Staircases should serve as escape routes and access routes for firefighting. Fire exit routes should be clearly marked. Stairwells, elevators, and chutes should be enclosed in masonry towers with minimum fire rating of 3 hr 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.

RIVER BEND STATION POSITION

Stairwells and elevators except in the containment are provided with 2-hr fire-rated enclosures with class B-rated doors consistent with the guidance provided by NFPA No. 101 (Life Safety Code). Exterior doors at grade and roof levels that are within a 50-ft radius of a fire hazard are fire-rated. All other exterior doors at these levels are not required to be fire-rated. Exit routes are marked and illuminated to comply with OSHA requirements.

9A.3.5.4.7 Smoke and Heat Vents

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 ft of venting area per 200 sq ft of floor area should be provided. if forced-convection ventilation is used, 300 cfm should be provided for every 200 sq ft of floor area. See NFPA No. 204 for additional guidance on smoke control.

RIVER BEND STATION POSITION

Fusible link actuated unit heat vents are provided in the turbine building roof, uniformly spaced and sized to provide 1 sq ft of area per 200 sq ft of floor area. Smoke venting for other structures is provided by the use of forced air systems as described in Sections 9A.3.5.4 and 9.4.

9A.3.5.4.8 Breathing Apparatus

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 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 practical. Service or operating life should be a minimum of 1/2 hr 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-hr 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.

RIVER BEND STATION POSITION

Self-contained breathing apparatus is provided for use by firefighting forces. Main control room personnel are similarly provided with self-contained apparatus, except it is located within the pressure envelope of the main control room.

9A.3.5.4.9 Flooding Gas Extinguishing Systems

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.")

RIVER BEND STATION POSITION

Intake and exhaust ventilation dampers close upon initiation of Halon 1301 flow where installed in plant areas. The exciter has openings which cannot be closed. The design of the carbon dioxide flooding system accounts for these openings.

9A.3.5.5 Lighting and Communications

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.

9A.3.5.5.1 Emergency Lighting

Fixed emergency lighting should consist of sealed beam units with individual 8-hr minimum battery power supplies.

RIVER BEND STATION POSITION

Internally illuminated exit signs and other means of egress lighting receive power from normal ac power sources. "Direction to Exit" signs are externally illuminated from the same source and are in compliance with OSHA requirements. Upon loss of normal power, the exit signs are powered from battery packs.

Emergency lighting required for personnel safety is provided by local, self-contained, sealed beam, battery-powered emergency lighting units. Emergency lights are provided with a power source which can sustain the required level of illumination for a period of 8 hr.

Special provisions for the main control room include the connection of about 20 percent of normal lighting to an emergency Class 1E source of power. In addition, the main control room has emergency lighting powered from the normal uninterruptible power supply (UPS) system and sealed beam battery packs.

9A.3.5.5.2 Sealed Beam Battery

Suitable sealed beam, battery-powered portable hand lights should be provided for emergency use.

RIVER BEND STATION POSITION

Sealed beam, battery-powered portable hand lights are provided as part of the emergency equipment.

9A.3.5.5.3 Emergency Communication

Fixed emergency communication should use voice-powered head sets at preselected stations.

RIVER BEND STATION POSITION

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A page-party/public address system (PP/PA) consisting of six channels, one for page and five for party communications, is provided. The PP/PA components are all solid state and include handset stations, unit speaker amplifiers, loudspeaker stations, cables, terminal boxes, muting facilities, and special plugs and connectors where required to interconnect these components. PP/PA equipment is placed in areas throughout the plant which may be occupied by personnel during normal, abnormal, startup, or shutdown conditions. A Control Room fire could potentially make the PP/PA system inoperable, however, the telephone system outside of the Control Room would not be affected.

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9A.3.5.5.4 Repeaters

Fixed repeaters installed to permit use of portable radio communication units should be protected from exposure fire damage.

RIVER BEND STATION POSITION

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Repeaters used for fire brigade radio communications are located in the Normal Switchgear Building and Services Building. These buildings do not house any safe shutdown equipment. In case of fire in these buildings, the loss of the repeaters would not affect safe shutdown of the plant. The normal power supply for the repeaters located in the Normal Switchgear Building is supplied from the Control Room; however, backup power, isolated from the Control Room, is available. Two of the four repeaters located in the Services Building are considered critical and are powered from a dedicated UPS System. The remaining two repeaters in the Services Building are powered locally and will lose power after a loss of power event. Loss of the two locally powered Services Building repeaters will not adversely affect fire brigade radio communications.

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9A.3.6 FIRE DETECTION AND SUPPRESSION

9A.3.6.1 Fire Detection

9A.3.6.1.1 NFPA 72D

Fire detection systems should as a minimum comply with NFPA 72D, "Standard for the Installation, Maintenance, and Use of Proprietary Protective Signaling Systems."

RIVER BEND STATION POSITION

See Section 9A.3.6.1.4.

9A.3.6.1.2 Audible and Visual Alarms

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.

RIVER BEND STATION POSITION

See Section 9A.3.6.1.4.

9A.3.6.1.3 Unique Alarms

Fire alarms should be distinctive and unique. They should not be capable of being confused with any other plant system alarms.

RIVER BEND STATION POSITION

See Section 9A.3.6.1.4.

9A.3.6.1.4 Emergency Power

Fire detection and actuation systems should be connected to the plant emergency power supply.

RIVER BEND STATION POSITION

Fire Detection

The fire detection system is a proprietary signaling system consisting of alarm initiating, indicating, and sounding devices, and remote data acquisition control (RDAC) panels and a microprocessor-based ROM/PROM. This system is designed utilizing guidance from NFPA 72D. Smoke detection zones are provided where there is a possibility of smoke generation such as cable areas. Thermal detection zones are provided where there is a possibility of heat development, such as turbine bearing areas, oil room, etc. If the possibility of both types of fires exists in the same area, then both types of detectors are provided.

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The RDAC panels function to control and supervise the detection zones, transmit appropriate alarms to be annunciated at the main control room, and sound the local building fire alarms. signal initiating, audible and visual alarm initiating, trouble signal, and valve supervision circuits are hardwired to RDAC panels which include suitable devices for multiplexing.

The microprocessor is located in the main control room. The control room console includes modem for communication, CRT display terminal, and a printer.

There are two types of fire detection systems provided. One system is dedicated to use in conjunction with fixed fire suppression systems. This system functions to detect a fire emergency, and to alarm locally and in the main control room. Where the fire suppression system is automatic, this detection and control system functions to actuate the suppression system control. Where the fire suppression system is manually actuated, this detection and control system includes appropriate components for actuation both from within the control room and locally except the charcoal filter water suppression systems which are actuated from locally only. The second system is dedicated for detection only, with alarms locally and within the control room. These systems are provided in the general plant area where the fire hazard analysis does not justify the need for fixed fire suppression capability. Manual pull stations are integrated into this system.

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Local alarms are arranged so that all areas of a particular building are alerted to a fire emergency within that building. These alarms are of an audible and visual nature so as to be clearly distinguishable from other plant system alarms.

The continuous source of power for the fire detection and actuation system is derived from a 120-V ac uninterruptible power supply (UPS). Power from the uninterruptible power supply is free from extraneous voltage spikes, switching surges, and momentary interruptions, and satisfies the voltage and frequency variation limits of the RDAC systems.

A high degree of power continuity is provided, with the uninterruptible power supply being able to switch automatically between two independent sources of input power, or to transfer to an independent alternate source of regulated ac power with sufficient speed so the operation of the fire detection system is not affected.

Normally, the uninterruptible power supply (see Figure 9A.3-1) receives both three-phase and single-phase ac power from 480-V ac motor control centers (MCC), with the source of dc power coming from the 125-V dc station battery which is sized to support its load for 2 hours. Any failure of the MCC feeding the 3-phase ac power to the rectifier results in the station battery carrying the uninterruptible power supply load without interruption. Malfunctions of either the dc source of power or the 3-phase ac source of power to the inverter, or the inverter itself, causes the static switch to automatically transfer the power source to an independent single-phase ac source fed from a 480-V ac MCC feeder through a voltage regulating transformer. A make-before-break manual bypass switch enables maintenance, inspection, and testing of the uninterruptible power supply components to be safely performed while feeding the loads from the alternate source voltage regulating transformer.

The uninterruptible power supply is normally connected to the Class 1E electrical distribution system via its 125-V ac input. The 125-V dc battery floats off the non-class IE 125-V ac battery charger, which, in turn, is energized by a Class 1E 480-V load center (ultimately connected to the standby [Class IE] diesel generator) via an air circuit breaker (ACB).

During LOCA, the ACB trips to separate the non-Class 1E distribution system from the Class IE system. The non-Class 1E battery charger may be administratively reconnected to the Class IE system only after the LOCA trip signals have been manually reset by the plant operator. During complete loss of offsite power without a simultaneous LOCA the battery charger automatically receives power after 60 sec from the standby (Class 1E) diesel generator.

RDAC panels for intake structure and fire pump house do not have UPS capability, but are provided with battery backup sized for 24-hr emergency service.

Annunciation and Control

Fig. 9A.2-10, Sheets I and 2 show various detection zones.

The appropriate zones are hardwired to the local RDAC panels from where the information is transmitted to the

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microprocessor located in the main control room. The microprocessor has the capability to process the fire alarm information received and update the alarm status of the building in question and generate a report on the printer in the control room.

Plant fire detection and supervision information is provided automatically and on demand from the operator console in the main control room.
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9A.3.6.2 Fire Protection Water Supply Systems

9A.3.6.2.1 Yard Fire Main Loop

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 organizations 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.

RIVER BEND STATION POSITION

The plant underground fire protection system is installed utilizing the guidance from NFPA 24 to meet the anticipated fire water requirement. Piping is cast iron or ductile iron, cement lined, mechanical joint. Looped mains with post indicator sectional valves are provided to isolate portions of the system for maintenance or repair, thereby retaining the availability of as much of the system as possible. Flushing was initially accomplished through open pipe utilizing the guidance from NFPA Standard No. 24. Later, during plant operation, flushing is through fire hydrants.

9A.3.6.2.2 Multi-Unit Nuclear Power Plant Sites

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 mi or more), separate yard fire main loops should be used.

RIVER BEND STATION POSITION

There is only one reactor unit at this site, which has its own individual fire main loop.

9A.3.6.2.3 Pumps

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., with 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 3-hr fire wall. 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."

RIVER BEND STATION POSITION

See Section 9A.3.6.2-5.

9A.3.6.2.4 Reliable Water Supplies

Two separate reliable water supplies should be provided. If tanks are used, two 100 percent (minimum of 300,000 gal each) system capacity tanks 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 8 hr.

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.

RIVER BEND STATION POSITION

See Section 9A.3.6.2.5.

9A.3.6.2.5 Fire Water Supply

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 2 hr, but not less than 300,000 gal. 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

2. The largest open head deluge system(s) operating.

RIVER BEND STATION POSITION

Fire water supply is from two ground-level steel suction tanks. Each tank has a maximum working capacity of 265,000 gals. These tanks are filled automatically by the shallow well makeup water pump at a rate of 800 gpm when the water level in the tanks fall 2'-O" below the overflow level. At this level, the usable volume is at its minimum of 241,000 gal. The makeup water pump shuts off automatically when the water level in the tanks reaches the overflow level. Additional makeup water is available from two 150 gpm, manually operated deep well pumps. Three fire pumps (50 percent), each rated at 1,500 gpm, 165 psig discharge pressure are provided. Two pumps are diesel engine driven and one is electric motor driven. Each pump is separated by a 3-hr fire-rated wall in the fire pump house. OS&Y valves are installed in the suction lines to the fire pumps utilizing the guidance of NFPA 20. Tanks, pumps, and discharge lines to the underground loop are provided with sectionalizing shutoff valves so that no single impairment incapacitates more than one tank or one pump. Storage tanks have low level alarms. This water supply is sufficient to supply 500 gpm for manual hose streams plus the largest (1,400 gpm) open head deluge system or all sprinkler heads expected to operate on a closed head system in any fire area serving safe shutdown areas. The 500 cjpm for manual hose stations is based on the requirements of BTP CMEB 9.5-1, Rev. 2, dated July 1981.

9A.3.6.2.6 Lakes or Fresh Water Ponds

Lakes or fresh water ponds of sufficient size may qualify as sole source of water for fire protection, 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.

RIVER BEND STATION POSITION

Lakes or fresh water ponds are not used at River Bend Station (Section 9A.3.6.2.5).

9A.3.6.2.7 Hose Installation

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 ft 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 ft.

Threads compatible with those used by local fire departments should be provided on all hydrants, hose couplings, and standpipe risers.

RIVER BEND STATION POSITION

Hydrants and hydrant hose houses are provided on the loop sufficient to provide coverage for any plant area with at least one stream. All laterals are controlled by key-operated curb box valves or visually indicating valves. Hose houses are located at about every other hydrant. Threads are compatible with local fire department equipment.

9A.3.6.3 Water Sprinklers and Hose Standpipe Systems

9A.3.6.3.1 Automatic Sprinkler System

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 OS&Y (outside screw and yoke) gate valve, or other approved shutoff 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.

RIVER BEND STATION POSITION

Two connections are provided from the yard water main to the auxiliary, control, fuel, radwaste, and turbine buildings so that the sprinkler/spray system and the hose station systems have independent connections to the plant underground fire protection water main. An interconnection between these connections from the yard are provided within the building with appropriate isolation valve. An additional loop internal to the turbine building fire protection room is provided since the supplies to the water spray systems for the electrical tunnels, the outdoor oil-filled transformers, and the cable area in the basement of the normal switchgear building are provided in this room, as well as the turbine building sprinkler and hose station systems. The design is in accordance with applicable NFPA standards.

Each sprinkler and standpipe system supply is provided with either an outside screw and yoke or a butterfly shutoff valve. Water flow alarm devices which annunciate in the control room are provided on each system supply.

9A.3.6.3.2 Supervised Valves (NFPA 26)

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.")

RIVER BEND STATION POSITION

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Fire protection valves, except underground hydrant valves and drainage and vent valves, are either electrically supervised or administratively controlled by being locked in position with locking device which assures component position but can be removed without the use of a key and are inspected every 31 days in accordance with the technical requirements.

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9A.3.6.3.3 Sprinkler Systems (NFPA 13 and NFPA 15)

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."

RIVER BEND STATION POSITION

All sprinkler systems are designed utilizing the guidance from NFPA Standard No. 13 and 15 requirements as applicable.

9A.3.6.3.4 Manual Hose Installation (NFPA 14)

Interior manual hose installation 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 ft of 1 1/2-in 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-ft intervals. Individual standpipes should be of at least 4-in diameter for multiple hose connections and 2 1/2-in 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.

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 shutoff valves and pressure-reducing devices (if applicable) outside the area.

Provisions should be made to supply water at least to standpipes and hose connections for manual firefighting 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 for the portion of hose standpipe system affected by this functional requirement should at least satisfy

ANSI Standard B31.1, "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 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.

RIVER BEND STATION POSITION

See Section 9A.3.6.3.5.

9A.3.6.3.5 Hose Nozzles

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.

RIVER BEND STATION POSITION

Adequate interior manual hose stations are provided to reach any location with at least one effective hose stream except as follows:

1. The motor generator building, normal cooling tower, and makeup water intake structure are provided with detectors and portable extinguishers.

2. The primary access point building, the remote air intake room, and the standby service water pumphouse are provided with detectors, portable extinguishers, and yard hose stream.

3. The diesel generator building is provided with detectors, portable extinguishers, yard hose stream, and an automatic preaction water spray system.

4. The fire pump house is provided with portable extinguishers and yard hose stream. In addition, the diesel-driven fire pump areas are protected by an automatic sprinkler system. The remainder of the areas in the fire pump house are provided with detectors.

5. The tunnel areas are provided with detectors and automatic water spray systems. The tunnel areas can also be reached by manual hose stations located in adjoining buildings.

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6. The reactor building drywell area. Detailed information is provided in Section 9A.2.5.8.6.

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Standpipes for two or more hose stations are 4 inch. Reduction to 2 1/2 inch is made at the station and to the last station on a system. Hose stations are equipped with a minimum of 75 feet and a maximum of 150 feet of 1 1/2 inch synthetic or cotton-jacketed, lined hose. Nozzles are provided commensurate with the hazard protected. Systems are designed using the guidance from NFPA Standard No. 14 requirements. Hose rack stations with in excess of 75 ft of hose are listed in Table 9A.3-4.

A seismically qualified QA Category I, standby service water (SWP) supply is available to manual hose stations located in the auxiliary, control, fuel, and reactor buildings. Piping for these hose stations is analyzed for SSE loading and provided with supports to assure system pressure integrity. The SWP supply is obtained by manual operator opening of valves. The cross connections are capable of providing flow to at least two hose stations in any building and do not degrade the performance of the Seismic Category I SWP supply system.

9A.3.6.3.6 Foam Suppression

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-on. These include the more common chemical and mechanical low expansion foams, high expansion foam, and the relatively new aqueous film forming foam (AFFF).

RIVER BEND STATION POSITION

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There are no fixed foam fire fighting systems provided at River Bend Station. Any of the currently available fire fighting foams may be obtained and used in manual fire fighting efforts outside of certain areas in the Fuel Building. The use of fire fighting foam is restricted from the areas where dry, new fuel is being handled or stored to ensure that the storage array is not moderated by a low density moderator.

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9A.3.6.4 Halon Suppression Systems

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.

Particular consideration should also be given to:

1. Minimum required Halon concentration and soak time

2. Toxicity of Halon

3. Toxicity and corrosive characteristics of thermal decomposition products of Halon.

RIVER BEND STATION POSITION

With the passing of the Clean Air Act in 1990, and the identification of Halon as an ozone depleting agent, Entergy Corporation is actively pursuing the elimination of halogenated fire extinguishing agents in non-critical applications. Halon 1301 remains an effective fire suppression agent, however installed systems are being phased out when suitable replacement agents are available and when it is economical to do so.

Halon 1301 systems are designed utilizing the guidance of NFPA 12A. These systems are provided to minimize damage due to cables in the underfloor areas of the PGCC system in the main control room and other non-safety related plant areas where it is economical and justified by the risk of loss.

Procedures are developed for maintenance and testing of these systems as described in Section 9.5.1.5.

9A.3.6.5 Carbon Dioxide Suppression Systems

The use of carbon dioxide extinguishing systems should as a minimum comply with the requirements of NFPA 12, "Carbon Dioxide Extinguishing Systems."

Particular consideration should also be given to:

1. Minimum required CO_2 concentration and soak time

2. Toxicity of CO_2

3. Possibility of secondary thermal shock (cooling) damage

4. Offsetting requirements for venting during CO_2 injection to prevent overpressurization versus sealing to prevent loss of agent

5. Design requirements from overpressurization

6. 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 though duration time for any visit is short) have often been found with CO_2 systems shut off.

RIVER BEND STATION POSITION

A high pressure CO_2 system is provided for fire protection of the turbine bearings and exciter enclosure. The system is designed utilizing the guidance of NFPA 12.

9A.3.6.6 Portable Extinguishers

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 installed with due consideration given to cleanup problems after use and possible adverse effects on equipment installed in the area.

RIVER BEND STATION POSITION

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The type, size and placement of portable fire extinguishers is determined after evaluation of the combustibles present utilizing guidance provided in NFPA 10.

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Extinguishers are securely mounted and locations clearly marked. In safety-related areas, special attention is given to locations and mounting so as not to affect safe plant shutdown.

9A.3.7 GUIDELINES FOR SPECIFIC PLANT AREAS

9A.3.7.1 Primary and Secondary Containment

9A.3.7.1.1 Normal Operation

Fire protection requirements for the primary and secondary containment areas should be provided on the basis of specific identified hazards. For example:

1. Lubricating oil or hydraulic fluid system for the primary coolant pumps
2. Cable tray arrangements and cable penetrations
3. Charcoal filters.

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.

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.

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 accompish 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. 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.

RIVER BEND STATION POSITION

The reactor recirculation pumps are located within the drywell and are electric motor driven, oil lubricated, and cooled. Pumps are widely separated and the fire hazards analysis indicates that they are not subject to detrimental effects from a single fire event. No fixed fire suppression system is provided for these pumps.

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Cables meeting IEEE 383-1974 fire tests are installed within the containment in accordance with Regulatory Guide 1.75 and transient fire analysis considerations. Use of non-fire propagating cable and large physical separation for redundant safety divisions, together with the low fire loadings developed by the fire hazards analysis, supports the conclusion that no compromise to safe plant shutdown exists. No fixed fire suppression is installed. Automatic smoke detectors, arranged to alarm in the main control room, and adequate hose station coverage are provided throughout the containment. Seismic Category I hose stations are backed up by portable extinguishers.

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There are no charcoal filters in these areas.

9A.3.7.1.2 Refueling and Maintenance

Refueling and maintenance operations in 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 9A.3.3-3.

In addition, manual firefighting capability should be permanently installed in containment. Standpipes with hose stations, and portable fire extinguishers, should be installed at strategic locations throughout containment for any required manual firefighting operations.

Adequate self-contained breathing apparatus should be provided near the containment entrances for firefighting and damage control personnel. These units should be independent of any breathing apparatus or air supply systems provided for general plant activities.

RIVER BEND STATION POSITION

Administrative procedures to control the potential hazards expected during refueling and maintenance are included with those discussed in Section 9.5.1.5. Hose stations, portable extinguishers, and breathing apparatus are provided.

9A.3.7.2 Control Room

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 3 hr.

Control room cabinets and consoles are subject to damage from two distinct fire hazards:

1. Fire originating within a cabinet or console; and

2. Exposure fire involving combustibles in the general room area.

Manual firefighting 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.

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 firefighting needs, satisfy electrical safety, and minimize physical damage to electrical equipment from hose stream impingement.

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.

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 3 hr. All penetration seals should be airtight.

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.

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.

Safety-related equipment should be mounted on pedestals or the control room should have curbs 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.

RIVER BEND STATION POSITION

The River Bend Station main control room is designed in accordance with the General Electric Power Generation Control Complex arrangement, which is described in the Licensing Topical Report NEDO-10466-A, dated February 1979. Protection for the floor modules follows the design shown in Fig. 6-1 of that report. Actuation of Halon 1301 flow is automatic based on thermal detection or manual through operator actuation of pull station located at the individual module control cabinet. The Halon storage containers provide for a 20-percent concentration within the floor modules with a 20-min soak time. Each module is protected individually. Fires within cabinets or consoles, or exposure fires involving combustibles in the general room area are extinguished using portable extinguishers located in the main control room. Main control room carpeting meets or exceeds the following requirements:

1. ASTM E-84-70 Steiner Tunnel Test

2. Flame spread - 25 maximum

3. Smoke development - 150 maximum

4. Fuel contribution - 150 maximum

5. Static electricity (AATCC test method 134-1975) less than 3.5 kV.

Smoke and thermal detectors are installed in the room. Hose stations located immediately outside the main control room are also available. Nozzles for these stations are pinned to preclude discharge of a straight stream of water onto electrical fires. Breathing apparatus is provided within the main control room. The main control room is included in the control building pressure boundary, which maintains 0.25 in W.G. positive pressure to preclude infiltration of potential contaminants. The pressure boundary is cut off from other areas of the building with 3-hr fire-rated construction, with all penetrations sealed and/or provided with dampers (HVAC) and doors with the same resistivity. Stair enclosures are 2-hr rated, consistent with the guidance provided by NFPA Standard No. 101 (Life Safety Code).

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A smoke detector is provided in the outside air intake plenum for the control room ventilation system. The detection system alarms locally and in the main control room. The main control room ventilation system provides 4,000 cfm of outside air, with 34,000 cfm recirculated. Remote air intake facilities are provided to accommodate any condition during which the normal intake becomes contaminated. Controls are provided within the main control room so that a change can be made during any event which might introduce contaminants into the room. The main control room has a separate purge or smoke removal fan, which allows the operator to divert the normal recirculated air to total exhaust. The smoke removal fan is sized for 13,200 cfm, to match the capability of the supply (air conditioning unit/fan), and provides 1.25 cfm per sq ft exhaust capability for the main control room.

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Cables are located within the PGCC floor panels as previously described and are monitored by the detection system and protected by the Halon 1301 system.

Safety-related equipment is not mounted on pedestals, as this is inconsistent with the PGCC concept. Since the use of water fire suppression within the main control room is through operator judgment and would not be expected to be extensive, there are no provisions for these pedestals.

9A.3.7.3 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 inadvertent 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.

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).

An automatic water suppression system with manual hoses and portable extinguisher backup is acceptable, provided:

1. At least two remote and separate entrances are provided to the room for access by fire brigade personnel

2. Aisle separation provided between tray stacks is at least 3 ft wide and 8 ft 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 and hose stations and portable extinguishers immediately outside the room and if the access requirements stated above are met.

Electric cable construction should, as a minimum, pass the flame test in IEEE Std. 383, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations."

Drains to remove firefighting water should be provided with adequate seals when gas extinguishing systems are also installed.

Redundant safety-related cable division should be separated by walls with a 3-hr fire rating.

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 3 hr.

(See NFPA 251, "Fire Tests, Building Construction, and Materials," or ASTM E119, "Fire Test of Building Construction and Materials," for fire test resistance rating.)

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.

RIVER BEND STATION POSITION

•→15

The cable spreading areas within the control building include the basement cable areas, the four cable chases, and the General Electric PGCC described in Section 9A.3.5.3.2. The cable areas are protected with fixed, automatic, zoned water spray systems with provisions for remote manual operation of the deluge valves. The cable chases are protected with automatic wet-pipe sprinkler system. To assure adequate coverage, cable tray sizing and arrangements were considered for sprinklers/nozzles design. Nozzles are placed in such a manner to obtain impingement of water spray into all trays. Locations and spacing of sprinklers/nozzles are arranged to obtain a density of 0.15 gpm per sq ft over the combined areas of the horizontal trays and the external vertical surfaces of the cable tray risers. Ionization-type detection systems are provided and arranged to alarm and annunciate in the main control room. The General Electric PGCC is protected as described in the Licensing Topical Report, NEDO-10466-A, dated February 1979. Manual hose stations are available as a backup to the fixed systems. Access to the spreading areas is from two remote locations. Aisle separation is in excess of 3 ft in width and 8 ft in height. Electrical cable construction passes the IEEE 383 flame test. Redundant safety-related cable is separated to comply with Regulatory Guide 1.75.

15←•

Each cable spreading area is separated from adjacent plant areas by minimum 3-hr rated fire barriers.

Smoke removal within the cable spreading areas i5 by means of the normal ventilation system used in the purge mode of operation. Smoke is exhausted outside by diverting the air stream through dampers located in the purge ductwork.

9A.3.7.4 Plant Computer Room

Safety-related computers should be separated from other areas of the plant by barriers having a minimum 3-hr 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.

RIVER BEND STATION POSITION

•→7

The plant computer and the fire detection system computer located within the main control room are not safety related. However, the main control room is isolated from the rest of the plant by 3-hr fire barriers.

Manual hose stations, portable extinguishers, smoke detectors, alarms, and annunciators are provided in the main control room.

7←•

9A.3.7.5 Switchgear Rooms

Switchgear rooms should be separated from the remainder of the plant by minimum 3-hr 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.

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 agent following discharge.

RIVER BEND STATION POSITION

•→7

Standby switchgear rooms within the control building and the rooms within the normal switchgear building are separated from the remainder of the plant by minimum 3-hr fire-rated barriers. All areas have automatic detection systems, which alarm and annunciate in the main control room and alarm locally. Water hose stations and portable extinguishers are readily available for use in these areas. Cables within these switchgear areas are associated directly with the switchgear and are minimal. Special protection is not warranted by the fire hazards analysis.

7←•

9A.3.7.6 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.

RIVER BEND STATION POSITION

•→7

Areas containing safety-related panels are provided with automatic detection systems, arranged to alarm and annunciate in the main control room. Portable extinguishers and water hose stations are available for use in these areas.

7←•

9A.3.7.7 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 3 hr 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 vol. percent hydrogen concentration. Standpipe and hose and portable extinguishers should be provided.

Alternatives:

1. Provide a total fire-rated barrier enclosure of the battery room complex that exceeds the fire load contained in the room

2. Reduce the fire load to be within the fire barrier capability of 1 1/2 hr

3. Provide a remote manual actuated sprinkler system in each room and provide the 1 1/2-hr fire barrier separation.

RIVER BEND STATION POSITION

Station battery rooms are separated from each other and remaining areas by minimum 3-hr rated barriers. Supply air at a rate of 5 air changes per hr is provided to prevent the accumulation of hydrogen above the permissible limit. Flow elements are provided to measure flow. Fan failure is indicated within the main control room.

9A.3.7.8 Turbine Lubrication and Control Oil Storage and Use Areas

A blank fire wall having a minimum resistance rating of 3 hr will separate all areas containing safety-related systems and equipment from the turbine oil system.

RIVER BEND STATION POSITION

The turbine lubrication oil storage and conditioning equipment is located in separate 3-hr fire-rated rooms. Piping from these areas is in guarded pipe up to the machine. Piping under the machine skirt is protected by automatic zoned water spray systems. Hydraulic valve control oil is of the high flash point type which presents no special fire hazard. No safety-related equipment is exposed by these systems.

9A.3.7.9 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 3 hr.

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 firefighting water and means for local manual venting of smoke should be provided.

Day tanks with total capacity up to 1,100 gal are permitted in the diesel generator area under the following conditions:

1. The day tank is located in a separate enclosure, with a minimum fire resistance rating of 3 hr, 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.

2. The enclosure should be protected by automatic fire suppression systems such as AFFF or sprinklers.

RIVER BEND STATION POSITION

Diesel generator areas are separated from each other and the remainder of the plant by 3-hr rated fire barriers. Each diesel generator area and fuel oil day tank is protected by an automatic preaction water sprinkler suppression system.

•→7
The steel supports for the day tanks are fireproofed. Concrete curbs are provided at the doors between the diesel generator bays and the diesel generator control rooms. Detection systems associated with these areas are heat sensitive and alarm locally and in the main control room. Venting of smoke is provided by a constantly operating normal exhaust system.
7←• •→11
The 612-gal day tank for each diesel is unenclosed, following guidance provided by NFPA Standard No. 37, Stationary Combustion Engines and Gas Turbines. Separation of diesel-generators from one another by these 3-hr rated fire barriers precludes affecting redundant diesels by a single fire event. Further isolation of hazards is not justified.
11←•
9A.3.7.10 Diesel Fuel Oil Storage Areas

Diesel fuel oil tanks with a capacity greater than 1,100 gal should not be located inside the buildings containing safety-related equipment. They should be located at least 50 ft from any building containing safety-related equipment, or if located within 50 ft, they should be housed in a separate building with construction having a minimum fire resistance rating of 3 hr. Buried tanks are considered as meeting the 3-hr fire resistance requirements. (See NFPA 30, "Flammable and Combustible Liquids Code," for additional guidance.)

When located in a separate building, the tank should be protected by an automatic fire suppression system such as AFFF or sprinklers.

Tanks, unless buried, will not be located directly above or below safety-related systems or equipment regardless of the fire rating of separating floors or ceilings.

RIVER BEND STATION POSITION

•→4
The diesel fuel oil storage tanks are buried beneath the building floor slab in sand-filled compartments which provides a 3-hr fire-rated barrier. Exceptions to this separation arrangement exist with two sumps that extend down to flanges on the top of each diesel fuel storage tank. These sumps are provided for tank sampling/inspection access and for the fuel transfer pumps that are mounted directly to a flange on the top of each tank. These sumps have been evaluated and determined not to present unacceptable exposure between the diesel generators and their respective fuel storage tanks. See Section 9A.3.7.9 for protection and separation of redundant diesel generators.
4←•

9A.3.7.11 Safety-Related Pumps

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 3-hr ratings. These rooms should be protected by automatic

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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.

Provisions should be made for manual control of the ventilation system to facilitate smoke removal if required for manual firefighting operation.

RIVER BEND STATION POSITION

The separation criteria for safety-related pumps and equipment is based on not exposing redundant equipment required for safe plant shutdown to impairment or failure from a single postulated accident. Three-hour fire-rated barriers are provided, where necessary.

The evaluation made has further imposed the design basis fire upon all safety-related areas using data included in the fire hazards analysis (Section 9A.2). In all cases, no compromise to safe plant shutdown exists. The fire hazards analysis also indicates no need to provide automatic sprinkler protection since exposure to redundant equipment does not exist.

•→7

Safety-related areas are provided with an early warning detection system with alarms and annunciation locally and in the control room. Portable extinguishers and hose stations are available. Smoke removal capability, using the normal ventilation system in the exhaust-only mode, is manually controlled.

7←•

9A.3.7.12 New Fuel Area

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.

The storage configuration of new fuel should always be so maintained as to preclude criticality for any water density that might occur during fire water application.

RIVER BEND STATION POSITION

•→7
Automatic sprinkler system, portable extinguishers, and hose stations are provided for the new fuel receiving area. Automatic fire detection is provided and arranged to alarm and annunciate in the control room and alarm locally. Combustibles are to be limited to the greatest extent practical and are removed from the area on a regular basis. Criticality is not a problem since no exposed fuel is susceptible to water impingement.
7←•

9A.3.7.13 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.

RIVER BEND STATION POSITION

•→7
Local hose stations and portable extinguishers are provided for use at spent fuel pool areas. Automatic fire detection is provided to alarm and annunciate in the control room and to alarm locally.
7←•

9A.3.7.14 Radwaste Building

The radwaste building should be separated from other areas of the plant by fire barriers having at least 3-hr ratings. 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 systems 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.

RIVER BEND STATION POSITION

The radwaste building is separated from surrounding areas by 3-hr fire-rated barriers. Automatic sprinkler systems are provided for protection of the truck pit area, baling area,

•→7
and drum storage area. Manual hose stations and portable extinguishers are located throughout. In the event of a fire, control of the ventilation system precludes discharging contaminated air to the atmosphere. An automatic fire detection system is provided to annunciate and alarm in the main control room and alarm locally.
7←•

9A.3.7.15 Decontamination Areas

The decontamination areas should be protected by automatic sprinklers if flammable liquids are stored. Automatic fire detection should be provided to annunciate 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.

RIVER BEND STATION POSITION

•→7
Decontamination areas are void of appreciable amounts of combustibles; therefore, automatic suppression is not provided. Automatic fire detection is provided to annunciate and alarm in the control room and alarm locally.
7←•

9A.3.7.16 Safety-Related Water Tanks

Storage tanks that supply water for safe shutdown should be protected from the effects of 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 ft of separation should be provided between outdoor tanks and combustible materials where feasible.

RIVER BEND STATION POSITION

There are no safety-related storage tanks that supply water for safe shutdown at the River Bend Station site.

9A.3.7.17 Cooling Towers

Cooling towers should be of noncombustible construction or so located that a fire should not adversely affect any safety-related systems 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.

RIVER BEND STATION POSITION

•→8

All cooling towers at River Bend Station are of reinforced concrete construction. Gear reducer maintenance platforms and walkways in the main cooling towers are constructed of pressure-treated redwood framing and fiberglass grating. The mass of redwood framing is very small as compared to the total mass of the cooling towers.

8←•

9A.3.7.18 Miscellaneous Areas

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 systems or equipment. Fuel oil tanks for auxiliary boilers should be buried or provided with dikes to contain the entire tank contents.

RIVER BEND STATION POSITION

•→7

Miscellaneous areas, such as record storage areas, shops, and warehouses, are located so that fire does not adversely affect any safety-related systems or equipment. The auxiliary boiler was electric and has been spared in place.

7←•

9A.3.8 SPECIAL PROTECTION GUIDELINES

9A.3.8.1 Welding and Cutting, Acetylene-Oxygen Fuel Gas Systems

This equipment is used in various areas throughout the plant. Storage locations will be chosen to permit fire protection by automatic sprinkler systems. Local hose stations and portable equipment will be provided as backup. The requirements of NFPA 51 and 51B are applicable to these hazards. A permit system will be required to utilize this equipment (also refer to Section 9A.3.3 herein).

RIVER BEND STATION POSITION

Most welding and cutting is done in the shops in the hot shop area. Where this is not possible, appropriate administrative controls are implemented by the plant staff. Adequate extinguishing equipment, a fire watch, and control and protection' of combustibles are included in the procedures described in Section 9.5.1.5.

9A.3.8.2 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 portableextinguishers 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").

RIVER BEND STATION POSITION

•→7

Dry ion exchange resins are not stored near essential safety-related systems. These resins are stored in the auxiliary boiler and water treatment building, and in the condensate demineralizer, and off-gas building. Fire loading does not justify the automatic sprinkler systems. Hose station and portable extinguishers are provided. The detection system alarms and annunciates in the main control room and alarms locally.

7←•

9A.3.8.3 Hazardous Chemicals

"Hazardous chemicals should be stored and protected in accordance with the recommendations of NFPA 49, Hazardous Chemicals Data." Chemicals storage areas should be well ventilated and protected against flooding conditions since some chemicals may react with water to produce ignition.

RIVER BEND STATION POSITION

Acids used in the regeneration area, radwaste building, and in the hot shop area are stored in appropriate metal or glass containers as recommended by the manufacturers. These areas, as well as use areas, are properly ventilated. Fire suppression capability is as required by the fire hazards analysis. Chemicals which react exothermically with water are properly segregated and protected so that these reactions are minimized.

9A.3.8.4 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.

RIVER BEND STATION POSITION

Any material containing radioactivity is transferred to metal drums or containers, as required, and stored inappropriate centralized locations awaiting disposal shipment. Combustible exposure to the containers is controlled in these areas.

TABLE 9A.3-1

COMPARISON OF TYPICAL FLOOR SYSTEM WITH UL-RATED SECTION

UL-Rated Section 0904	River Bend
Restrained assembly	Restrained assembly
Steel beam-W 10 x 29 min. size	Steel beam - W 8 x 24 typ.
Nom. conc. thk. - 6 3/4" 3 hr rating	Nom. conc. thk. - 8" min.
Concrete density - 147 pcf	Concrete density - 150 pcf
Min. reinforcement - 6x6- 6 x 6 WWF	Min. reinforcement - No. 6 @ 12" c/c
Conc. comp. strength - 3500 psi	Conc. comp. strength - 3000 psi
Steel floor forms Composite	Steel floor forms - noncomposite
Steel floor forms type Keystone CR by H. H. Robertson (1 1/2" or 2" deep)	Steel floor forms type - Type 2 VOR 3"V, 3"N or 4 1/2"C by INRYCO
Aggregate - Carbonate or silicious	Aggregate - silicious
Sprayed fiber or cementitious mixture in accordance with manufacturer's instructions on the steel beam(s)	Cementitious mixture in accordance with manufacturer's instructions on the steel beam(s)

TABLE 9A.3-2

COMPARISON OF TYPICAL STEEL BEAM WITH UL-RATED SECTION

UL-Rated Sections N714	River Bend
Restrained or unre-strained	Restrained
Minimum size beam W 8 x 24 or W 10 x 21	Minimum size beam W 8 x 24 typ.
1 l/2″ to 3" steel floor form units	2 " to 3 " (some 4 l/2″) steel floor form units
2 l/2″ minimum, 3000 psi, 148 pcf concrete	8" minimum 3000 psi, 150 pcf concrete
Cementitious mixture, minimum density 34 pcf, minimum thickness 1 l/2″	Cementitious mixture, min. density 34 pcf, minimum thickness 1 l/2″

TABLE 9A.3-3

COMPARISON OF TYPICAL WALL SECTION
WITH UL-RATED SECTION

UL-Rated Section U904	River Bend
8-in nominal thickness hollow concrete block, 3-hr fire-resistance rating	8-in minimum thickness solid poured-in-place reinforced concrete
Portland cement stucco or gypsum plaster (3/4-in thickness) adds l/2 hr to fire-resistance rating	Not applicable
If hollow, then core spaces are filled with some approved masonry fill. Add 1 hr to fire-resistance rating.	Solid, homogeneously poured concrete wall is at least equivalent to filled hollow masonry wall.

TABLE 9A.3-4

HOSE RACK STATIONS WITH MORE THAN 75 FEET OF HOSE

Hose Rack	Elevation (ft-in)	Length of Hose (ft)
2	Fuel Bldg, 70-0	100
84	Auxiliary Bldg, 70-0	100
35	Radwaste Bldg, 106-0	100
30	Radwaste Bldg, 65-0	150
82	Fuel Bldg, 70-0	150
83	Pipe Tunnel, 70-0	150
85	Control Bldg, 70-0	150
94	Control Bldg, 116-0	150
96	Control Bldg, 136-0	150

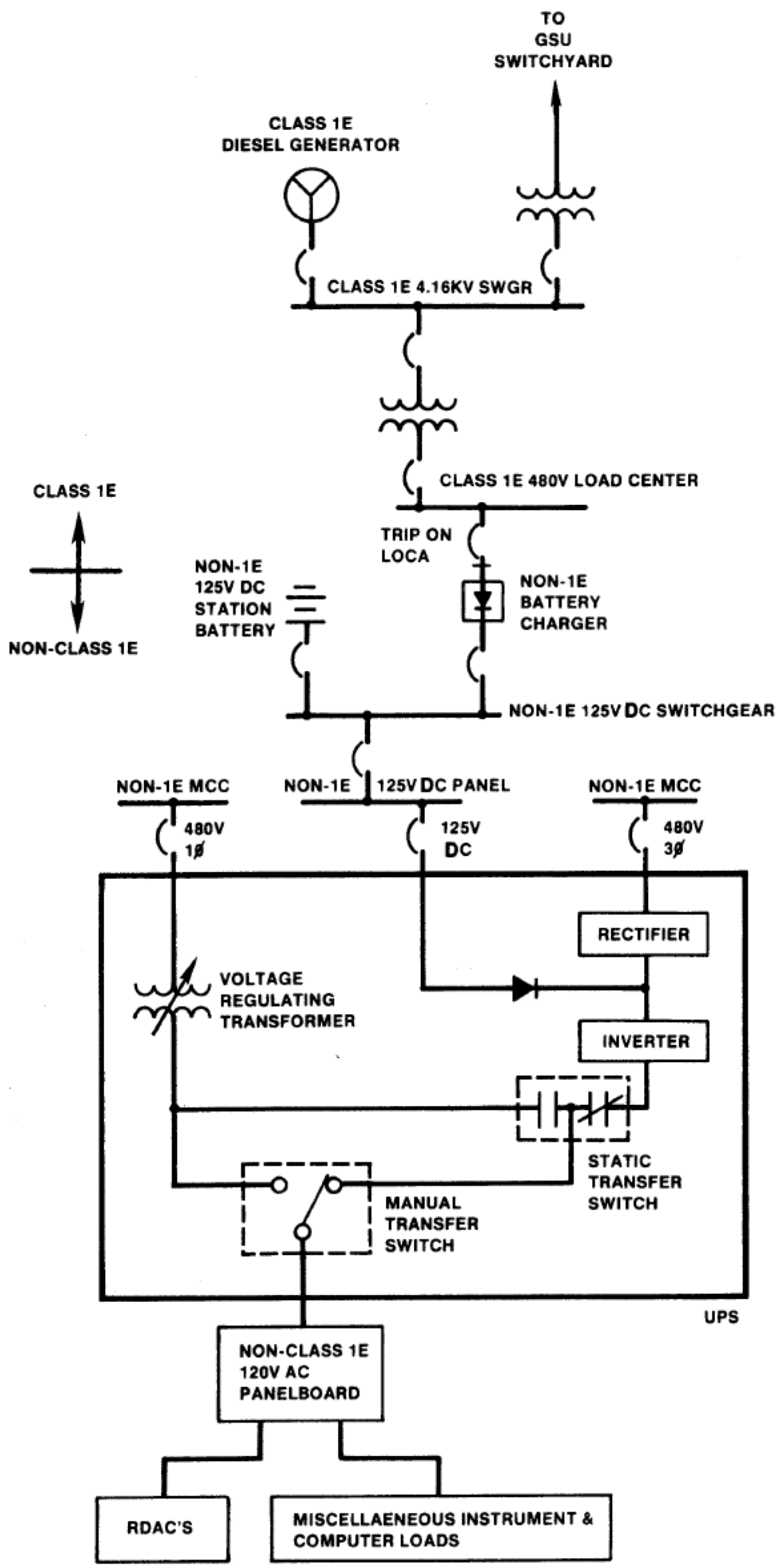

FIGURE 9A.3-1

RDAC UPS
POWER SUPPLY

RIVER BEND STATION
UPDATED SAFETY ANALYSIS REPORT

ATTACHMENT A
(TO APPENDIX 9A)

(Enclosure 2 to NRC letter dated September 30, 1976)

SUPPLEMENTARY GUIDANCE ON INFORMATION NEEDED FOR FIRE PROTECTION PROGRAM EVALUATION

In order to perform a proper fire hazards analysis, the services of a qualified fire protection engineer should be utilized. To demonstrate the results of the fire hazards analysis the following information must be provided:

1. Provide plan and elevation views of the plant that show the plant as divided into distinct fire areas. Provide a description of the various systems, both safety-related and nonsafety-related, which occupy the fire area and could provide cooling to the core to safely shutdown the reactor, including decay heat removal. Provide a description of areas of the plant that contain radioactive material that may be released to the exclusion area or beyond should a fire occur in those areas.

For each fire area, provide the following:

a) Describe the fire barrier that defines the fire area, the consequences of the design basis fire for that area, and the consequences of the fire if the fire protection system functions as designed.

b) Identify the safety-related equipment and associated cabling. Provide the design criteria for the fire protection related to such equipment. Provide the design criteria for protection of such equipment against inadvertent operation, careless operation, or rupture of extinguishing systems.

c) Provide a list of the type, quantity, and other pertinent characteristics of combustible materials associated with each fire area.

d) Provide a list of the fire loadings which represents the combustibles identified in (c) above for each fire area.

e) Describe all the extinguishing and detection capabilities within each fire area. Discuss all means for containing and inhibiting the progress a fire, e.g., the use of fire stops, coatings, curbs, walls, etc. Describe the extinguishing equipment outside an area which has access to the area.

Note: If large fire areas are divided into fire zones for the purpose of fire protection, the above information should be provided for each zone.

2. Where redundant safety-related equipment or cabling is located in a given fire area, describe the design features which prevent the loss of both redundant trains in a common fire, e.g., the separation provided by distance, physical barriers, and electrical isolation. Where control, power, or instrument cables of redundant systems used for bringing the reactor to safe, cold shutdown are located in the same cable trays, either provide a bounding analysis demonstrating that the worst consequences as a result of a fire in the cable trays are acceptable, or show that redundant systems required to achieve and maintain a cold shutdown are adequately protected against damage by the fire.

ATTACHMENT B
(To Appendix 9A)

(Enclosure 1 to NRC Letter dated September 30, 1976)

APPENDIX A TO
BRANCH TECHNICAL POSITION APCSB 9.5-1

GUIDELINES FOR FIRE PROTECTION FOR NUCLEAR POWER PLANTS DOCKETED PRIOR TO JULY 1, 1976

SCOPE

This Appendix A provides guidance on the preferred and, where applicable, acceptable alternatives to fire protection design for those nuclear power plants for which applications for construction permits were docketed prior to July 1, 1976.

The provisions of this appendix will apply to the following categories of nuclear power plants:

(1) Plants for which applications for construction permits were docketed prior to July 1, 1976, but have not received a construction permit;

(2) Plants for which construction permits were issued prior to July 1, 1976, and operating plants.

This appendix modifies, as deemed appropriate, the guidelines in Branch Technical Position (BTP) APCSB 9.5-1, "Fire Protection for Nuclear Power Plants" which are intended for plants whose applications for construction permit were docketed after July 1, 1976. The guidelines of the above cited BTP were adopted for this appendix and are preferred in all instances. Alternative acceptable fire protection guidelines are identified in this appendix for areas where, depending on the construction or operational status of a given plant, application of the guidelines per se could have significant impact, e.g., where the building and system designs are already finalized and construction is in progress, or where the plant is in operation. These alternative guidelines are intended to provide adequate and acceptable fire protection consistent with safe plant shutdown requirements without a significant impact on plant design, construction, and operation.

Particular sections that are intended to apply only to plants under review, under construction or operating are identified under the appropriate column.

Although this appendix provides specific guidance, alternatives may be proposed by applicants and licensees. These alternatives will be evaluated by the NRC staff on a case-by-case basis where such departures are suitably justified. Among the alternatives that should be considered is the provision of a "dedicated" system for assuring continued safe shutdown of the plant. This dedicated system should be completely independent of other plant systems, including the power source; however, for fire protection, it is not necessary for the system to be designed to seismic Category I criteria or meet single failure criteria. Manual fire fighting capability to protect the other safety-related systems would still be required.

APPENDIX 9B

FIRE PROTECTION PROGRAM COMPARISON WITH APPENDIX R TO 10CFR50

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9B.1 FOREWORD

The Nuclear Regulatory Commission published Appendix R to 10CFR50 on November 19, 1980. This rule became effective February 19, 1981. It specified certain fire protection features for operating nuclear power plants licensed before January 1979.

It has recently been NRC practice to perform fire protection reviews for Operating License Stage (OLS) plants using the provisions of Appendix R. Accordingly, the NRC requested GSU (letter dated October 20, 1981, from Mr. Darrell G. Eisenhut of NRC to Mr. William J. Cahill, Jr. of GSU) to include a comparison of the River Bend Station Fire Protection Program to Appendix R, as a part of the overall fire protection program submittal.

This required comparison is provided in this appendix to the River Bend Station USAR.

Appendix 9B correlates to sections of Appendix R. All sections of Appendix R have been repeated and are followed by the River Bend Station position.

9B.2 INTRODUCTION AND SCOPE (Item I of Appendix R)

Appendix R to 10CFR50 applies to licensed nuclear power electric generating stations operating prior to January 2, 1979, except to the extent set forth in paragraph 50.48(b) of this part. With respect to certain generic issues for such facilities it sets forth fire protection features required to satisfy Criterion 3 of Appendix A to this part.[1]

Criterion 3 of Appendix A to this part specifies that, "Structures, systems, and components important to safety shall be designed and located to minimize, consistent with other safety requirements, the probability and effect of fires and explosions."

When considering the effects of fire, those systems associated with achieving and maintaining safe shutdown conditions assume major importance to safety because damage to them can lead to core damage resulting from loss of coolant through boiloff.

The phrases "important to safety," or "safety-related," will be used throughout Appendix R as applying to all safety functions. The phrase "safe shutdown" will be used throughout Appendix R as applying to both hot and cold shutdown functions.

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[1] Clarification and guidance with respect to permissable alternatives to satisfy Appendix A to BTP APCSB 9.5-1 has been provided in four other NRC documents.

- "Supplementary Guidance on Information Needed for Fire Protection Evaluation," dated October 21, 1976.
- "Sample Technical Specification," dated May 12, 1977.
- "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Control and Quality Assurance," dated June 14, 1977.
- "Manpower Requirements for Operating Reactors", dated May 11, 1978.

A Fire Protection Safety Evaluation Report that has been issued for each operating plant states how these guidelines were applied to each facility and identifies open fire protection issues that will be resolved when the facility satisfies the appropriate requirements of Appendix R to this part.

Because fire may affect safe shutdown systems, and because the loss of function of systems used to mitigate the consequences of design basis accidents under postfire conditions does not impact public safety per se, the need to limit fire damage to systems required to achieve and maintain safe shutdown conditions is greater than the need limit fire damage to those systems required to mitigate the consequences of design basis accidents. Three levels of fire damage limits are established according to the safety functions of the structure, system, or component:

Safety Function: Hot Shutdown

Fire Damage Limits

One train of equipment necessary to achieve hot shutdown from either the control room or emergency control station(s) must be maintained free of fire damage by a single fire, including an exposure fire.[2]

Safety Function: Cold Shutdown

Fire Damage Limits

Both trains or equipment necessary to achieve cold shutdown may be damaged by a single fire, including an exposure fire, but damage must be limited so that at least one train can be repaired or made operable within 72 hours using onsite capability.

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[1] Exposure Fire. An exposure fire is a fire in a given area that involves either in situ or transient combustibles and is external to any structures, systems, or components located in or adjacent to that same area. The effects of such fire (e.g., smoke, heat, or ignition) can adversely affect those structures, systems, or components important to safety. Thus, a fire involving one train of safe shutdown equipment may constitute an exposure fire for the redundant train located in the same area, and a fire involving combustibles other than either redundant train may constitute an exposure fire to both redundant trains located in the same area

Safety Function: Design Basis Accidents

Fire Damage Limits

Both trains of equipment necessary for mitigation of consequences following design basis accidents may be damaged by a single exposure fire.

The most stringent fire damge limit shall apply for those systems that fall into more than one category. Redundant systems used to mitigate the consequences of other design basis accidents but not necessary for safe shutdown may be lost to a single exposure fire. However, protection shall be provided so that a fire within only one such system will not damage the redundant system.

RIVER BEND STATION POSITION

RBS complies with these criteria as discussed in the remainder of this appendix.

9B.3 GENERAL REQUIREMENTS (Item II of Appendix R)

9B.3.1 Fire Protection Program (Item II.A of Appendix R)

A fire protection program shall be established at each nuclear power plant. The program shall establish the fire protection policy for the protection of structures, systems, and components important to safety at each plant and the procedures, equipment, and personnel required to implement the program at the plant site.

The fire protection program shall be under the direction of an individual who has been delegated authority commensurate with the responsibilities of the position and who has available staff personnel knowledgeable in both fire protection and nuclear safety.

The fire protection program shall extend the concept of defense-in-depth to fire protection in fire areas important to safety with the following objectives:

- To prevent fires from starting.
- To detect rapidly, control, and extinguish promptly those fires that do occur.
- To provide protection for structures, systems, and components important to safety so a fire that is not promptly extinguished by fire suppression activities will not prevent safe shutdown of the plant.

RIVER BEND STATION POSITION

The RBS overall fire protection program is based upon an evaluation of potential fire hazards throughout the plant and the effect of fires relative to maintaining safety shutdown functions and minimizing radioactive releases to the environment.

Fire fighting procedures (FFP) are referenced in Section 9.5.1.5. Fire detection and suppression equipment are discussed in Section 9A.3.6, whereas an overall system description may be found in Section 9.5.1.2. The site fire brigade is addressed in Section 9B.4.8.

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Responsibility for the overall fire protection program is assigned to the Site Vice President, who retains ultimate responsibility, even though formulation and assurance of
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program implementation is delegated. Personnel to whom authority is delegated for implementation and formulation of the program are trained to their levels of responsibility. The Manager - Maintenance is responsible for development of the fire protection program, including assisting in the development of the fire protection-related training program, and maintaining, inspecting, and testing all fire protection equipment.
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The fire protection program utilizes the defense-in-depth concept to fire protection in fire areas important to safety. The following methods are used to prevent fires from starting.

1. Use of noncombustible materials to the greatest extent practical.

2. Use of administrative controls for: bulk storage of combustible materials; transient fire loads, ignition sources; removal of all waste; periodic housekeeping, inspections, fire watch, etc.

3. Taking necessary action from the result of updating of fire hazard analysis and QA programs.

If a fire occurs, it is detected, controlled, and rapidly extinguished using the following methods and equipment.

1. Appropriate detectors, control panels, and alarm/signaling systems.

2. Control spreading of fire using materials with a rating of 25 or less for flame spread, fuel contribution, and smoke distribution.

3. Fire-rated barriers and seals.

4. Emergency lighting and communications.

5. Smoke and heat venting facilities.

6. Drainage facilities.

7. Testing and maintenance of fire protection equipment.

8. Fire water tanks, fire pumps, yard hydrants, standpipe and hose systems, sprinkler and spray systems,

portable extinguishers, high pressure carbon dioxide, and Halon 1301 systems.

9. Trained fire brigade personnel.

In the event a fire is not promptly extinguished, protection is provided for structures, systems, and components which are responsible for safe shutdown of the facility. This protection is provided by emergency core cooling systems (ECCS) with built-in redundancy. ECCS consists of, as a minimum, high pressure core spray (HPCS), low pressure core spray (LPCS), low pressure coolant injection loops (LPCI) of residual heat removal (RHR), and automatic depressurization system (ADS).

Additional information is provided in Section 9.5.1.5 of the FSAR, Section 9A.3.2.1 of Appendix 9A to the FSAR, and Section 9B.4.7 of Appendix 9B to the FSAR.

9B.3.2 Fire Hazard Analysis (Item II.B of Appendix R)

A fire hazard analysis shall be performed by qualified fire protection and reactor systems engineers to (1) consider potential in situ and transient fire hazards; (2) determine the consequences of fire in any location in the plant on the ability to safely shut down the reactor or on the ability to minimize and control the release of radioactivity to the environment; and (3) specify measures for fire prevention, fire detection, fire suppression, and fire containment and alternative shutdown capability as required for each fire area containing structures, systems, and components important to safety in accordance with NRC guidelines and regulations.

RIVER BEND STATION POSITION

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The fire hazard analysis is performed by qualified fire protection and reactor systems engineers. In addition, input is provided by other discipline engineers (structural, electrical, control, HVAC, etc). This analysis includes review of fire hazards, fire loads, safety-related equipment and components, radioactive release considerations, fire barriers, fire detections, and fire suppression systems. This analysis is described in Section 9A.2. This analysis concludes there is no compromise to the safe shutdown of the plant.

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However, fire hazard analysis efforts have been extended to evaluate transient fire considerations and the requirements of Appendix R.

Additional information is provided in Section 9B.4.7.

9B.3.3 Fire Prevention Features (Item II.C of Appendix R)

Fire protection features shall meet the following general requirements for all fire areas that contain or present a fire hazard to structures, systems, or components important to safety.

1. In situ fire hazards shall be identified and suitable protection provided.

2. Transient fire hazards associated with normal operation, maintenance, repair, or modification activities shall be identified and eliminated where possible. Those transient fire hazards that can not be eliminated shall be controlled and suitable protection provided.

3. Fire detection systems, portable extinguishers, and standpipe and hose stations shall be installed.

4. Fire barriers or automatic suppression systems or both shall be installed as necessary to protect redundant systems or components necessary for safe shutdown.

5. A site fire brigade shall be established, trained, and equipped and shall be onsite at all times.

6. Fire detection and suppression systems shall be designed, installed, maintained, and tested by personnel properly qualified by experience and training in fire protection systems.

7. Surveillance procedures shall be established to ensure that fire barriers are in place and that fire suppression systems and components are operable.

RIVER BEND STATION POSITION

1. A fire hazard analysis is performed for each fire area/zone. This analysis includes identification of fire hazards and a description of the protection provided.

2. Transient fire hazards associated with normal operation, maintenance, repair or modification activities will be controlled by administrative procedures. Effects of transient fires are evaluated considering a fire equivalent of 5 gallons of gasoline. Detailed information is given in Sections 9A.2.1, 9B.3.2 and 9B.4.7 to the FSAR.

3,4,&6. Fire detection systems, portable extinguishers, standpipe and hose stations, and fire suppression systems are provided as stated in the fire hazard analysis described in Appendix 9A to the FSAR.

5. The site fire brigade is equipped and onsite at all times. Further discussion is provided in Sections 9B.4.8 and 9B.4.9.

7. Surveillance procedures ensure that fire barriers are in place and fire suppression systems and components are operable.

9B.3.4 Alternative or Dedicated Shutdown Capability (Item II.D of Appendix R)

In areas where the fire protection features cannot ensure safe shutdown capability in the event of a fire in that area, alternative or dedicated safe shutdown capability shall be provided.

RIVER BEND STATION POSITION

See Sections 9B.3.2 and 9B.4.7.

9B.4 SPECIFIC REQUIREMENTS (Item III of Appendix R)

9B.4.1 Water Supplies for Fire Suppression System (Item III.A of Appendix R)

Two separate water supplies shall be provided to furnish necessary water volume and pressure to the fire main loop. Each supply shall consist of a storage tank, pump, piping, and appropriate isolation and control valves. Two separate redundant suctions in one or more intake structures from a large body of water (river, lake, etc) will satisfy the requirement for two separated water storage tanks. These supplies shall be separated so that a failure of one supply will not result in a failure of the other supply.

Each supply of the fire water distribution system shall be capable of providing for a period of 2 hours the maximum expected water demands as determined by the fire hazards analysis for safety-related areas or other areas that present a fire exposure hazard to safety-related areas. When storage tanks are used for combined service-water/fire-water uses the minimum volume for fire uses shall be ensured by means of dedicated tanks or by some physical means such as a vertical standpipe for other water service. Administrative controls, including locks for tank outlet valves, are unacceptable as the only means to ensure minimum water volume.

Other water systems used as one of the two fire water supplies shall be permanently connected to the fire main system and shall be capable of automatic alignment to the fire main system. Pumps, controls, and power supplies in these systems shall satisfy the requirements for the main fire pumps. The use of other water systems for fire protection shall not be incompatible with their functions required for safe plant shutdown. Failure of the other system shall not degrade the fire main system.

RIVER BEND STATION POSITION

The River Bend Station fire protection water supply system consists of two water storage tanks, three 1,500 gpm at 165 psi capacity fire pumps (one electric and two diesels), pressure maintenance jockey pump, piping and valves. Additional information is provided in USAR Sections 9.5.1.2.1 through 9.5.1.2.3.

9B.4.2 Sectional Isolation Valves (Item III.B of Appendix R)

Sectional isolation valves such as post indicator valves or key operated valves shall be installed in the fire main loop to permit isolation of portions of the main fire main loop for maintenance or repair without interrupting the entire water supply.

RIVER BEND STATION POSITION

Sectional isolation valves are installed in the fire main loop. These are shown in Figure 9A.2-6 of Appendix 9A of the USAR.

9B.4.3 Hydrant Isolation Valves (Item III.C of Appendix R)

Valves shall be installed to permit isolation of outside hydrants from the fire main for maintenance or repair without interrupting the water supply to automatic or manual fire suppression systems in any area containing or presenting a fire hazard to safety-related or safe shutdown equipment.

RIVER BEND STATION POSITION

Valves are installed to permit isolation of outside hydrants from the fire main. These are shown in Figure 9A.2-6 of Appendix 9A to the USAR.

9B.4.4 Manual Fire Suppression (Item III.D of Appendix R)

Standpipe and hose systems shall be installed so that at least one effective hose stream will be able to reach any location that contains or presents an exposure fire hazard to structures, systems, or components important to safety.

Access to permit effective functioning of the fire brigade shall be provided to all areas that contain or present an exposure fire hazard to structures, systems, or components important to safety.

Standpipe and hose stations shall be inside PWR containments and BWR containments that are not inerted. Standpipe and hose stations inside containment may be connected to a high quality water supply of sufficient quantity and pressure other than the fire main loop if plant-specific features prevent extending the fire main supply inside containment. For BWR drywells, standpipe and hose stations shall be placed outside the dry well with adequate lengths of hose to reach any location inside the dry well with an effective hose stream.

RIVER BEND STATION POSITION

Adequate manual hose stations are provided to reach any location with at least one effective hose stream except in the drywell area, tunnel areas and the diesel generator building. Fire hazards in tunnel areas are protected by automatic water spray systems and portable extinguishers. Fire hazards in the diesel generator building are protected by automatic preaction water systems and portable extinguishers. The drywell area is inaccessible during normal operation and administrative controls exist to limit the introduction of combustibles and provide fire protection equipment during shutdown. Fire hazards in the diesel generator building are protected by automatic preaction water systems and portable extinguishers. Detailed information is provided in Sections 9A.3.6.3.4 and 9A.3.6.3.5 of Appendix 9A to the USAR. Required access is also provided.

9B.4.5 Hydrostatic Hose Tests (Item III.E of Appendix R)

Fire hose shall be hydrostatically tested at a pressure of 150 psi or 50 psi above maximum fire main operating pressure, whichever is greater. Hose stored in outside hose houses shall be tested annually. Interior standpipe hose shall be tested every 3 years.

RIVER BEND STATIONS POSITION

Fire hose is hydrostatically tested at a pressure of at least 150 psi or 50 psi above maximum fire main operating pressure, whichever is greater. Hose stored in outside hose houses is tested annually. Interior standpipe hose is tested every 3 years.

9B.4.6 Automatic Fire Detection (Item III.F Appendix R)

Automatic fire detection systems shall be installed in all areas of the plant that contain or present an exposure fire hazard to safe shutdown or safety-related systems or components. These fire detection systems shall be capable of operating with or without offsite power.

RIVER BEND STATION POSITION

River Bend Station complies with the above requirements. Detailed information is provided in Section 9A.3.6.1 and Figures 9A.2-1 to -5 and -10 of Appendix 9A of the USAR.

9B.4.7 Fire Protection of Safe Shutdown Capability (Item III.G of Appendix R)

1. Fire protection features shall be provided for structures, systems, and components important to safe shutdown. These features shall be capable of limiting fire damage so that:

   a. One train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station(s) is free of fire damage.

   b. Systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station(s) can be repaired within 72 hours.

2. Except as provided for paragraph G.3 of this section, where cables or equipment, including associated non-safety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, or redundant trains of systems necessary to achieve and maintain hot shutdown conditions are located within the same fire area outside of primary containment, one of the following means of ensuring that one of the redundant trains is free of fire damage shall be provided.

   a. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a fire barrier having a 3-hour rating. Structural steel forming a part of or supporting such fire barriers shall be protected to provide fire resistance equivalent to that required of the barrier.

   b. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustible or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

   c. Enclosure of cable and equipment and associated nonsafety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

Inside noninerted containments one of the fire protection means specified above or one of the following fire protection means shall be provided.

d. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards.

e. Installation of fire detectors and an automatic fire suppression system in the fire area.

f. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a noncombustible radiant energy shield.

3. Alternative or dedicated shutdown capability and its associated circuits,(3) independent of cables, systems or components in the area, room or zone under consideration, shall be provided:

a. Where the protection of systems whose function is required for hot shutdown does not satisfy the requirement of paragraph G.2 of this section, or

b. Where redundant trains of systems required for hot shutdown located in the same fire area may be subject to damage from fire suppression activities or from the rupture or inadvertent operation of fire suppression systems.

In addition, fire detection and a fixed fire suppression system shall be installed in the area, room, or zone under consideration.

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(3) Alternative shutdown capability is provided by rerouting, relocating or modificating of existing systems; dedicated shutdown capability is provided by installing new structures and systems for the function of post-fire shutdown.

RIVER BEND STATION POSITION

See Section 9A.2

9B.4.8 Fire Brigade (Item III.H of Appendix R)

A site fire brigade trained and equipped for fire fighting shall be established to ensure adequate manual fire fighting capability for all areas of the plant containing structures, systems, or components important to safety. The fire brigade shall be at least five members on each shift. The brigade leader and at least two brigade members shall have sufficient training in or knowledge of plant safety-related systems to understand the effects of fire and fire suppressants on safe shutdown capability. The qualification of fire brigade members shall include an annual physical examination to determine their ability to perform strenuous fire fighting activities. The shift supervisor shall not be a member of the fire brigade. The brigade leader shall be competent to assess the potential safety consequences of a fire and advise control room personnel. Such competence by the brigade leader may be evidenced by possession of an operator's license or equivalent knowledge of plant safety-related systems.

The minimum equipment provided for the brigade shall consist of personal protective equipment such as turnout coats, boots, gloves, hard hats, emergency communications equipment, portable lights, portable ventilation equipment, and portable extinguishers. Self-contained breathing apparatus using full-face positive-pressure masks approved by NIOSH (National Institute for Occupational Safety and Health - approval fomerly given by the U.S. Bureau of Mines) shall be provided for fire brigade, damage control, and control room personnel. At least 10 masks shall be available for fire brigade personnel. Control room personnel may be furnished breathing air by a manifold system piped from a storage reservoir if practical. Service or rated operating life shall be a minimum of one-half hour for the self contained units.

At least two extra air bottles shall be located onsite for each self-contained breathing unit. In addition, an onsite 6-hour supply of reserve air shall 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 shall be used; compressors shall be operable assuming a loss of offsite power. Special care must be taken to locate the compressor in areas free of dust and contaminants.

RIVER BEND STATION POSITION

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The site fire brigade is trained and equipped to ensure an adequate manual fire fighting capability for protection of safety-related structures, systems, and components. Five members of each shift have fire brigade duties and are required to pass an annual physical examination. These shift members normally include a Reactor Operator or an Auxiliary Operator to act as fire brigade leader, two Auxiliary Operators, and two other qualified members. If sufficient numbers of trained personnel are not available from the above, other individuals who are qualified as fire brigade members will be assigned to that shift to complete the five-man fire brigade. The fire brigade leader informs the Shift Manager from the scene of the fire. The fire brigade leader understands the effects of fire and fire suppressants on safe shutdown capability (two additional brigade members possess similar knowledge).

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Turnout coats, boots, gloves, hard hats, portable hand lights and extinguishers are provided for fire brigade members. Page party/public address (PP/PA) equipment is available for emergency communications. In each fire brigade locker, 6 full-face positive pressure, self-continued breathing apparatuses (SCBA) and spare air bottle are provided. Additionally, in the main control room 10 full-face, positive pressure, self-contained breathing apparatuses (SCBA), and 3 spare air bottles per SCBA are provided for fire brigade use. Each SCBA supplies one individual for 1 hour during moderate exertion. Routine replenishment is available through a cascade system located onsite with offsite replenishment available through compressed gas suppliers in the Baton Rouge area.

9B.4.9 Fire Brigade Training (Item III.I of Appendix R)

The fire brigade training program shall ensure that the capability to fight potential fires is established and maintained. The program shall consist of an initial classroom instruction program followed by periodic classroom instruction, fire fighting practice, and fire drills.

1. Instruction

    a. The initial classroom instruction shall include:

(1) Indoctrination of the plant fire fighting plan with specific identification of each individual's responsibilities.

(2) Identification of the type and location of fire hazards and associated types of fires that could occur in the plant.

(3) The toxic and corrosive characteristics of expected products of combustion.

(4) Identification of the location of fire fighting equipment for each fire area and familiarization with the layout of the plant, including access and egress routes to each area.

(5) The proper use of available fire fighting equipment and the correct method of fighting each type of fire. The types of fires covered should include fires in energized electrical equipment, fires in cables and cable trays, hydrogen fires, fires involving flammable and combustible liquids or hazardous process chemicals, fires resulting from construction or modifications (welding), and record file fires.

(6) The proper use of communications, ventilation, and emergency breathing equipment.

(7) The proper method for fighting fires inside buildings and confined spaces.

(8) The direction and coordination of the fire fighting activities (fire brigade leaders only).

(9) Detailed review of fire fighting strategies and procedures.

(10) Review of the latest plant modifications and corresponding changes in fire fighting plans.

NOTE: Items (9) and (10) may be deleted from the training of no more than two of the non-operations personnel who may be assigned to the fire brigade.

b. Instruction shall be provided by qualified individuals who are knowledgeable, experienced, and suitably trained in fighting the types of fires that could occur in the plant and in using types of equipment available in the nuclear power plant.

c. Instruction shall be provided to all fire brigade members and fire brigade leaders.

d. Regular planned meetings shall be held every 3 months for all brigade members to review changes in the fire protection program and other subjects as necessary.

e. Periodic refresher training sessions shall be held to repeat the classroom instruction program for all brigade members over a 2-year period. These sessions may be concurrent with regular planned meetings.

2. Practice

Practice sessions shall be held for each shift fire brigade on the proper method of fighting various fires that could occur in a nuclear power plant. These sessions shall provide brigade members with experience in actual fire extinguishment and the use of emergency breathing apparatus under strenuous conditions encountered in fire fighting. These practice sessions shall be provided at least once per year for each fire brigade member.

3. Drills

a. Fire brigade drills shall be performed in the plant so that the fire brigade can practice as a team.

b. Drills shall be performed at regular intervals not to exceed 3 months for each shift fire brigade. Each fire brigade member should participate in every drill, but must participate in at least two drills per year.

A sufficient number of these drills, but not less than one for each shift fire brigade per year, shall be unannounced to determine the fire fighting readiness of the plant fire brigade, brigade leader, and fire protection systems and equipment. Persons planning and authorizing an unannounced drill shall ensure that the responding shift fire brigade members are not aware that a drill is being planned until it is begun. Unannounced drills shall not be scheduled sooner than 4 weeks.

At least one drill per year shall be performed on a "back shift" for each shift fire brigade.

c. The drills shall be preplanned to establish the training objectives of the drill and shall be critiqued to determine how well the training objectives have been met. Unannounced drills shall be planned and critiqued by members of the management staff responsible for plant safety and fire protection. Performance deficiencies of a fire brigade or individual fire brigade members shall be remedied by scheduling additional training for the brigade or members.

   Unsatisfactory drill performance shall be followed by a repeat drill within 30 days.

d. At 3-year intervals, a randomly selected unannounced drill shall be critiqued by qualified individuals independent of the licensee's staff. A copy of the written report from such individuals shall be available for NRC review.

e. Drills shall as a minimum include the following:

   (1) Assessment of fire alarm effectiveness, time required to notify and assemble fire brigade, and selection, placement and use of equipment, and fire fighting strategies.

   (2) Assessment of each brigade member's knowledge of his or her role in the fire fighting strategy for the area assumed to

contain the fire. Assessment of the brigade member's conformance with established plant fire fighting procedures and use of fire fighting equipment, including self-contained emergency breathing apparatus, communications equipment, and ventilation equipment, to the extent practicable.

(3) The simulated use of fire fighting equipment required to cope with the situation and type of fire selected for the drill. The area and type of fire chosen for the drill should differ from those used in the previous drill so that brigade members are trained in fighting fires in various plant areas. The situation selected should simulate the size and arrangement of a fire that could reasonably occur in the area selected, allowing for fire development due to the time required to respond, to obtain equipment, and organize for the fire, assuming loss of automatic suppression capability.

(4) Assessment of brigade leader's direction of the fire fighting effort as to thoroughness, accuracy, and effectiveness.

4. Records

Individual records of training provided to each fire brigade member, including drill critiques, shall be maintained for at least 3 years to ensure that each member receives training in all parts of the training program. These records of training shall be available for NRC review. Retaining or broadened training for fire fighting within buildings shall be scheduled for all those brigade members whose performance records show deficiencies.

RIVER BEND STATION POSITION

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RBS complies with the Appendix R Fire Brigade Training Requirements provided above. Site fire Brigade organization, and training are discussed in Section 13.2.3. Retraining, drills, and records associated with the site fire brigade are discussed in Section 13.2.3.4. Training

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records are maintained for 3 years to ensure that each fire brigade member receives instruction in all parts of the training program. Deficient performance records indicate the need for additional training.

9B.4.10 Emergency Lighting (Item III.J. of Appendix R)

Emergency lighting units with at least an 8-hour battery power supply shall be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto.

RIVER BEND STATION POSITION

See Section 9A.3.5.5.1 of Appendix 9A to USAR.

9B.4.11 Administrative Controls (Item III.K of Appendix R)

Administrative controls shall be established to minimize fire hazards in areas containing structures, systems, and components important to safety. These controls shall establish procedures to:

1. Govern the handling and limitation of the use of ordinary combustible materials, combustible and flammable gases and liquids, high efficiency particulate air and charcoal filters, dry ion exchange resins, or other combustible supplies in safety-related areas.

2. Prohibit the storage of combustibles in safety-related areas or establish designated storage areas with appropriate fire protection.

3. Govern the handling of and limit transient fire loads such as combustible and flammable liquids, wood and plastic products, or other combustible materials in buildings containing safety-related systems or equipment during all phases of operating, and especially during maintenance, modification, or refueling operation.

4. Designate the onsite staff member responsible for the inplant fire protection review of proposed work activities to identify potential transient fire hazards and specify required additional fire protection in the work activity procedure.

5. Govern the use of ignition sources by use of a flame permit system to control welding, flame

cutting, brazing, or soldering operations. A separate permit shall be issued for each area where work is to be done. If work continues over more than one shift, the permit shall be valid for not more than 24 hours when the plant is operating or for the duration of a particular job during plant shutdown.

6. Control the removal from the area of all waste, debris, scrap, oil spills, or other combustibles resulting from the work activity immediately following completion of the activity, or at the end of each work shift, whichever comes first.

7. Maintain the periodic housekeeping inspections to ensure continued compliance with these administrative controls.

8. Control the use of specific combustibles in safety-related areas. All wood used in safety-related areas during maintenance, modification, or refueling operations (such as lay-down blocks or scaffolding) shall be treated with a flame retardant. Equipment or supplies (such as new fuel) shipped in untreated combustible packing containers may be unpacked in safety-related areas if required for valid operating reasons. However, all combustible materials shall be removed from the area immediately following the unpacking. Such transient combustible material, unless stored in approved containers, shall not be left unattended during lunch breaks, shift changes, or other similar periods. Loose combustible packing material such as wood or paper excelsior, or polyethylene sheeting, shall be placed in metal containers with tight-fitting self-closing metal covers.

9. Control actions to be taken by an individual discovering a fire. For example, notification of control room, attempt to extinguish fire, and actuation of local fire suppression systems.

10. Control actions to be taken by the control room operator to determine the need for brigade assistance upon report of a fire or receipt of alarm on control room annunciator panel. For example, announcing location of fire over PA system, sounding fire alarms, and notifying the

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shift superintendent and the fire brigade leader of the type, size, and location of the fire.

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11. Control actions to be taken by the fire brigade after notification by the control room operator of a fire. For example, assembling in a designated location, receiving directions from the fire brigade leader, and discharging specific fire fighting responsibilities including selection and transportation of fire fighting equipment to fire location, selection of protective equipment, operating instructions for use of fire suppression systems, and use of preplanned strategies for fighting fires in specific areas.

12. Define the strategies for fighting fires in all safety-related areas and areas presenting a hazard to safety-related equipment. These strategies shall designate:

    a. Fire hazards in each area covered by the specific prefire plans.

    b. Fire extinguishants best suited for controlling the fires associated with the fire hazards in that area and the nearest location of these extinguishants.

    c. Most favorable direction from which to attack a fire in each area in view of the ventilation direction, access hallways, stairs, and doors that are most likely to be free of fire, and the best station or elevation for fighting the fire. All access and egress routes that involve locked doors should be specifically identified in the procedure with the appropriate precautions and methods for access specified.

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    d. Plant systems that should be managed to reduce the damage potential during a local fire and the location of local and remote controls for such management (e.g., any hydraulic or electrical systems in the zone covered by the specific fire fighting procedure that could increase the hazards in the area because of overpressurization or electrical hazards).

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    e. Vital heat-sensitive system components that need to be kept cool while fighting a local fire. Particularly hazardous combustibles that need cooling should be designated.

f. Organization of fire fighting brigades and the assignment of special duties according to job title so that all fire fighting functions are covered by any complete shift personnel complement. These duties include command control of the brigade, transporting fire suppression and support equipment to the fire scenes, applying the extinguishant to the fire, communication with the control room, and coordination with outside fire departments.

g. Potential radiological and toxic hazards in fire zones.

h. Ventilation system operation that ensures desired plant air distribution when the ventilation flow is modified for fire containment or smoke clearing operations.

i. Operations requiring control room and shift engineer coordination or authorization.

j. Instructions for plant operators and general plant personnel during fire.

RIVER BEND STATION POSITION

Administrative controls in the form of written procedures are established to address Item III.K. These procedures, referenced in Section 9.5.1.5, cover:

1. Handling of flammable liquids and gases.

2. Bulk storage of combustible materials (especially in or near safety-related buildings and systems).

3. Control of transient combustibles.

4. Authority and responsibilities of personnel assigned specific fire protection duties.

5. Control of ignition sources.

6. Housekeeping requirements, including disposal of combustible materials and periodic inspections in accordance with Regulatory Guide 1.39.

7. Fire watch duties, fire reporting, fire fighting strategies, and recovery actions.

In addition, Section 9A.3.5.2 addresses the control of combustibles near safety-related systems, bulk gas storage, plastic materials, and flammable liquids. Special protection measures for welding and cutting, dry ion exchanges resins, hazardous chemicals, and materials containing radioactivity are outlined in Section 9A.3.8.

9B.4.12 Alternative and Dedicated Shutdown Capability (Item III.L of Appendix R)

1. Alternative or dedicated shutdown capability provided for a specific fire area shall be able to achieve and maintain subcritical reactivity conditions in the reactor, maintain reactor coolant inventory, achieve and maintain hot standby[(4)] conditions for a PWR (hot shutdown[(4)] for a BWR) and achieve cold shutdown[(4)] conditions within 72 hours and maintain cold shutdown conditions thereafter. During the postfire shutdown, the reactor coolant system process variables shall be maintained within those predicted for a loss of normal ac power, and the fission product boundary integrity shall not be affected; i.e., there shall be no fuel clad damage, rupture of any primary coolant boundary, or rupture of the containment boundary.

2. The performance goals for the shutdown functions shall be:

   a. The reactivity control function shall be capable of achieving and maintaining cold shutdown reactivity conditions.

   b. The reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for BWRs and be within the level indication in the pressurizer for PWRs.

   c. The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.

[(4)] As defined in the Standard Technical Specifications.

d. The process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the above functions.

e. The supporting functions shall be capable of providing the process cooling, lubrication, etc., necessary to permit the operation of the equipment used for safe shutdown functions.

3. The shutdown capability for specific fire areas may be unique for each such area, or it may be one unique combination of systems for all such areas. In either case, the alternative shutdown capability shall be independent of the specific fire area(s) and shall accommodate postfire conditions where offsite power is available and where offsite power is not available for 72 hours. Procedures shall be in effect to implement this capability.

4. If the capability to achieve and maintain cold shutdown will not be available because of fire damage, the equipment and systems comprising the means to achieve and maintain the hot standby or hot shutdown condition shall be capable of maintaining such conditions until cold shutdown can be achieved. If such equipment and systems will not be capable of being powered by both onsite and offsite electric power systems because of fire damage, an independent onsite power system shall be provided. The number of operating shift personnel, exclusive of fire brigade members, required to operate such equipment and systems shall be onsite at all times.

5. Equipment and systems comprising the means to achieve and maintain cold shutdown conditions shall not be damaged by fire; or the fire damage to such equipment and systems shall be limited so that the systems can be made operable and cold shutdown achieved within 72 hours. Materials for such repairs shall be readily available onsite and procedures shall be in effect to implement such repairs. If such equipment and systems used before 72 hours after the fire will not be capable of being powered by both onsite and offsite electrical power systems because of fire damage, an independent onsite power system shall be provided. Equipment and systems used after 72 hours may be powered by offsite power only.

6. Shutdown systems installed to ensure postfire shutdown capability need not be designed to meet Seismic Category I criteria, except where required for other reasons, e.g., because of interface with or impact on existing safety systems, or because of adverse valve actions due to fire damage.

7. The safe shutdown equipment and systems for each fire area shall be known to be isolated from associated nonsafety circuits in the fire area so that hot shorts, open circuits, or shorts to ground in the associated circuits will not prevent operation of the safe shutdown equipment. The separation and barriers between trays and conduits containing associated circuits of one safe shutdown division and trays and conduits containing associated circuits or safe shutdown cables from the redundant division, or the isolation of these associated circuits from the safe shutdown equipment, shall be such that a postulated fire involving associated circuits will not prevent safe shutdown[5].

RIVER BEND STATION POSITION

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Methods for safe shutdown (evaluated in the Fire Hazards Analysis in Section 9A.2 of the USAR) consist mostly of Division I or Division II equipment and power. In the event of a fire at least one train remains free of fire damage to achieve safe shutdown. In a few cases, the fire damage is limited so that the system can be repaired and cold shutdown achieved within 72 hr. The necessary materials for these repairs are maintained onsite in a separate fire area and procedures are in effect to implement these repairs.

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[5] An acceptable method of complying with this alternative would be to meet Regulatory Guide 1.75 position 4 related to associated circuits and IEEE Std 384-1974 (Section 4.5) where trays from redundant safety divisions are so protected that postulated fires affect trays from only one safety division.

Dedicated shutdown capability, as defined by Footnote 2 of 10CFR50, Appendix R, is not used at River Bend Station.

9B.4.13 Fire Barrier Cable Penetration Seal Qualification (Item III.M of Appendix R)

Penetration seal designs shall utilize only noncombustible materials and shall be qualified by tests that are comparable to tests used to rate fire barriers. The acceptance criteria for the test shall include:

1. The cable fire barrier penetration seal has withstood the fire endurance test without passage of flame or ignition of cables on the unexposed side for a period of time equivalent to the fire resistance rating required of the barrier.

2. The temperature levels recorded for the unexposed side are analyzed and demonstrate that the maximum temperature is sufficiently below the cable insulation ignition temperature.

3. The fire barrier penetration seal remains intact and does not allow projection of water beyond the unexposed surface during the hose stream test.

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Fire barrier cable penetration seals utilize materials qualified by test. Some of these materials may be of limited combustibility (e.g., silicone foams). The acceptance criteria for fire test include:

1. Fire shall not propagate to the unexposed side of the test assembly nor shall any visible flame be observed.

2. No individual thermocouple of the exposed surface of the fire stop shall exceed 325°F above ambient temperature.

3. No opening develops that permits a projection of water from the stream beyond the unexposed surface during the hose stream t test.

9B.4.14 Fire Doors (Item III.N of Appendix R)

Fire doors shall be self-closing or provided with closing mechanisms and shall be inspected semiannually to verify that automatic hold-open, release, and closing mechanisms and latches are operable.

One of the following measures shall be used to ensure protection of the opening as required in case of fire:

1. Fire doors shall be kept closed and electrically supervised at a continuously manned location.

2. Fire doors shall be locked and inspected weekly to verify that the doors are in the closed position.

3. Fire doors shall be provided with automatic hold-open and release mechanisms and inspected daily to verify that doorways are free of obstructions.

4. Fire doors shall be kept closed and inspected daily to verify that they are in the closed position.

The fire brigade leader shall have ready access to keys for any locked fire doors.

Areas protected by automatic total flooding gas suppression systems shall have electrically supervised self-closing fire doors or shall satisfy option 1 above.

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Fire doors are self closing and kept in the closed position except for: (a) security doors which are kept closed (locked from the outside but may be manually opened from the inside) and electrically supervised; and (b) fire doors AB-095-08, and AB-095-09 are kept open in order to relieve high pressure in the event of pipe ruptures. Fire door AB095-14 is kept open for personnel safety access through its vertical ladder opening. Fire doors C-070-25, C-098-31, and C-098-32 are kept open for ventilation reasons. However, these doors are provided with fusible link so that in the event of fire the doors will close. Fusible links are provided as automatic hold open and release mechanisms in accordance with NFPA-80. These doors are inspected daily for clear travel (i.e., no obstruction to closing).

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Self-closing doors are inspected semiannually to verify that automatic closing mechanisms and latches are operable. Fire doors are kept closed and inspected daily to verify that they are in the closed position. The fire brigade leader has ready access to keys for any locked fire doors. Areas protected by automatic gas suppression systems (Halon 1301) have electrically supervised, self-closing fire doors.

9B.4.15 Oil Collection System for Reactor Coolant Pump (Item III.O of Appendix R)

The reactor coolant pump shall be equipped with an oil collection system if the containment is not inerted during normal operation. The oil collection system shall be so designed, engineered, and installed that failure will not lead to fire during normal or design basis accident conditions and there is reasonable assurance that the system will withstand the Safe Shutdown Earthquake[6].

Collection systems shall be capable of collecting lube oil from all potential pressurized and unpressurized leakage sites in the reactor coolant pump lube oil systems. Leakage shall be collected and drained to a vented closed container that can hold the entire lube oil system inventory. A flame arrester is required in the vent if the flash point characteristics of the oil present the hazard of fire flashback. Leakage points to be protected shall include lift pump and piping, overflow lines, lube oil cooler, oil fill and drain lines and plugs, flanged connections on oil lines, and lube oil reservoirs where such features exist on the reactor coolant pumps. The drain line shall be large enough to accommodate the largest potential oil leak.

RIVER BEND STATION POSITION

Oil collection systems for the two reactor recirculating pumps are not provided for the following reasons:

1. There is limited amount of oil with a relatively high flash point (minimum 400°F). Oil is contained within two internal reservoirs (one serving the lower radial bearing and one serving the upper radial bearing and thrust bearing) and two supplemental external oilers. The internal reservoirs are 7.5 gal and 46.25 gal respectively, each having a fill connection fundamentally similar to that on an automobile, but fitted with threaded caps. Two 1-gallon supplemental external oilers are attached to the lower reservoir. There are no pressurized oil lines external to the casing of the motor. Since the units are located within the drywell, filling is only done when the plant is shut down and the pump stopped. Also each reservoir contains a low oil level monitor which alarms in the control room if for any reason the oil level drops below a predetermined level.

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[6] See Regulatory Guide 1.29 "Seismic Design Classification," paragraph C.2.

2. Each oil reservoir contains a cooling system supplied from the reactor plant component cooling water system. Although also considered remote, there exists a potential for a leak in the pressurzied water line within a reservoir. In such an event, an oil-water mixture would pass through the reservoir vent line discharging at and around the unit. Some internal leakage would also occur within the unit casing, but would be minimal compared to that passing through the vent line. It is unlikely that this oil-water mixture would ignite. There is a high level monitor in each reservoir which alarms in the control room to warn of this condition.

3. Collecting a potential oil leak in a pan or other holding container beneath the pump assembly would not appreciably reduce exposure to the assembly since it could be assumed that the oil had been ignited at or near the point of leakage and therefore involved the pump in a three-dimensional flowing combustible liquid fire.

4. Although spilling of oil on the floor is not expected, in case of an unforeseen accident, oil (more probably an oil-water mixture) will be drained through the 4-inch floor drain located approximately 5 feet away from the pump. It will then be collected in a sump located at least 20 feet away from the pump. The sump capacity is 650 gal, and is provided with two pumps, each with a 50 gpm discharge capacity. The pumps in the sump will discharge oil to the liquid radwaste system.

5. Reactor recirculating pumps are widely separated and are not required for shutdown of the plant.

6. In the worst case, fire would only affect snubbers, supports, MOVs for WCS, associated cables, and sump pumps. These are not required for shutdown of the plant.