CHAPTER 9 - AUXILIARY SYSTEMS

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

TABLE OF CONTENTS (Cont'd)

CHAPTER 9 - AUXILIARY SYSTEMS

LIST OF TABLES

LIST OF TABLES (cont'd)

LIST OF TABLES (cont'd)

LIST OF TABLES (cont'd)

LIST OF TABLES (cont'd)

CHAPTER 9 - AUXILIARY SYSTEMS

LIST OF FIGURES

LIST OF FIGURES (cont'd)

LIST OF FIGURES (cont'd)

LIST OF FIGURES (cont'd)

LIST OF FIGURES (cont'd)

CHAPTER 9 - AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

The fuel storage and handling facilities provide safe and effective means of storage, cooling, transportation, and handling of nuclear fuel from the time it reaches the plant in a non-irradiated condition until it leaves the plant after post-irradiation cooling. These systems have no function related to the safe shutdown of the plant.

Additional spent fuel storage is provided on site and within the plant protected area boundary by an Independent Spent Fuel Storage Installation (ISFSI) meeting the requirements of 10CFR72. Safety evaluations for the ISFSI are covered in a separate "10CFR72.212" document, and are therefore not detailed here. It is noted that existing UFSAR Section 9.1.4 and 9.1.5 references to a "cask" are actually referring to the shipping cask referred to above for the function to "leaves the plant after post-irradiation cooling." Minor differences for the ISFSI "transfer cask" (TC) handling, such as cask positioning for preparations for loading and post-loading decontamination, lids placement and sealing, are not covered herein.

9.1.1 NEW FUEL STORAGE

The new fuel is brought onsite prior to a scheduled refueling and is inspected and then stored in the spent fuel racks, which are located in the refueling area in the spent fuel pool (drawings M-122 and M-137).

9.1.1.1 Design Bases

New fuel is stored in the spent fuel pool. The design bases are discussed in Section 9.1.2.1.

9.1.1.2 Facility Description

The new fuel is stored in the spent fuel storage racks. The facility description is discussed in Section 9.1.2.2. Section 9.1.4 describes receipt inspection and handling of new fuel within the reactor enclosure.

9.1.1.3 Safety Evaluation

New fuel is stored in the spent fuel pool. Storage of new fuel bundles in the storage vault is prohibited by existing fuel handling procedures that require new fuel to be stored in the spent fuel pool. The safety evaluation is discussed in Section 9.1.2.3.

9.1.2 SPENT FUEL STORAGE

The spent fuel storage facility provides specially designed underwater storage space for the new and spent fuel assemblies. The facility is located in the refueling area and is shown in drawings M-122 and M-137. Prior to each refueling, new fuel is brought onsite, inspected, and stored in the spent fuel storage racks.

9.1.2.1 Design Bases

The following design bases for the spent fuel storage facilities are discussed in the indicated sections:

a.	Seismic and quality group classification	Section 3.2
b.	Protection from wind and tornado effects	Section 3.3
c.	Flood design	Section 3.4
d.	Missile protection	Section 3.5
e.	Protection against dynamic effects associated with postulated rupture of piping	Section 3.6
f.	Seismic design	Section 3.7
g.	Environmental design	Section 3.11
h.	Fire protection	Section 9.5.1

In addition to the design bases listed above, the following design bases and codes and standards are applicable to the spent fuel storage facilities:

a. The spent and new fuel storage facility is designed to store fuel assemblies so that a k_{eff} less than or equal to 0.95 is maintained, assuming that the fuel storage racks are fully loaded with fuel of the highest anticipated enrichment and flooded with nonborated water, in compliance with GDC 62. This is achieved through use of a neutron poisoning material (Boral) sandwiched in the racks between adjoining fuel assemblies to ensure subcriticality by at least 5% Δk under all conditions. The presence of Boral is verified by receipt and inservice testing.

b. The spent fuel storage facility and all piping connections are designed to prevent a loss of cooling water from the spent fuel pool that could uncover stored fuel.

c. The spent fuel storage facility is designed to remain functional following an SSE.

d. Failures of systems or structures not designed to seismic Category I standards and located in the vicinity of the spent fuel storage facility do not cause a decrease in the subcriticality provided.

e. The design of the spent fuel storage racks is such that a fuel assembly can be inserted into any designated rack storage location.

f. The spent fuel storage facility is designed to prevent accidental criticality of stored fuel under adverse environmental and postulated fuel handling accident conditions.

g. The spent fuel pool is designed to withstand thermal- stresses resulting from the pool water boiling.

h. The spent fuel pool is designed to accommodate the storage of approximately 539% of the total number of fuel assemblies in the reactor core. (Placement of the storage racks which contain control rod blades and/or defective fuel assemblies in the fuel pool could limit fuel storage capability to approximately 513%.) Storage capacity is dependent on rack installation.

i. Shielding for the stored spent fuel assemblies is designed to protect plant personnel from exposure to direct radiation greater than that permitted for continuous occupational exposure during normal operations.

j. Applicable codes and standards are provided in Table 9.1-21.

9.1.2.2 Facility Description

9.1.2.2.1 General Description

The spent fuel storage facility consists of the spent fuel pool, containing spent fuel storage racks, and serves as the storage area for irradiated fuel assemblies. The spent fuel pool and the adjacent reactor well, dryer/separator pool, and cask loading pit are located in the refueling area as shown in drawings M-122 and M-137. Figure 9.1-34 shows the initial layout of the Unit 1 fuel storage pool with a storage capacity of 3665 fuel assemblies (3714 fuel assemblies including the control rod blade/defective fuel storage rack). Figure 9.1-36 shows the initial layout of the Unit 2 fuel storage pool with a storage capacity of 3921 fuel assemblies (3970 fuel assemblies including the control rod blade/defective fuel storage rack). Figures 9.1-35 and 9.1-37 depict the potential maximum capacity layout for Unit 1 and Unit 2 (respectively) with a fuel storage capacity equal to the maximum licensed capacity of 4117 fuel assemblies. Cooling and cleanup of the spent fuel pool water is discussed in Section 9.1.3. Fuel handling systems are discussed in Section 9.1.4. The reactor enclosure crane is discussed in Section 9.1.5.

9.1.2.2.2 Component Description

9.1.2.2.2.1 Spent Fuel Pool

The spent fuel pool is a post-tensioned, reinforced concrete structure that forms an integral part of the reactor enclosure. The pool has a volume of approximately 46,000 ft^3 and is filled with demineralized water to a normal depth of 38'-3". This provides about 23 feet of water above the tops of the stored fuel assemblies.

The spent fuel pool is lined with stainless steel plate (Table 9.1-14) to minimize leakage and reduce corrosion product formation. A leakage collection system is provided to permit expedient detection of leaks through the stainless steel liner plate and to prevent the uncontrolled loss of pool water to areas below the pool. Drainage paths, designed to permit free gravity flow, are formed by welding channels behind the pool wall liner welded joints and by two trench monitoring systems embedded in the floor slab below the floor liner. The design of a typical drainage system is shown in Figure 9.1-40. Pool leakage is routed through a piping system, provided at the base of the pool wall, one of three dirty radwaste funnels as shown in drawing M-53. Leakage from each of seven segments of the leak collection system is routed through separate piping to enable identification of the area of the liner that is leaking.

Leakage is detected by observation of water flowing out of the piping into the dirty radwaste funnel (drawing M-53) or by low level indication in the skimmer surge tank or the spent fuel pool (drawing M-53). Flow into the funnels is observed during periodic operator inspections. Skimmer surge tank low level alarms and trips are described in Section 9.1.3.5.

9.1.2.2.2.2 Spent Fuel Storage Racks

The Unit 1 and Unit 2 spent fuel pools are licensed for a maximum fuel storage capacity of 4117 fuel assemblies each. Analyses were performed prior to the installation of maximum density fuel storage racks for the Unit 2 spent fuel pool. All analyses performed for the Unit 2 spent fuel pool are bounding for the Unit 1 spent fuel pool design and installation.

The high density fuel storage racks are installed in the Unit 1 spent fuel storage pool in such a manner as to ensure that there is a Boral plate between each adjoining fuel storage position. Each storage module is level with each other module at the top. There are 7.25 inches of clearance from the bottom of the module to the pool floor. This ensures adequate clearance for cooling water to enter each fuel cell and, through natural convection, keep each fuel assembly adequately cooled.

The maximum density spent fuel storage racks are modular, freestanding, top entry racks designed to maintain the spent (and new) fuel in a space geometry whereby each fuel assembly has a neutron poisoning material between it and any adjoining fuel assemblies. This precludes the possibility of criticality under normal and abnormal conditions. The only point of contact of the maximum density spent fuel storage rack is with the bottom liner plate.

The maximum density spent fuel storage racks (Figure 9.1-41) consists of five basic structural components: the storage box subassembly, the baseplate, the neutron poison material, the picture frame sheathing, and the support legs. The storage box subassemblies (Figure 9.1-41) are fabricated from two precision formed stainless steel channels by seam welding. Each storage box subassembly has two lateral holes punched near the bottom edge to provide an auxiliary flow path. The stainless steel picture frame sheathing is attached to each side of a storage box subassembly by welds. The picture frame sheathing serves as the locator and retainer of the neutron poison material. A storage cell box subassembly, with picture frame sheathing and neutron poison material on all four sides is referred to as a composite box. The composite boxes are arranged in a checkerboard array and welded corner to corner to form an assemblage of storage cell locations (Figure 9.1-41). This assemblage is welded to the baseplate. The baseplate is 3/4 inches thick and provides a continuous horizontal surface for supporting the fuel assemblies. The baseplate has a concentric hole with a 45° taper in each storage cell location to provide a seating surface conforming to the fuel assembly. Adjustable support legs are welded to each corner of the baseplate. Each adjustment support leg is provided with a socket to enable remote leveling of the maximum density spent fuel storage rack after its placement in the fuel pool.

There are various sizes of maximum density spent fuel storage racks (Figures 9.1-35 through 9.1-37 and Table 9.1-23). The nominal center-to-center spacing between fuel assemblies in a maximum density spent fuel storage rack is 6.244 inches.

The neutron poison material used in the maximum density spent fuel storage racks is Boral. Boral is a thermal neutron poison material composed of boron carbide and 1100 alloy aluminum. The Boral is in plate form and is located and retained by the picture frame sheathing (Figure 9.1-41). The sheathed volumes which contain the Boral plates are vented.

The maximum density fuel storage racks are installed in the spent fuel storage pool in such a manner as to ensure that there is a Boral plate between each adjoining fuel storage position. Each maximum density spent fuel storage rack is level with each other rack at the top. There is a clearance of approximately 7.00 inches between the bottom of the rack and the fuel pool floor liner. This ensures adequate clearance for cooling water to enter each fuel storage cell.

All materials used for construction are specified in accordance with the issue of the ASTM specifications. Traceability of major rack components to a heat lot are maintained. In addition, the suppliers' quality assurance/ quality control program was audited by the manufacturer and user to ensure that the Boral has the required minimum B_4C density and uniform B_4C distribution in each sheet. Boral traceability is maintained.

A dimensional, visual, and functional (including testing with a dummy fuel assembly) inspection of the racks is performed prior to shipment by the rack manufacturer.

The rack materials will have no significant degradation due to the total radiation doses expected in the spent fuel pool over the design life.

The racks are designed to withstand the loading under the following loading conditions: dead, live, jammed fuel assembly, dropped fuel assembly, thermal, OBE and design basis event seismic, SRV, and LOCA or chugging.

An ISI program will be in effect throughout the period in which spent fuel is stored in the spent fuel pool to ensure that the quality of the poisoned racks is maintained (Section 9.1.2.4).

9.1.2.2.2.3 Refueling Area Cavities

As shown in drawing M-122 and M-137, adjacent to the spent fuel pool, but on opposite sides of it, are the cask loading pit and the reactor well. Adjacent to the reactor well is the dryer/separator pool. The cask loading pit is common to the two reactor units. Like the spent fuel pool, these cavities are lined with stainless steel plate and are provided with liner leakage collection systems. The reactor well and the cask loading pit are connected to the spent fuel pool by fuel transfer canals approximately 4 feet wide. Each canal is provided with two gates to prevent loss of water from the spent fuel pool during periods when the adjacent cavity is not filled with water.

The cask loading pit is used for Low Level Radwaste (LLW) storage. In the cask loading pit free standing storage racks containing Storage Containers (SCs). The rack compartments hold LLW including control rod blades (CABs), fuel channels in sheaths, LPRM strings, velocity limiters, filters, stellite ball bearing and other small components. During LLW processing, processing equipment will be placed in the cask loading pit or on the Refuel Floor. The equipment can be removed when not in use. Equipment includes Activated Services Compactor (ASC) and Control Rod Blade Compactor (CABC), grapple, shear and punching tools, and supporting equipment. All LLW components are classified as non-safety related and Seismic II/I components. Because of the LLW stored in the cask loading pit, it must remain full at all times.

The cask loading pit is designed to permit the underwater loading of spent fuel assemblies into ISFSI transfer cask and/or spent fuel shipping casks. Decontamination of the spent fuel shipping and/or ISFSI transfer cask can be performed on the refueling floor adjacent to the cask loading pit. Cross connecting the Unit 1 and 2 spent fuel pools

(SFPs) through the cask loading pit allows the transfer of spent fuel and equipment from one Unit's Spent Fuel Pit to the other unit's SFP. Prior to transferring fuel or equipment, adequate spent fuel pool cooling capacity must be verified.

The reactor well is a basically circular cavity located directly above the primary containment. Removal of the drywell head and reactor vessel head provides direct access from the reactor well to the inside of the reactor vessel. The reactor well is filled with water during transfer of fuel assemblies between the well and the spent fuel pool. Seals are provided at the bottom of the reactor well between the drywell and reactor well wall and a refueling bellows is provided between the reactor vessel and containment seal plate to prevent leakage of water out of the well.

The dryer/separator pool provides a place for storage of the steam dryer and steam separator when these two reactor components are removed from the reactor vessel. The dryer/separator pool is connected to the reactor well to permit underwater transfer of components between the two cavities. Seal plugs are provided to prevent loss of water during periods when the adjacent cavity is not filled with water.

9.1.2.2.2.4 Other Features

The ventilation system for the refueling floor area is designed to minimize potential offsite exposures if there is a significant release of radioactivity from the spent fuel storage facility. The ventilation system for the refueling floor area is discussed in Section 9.4.2.

The area radiation monitoring equipment for the spent fuel storage facility is described in Section 12.3.4.

9.1.2.3 Safety Evaluation

The subcriticality of the fuel assemblies stored in the spent fuel storage racks is the result of the geometrical arrangement of the fuel array and the presence of neutron-absorbing materials. The arrangement of the fuel assemblies in the spent fuel storage racks results in k_{eff} less than or equal to 0.95, assuming that the spent fuel storage racks are fully loaded with fuel of the highest anticipated enrichment. This is discussed in Section 9.1.2.3.1.

The design is in conformance with Regulatory Guide 1.13.

The bottoms of the fuel transfer canals between the spent fuel pool and the reactor well and between the spent fuel pool and cask loading pit are above the top of the stored spent fuel, thus ensuring that failure of the gates in these canals cannot result in the uncovering of the fuel.

To ensure that the spent fuel pool water level is not lowered by a malfunction of the fuel pool cooling and cleanup system, the system takes suction from the pool near the normal water level via the skimmer surge tanks. The system return lines enter the spent fuel pool from above the normal water level and are provided with siphon breaker holes near the normal water level to preclude the possibility of siphoning the pool.

The spent fuel storage facility is designed in accordance with seismic Category I requirements as specified in Section 3.2. The components (and supporting structures) of any system, equipment, or structure that is not seismic Category I and whose collapse could result in loss of a required

function of the spent fuel storage facility are analytically checked to determine that they will not collapse when subjected to seismic loading resulting from the SSE.

All spent fuel pool gates and liners are seismic Category I.

Liner leakage detection system piping, the fuel pool cooling and cleanup system piping, and the wave suppression scupper piping are all seismic Category IIA. The only other piping attached to or in the spent fuel pool is from the RHR and ESW systems for backup cooling and makeup. This piping is seismic Category I.

Loss of any of the seismic Category IIA piping would not affect the ability to maintain spent fuel cooling or to maintain adequate submergence of the fuel.

Accidental dropping of movable heavy objects into the fuel pool is precluded by the use of administrative procedures, electrical interlocks to limit the load travel over the spent fuel pool, and the use of guardrails and curbs around all pools and the reactor wells to prevent fuel handling and servicing equipment from falling into the pools. The electrical interlocks and administrative procedures are described in Section 9.1.4. In addition, heavy load handling in the vicinity of the fuel pools is in compliance with NUREG-0612 guidelines such that the likelihood of a heavy load drop is precluded.

The design of the spent fuel pool provides enough reinforcement in the concrete to withstand the thermal-stresses resulting from pool boiling.

The maximum density spent fuel storate rack is capable of withstanding a force of 4000 pounds in any direction at the top of the rack without any permanent deformation of the fuel cell in the active fuel region.

The auxiliary hoist of the reactor enclosure crane has a maximum uplift force in excess of 4000 pounds. The auxiliary hoist does not handle new fuel above, or in the fuel pool, except to transfer new fuel to the fuel prep machines. Other fuel handling operations are performed by the hoists on the refueling platform which have an uplift (controlled) limit of 1200 pounds or less.

If there is a stuck fuel assembly, the lifting bail yields at an uplift force greater than 1500 pounds; therefore, possible damage to the racks is precluded even if the 1200 pound control limit is not considered.

9.1.2.3.1 Criticality Control

9.1.2.3.1.1 Basic Assumptions of Criticality Analysis

The spent fuel storage facility is designed to prevent accidental criticality of stored fuel under adverse environmental and postulated fuel handling accident conditions. The geometry of the spent fuel storage array is such that K_{eff} will be ≤0.95. Studies were performed which establish fuel storage compliance limits consistent with K_{eff} ≤0.95 for the Maximum Density racks (Reference 9.1-9). All General Electric supplied fuel shall comply with the fuel storage reactivity criteria in Reference 9.1-7 (GESTAR-II), which conservatively bounds the rack designs analyzed in Reference 9.1-9. Additional studies for fuel designs not covered under GESTAR-II are listed as references in Section 9.1.6. To ensure that the design criteria are met, the following normal and abnormal spent fuel storage conditions were analyzed:

a. Normal positioning in the spent fuel storage array

b. Pool water temperature increases to 212°F

c. Abnormal positioning in the spent fuel storage array

d. Dropped fuel bundle adjacent to storage area

e. Dropped fuel bundle on top of and through fuel storage racks.

Transport to Diffusion Correction	= 0.917 - 0.898 - 0.001
	= 0.018

This result should be applied to the adjusted PDQ k_{eff}

c. Summary of Results:

k_{eff} (PDQ) adjusted	0.915
Transport to Diffusion Correction, PDQ-KENO	0.018
Final k_{eff} (upper bound, 95% confidence)	0.933
Design Limit, k_{eff}	0.950

The final k_{eff} value (0.933) includes all the design specification tolerances, the postulation of a dropped fuel assembly, the model bias, and the 95% confidence interval from the KENO calculations. However, the negative reactivity effect (approximately -0.005 Δk) due to the presence of U-234 and the parasitic structure materials (i.e. spacer grids) in each assembly, and the positive reactivity effect (0.006 Δk) due to the possible absence of a Boral plate are not included.

9.1.2.3.1.2.1 Assumptions of Criticality Analysis - Maximum Density Spent Fuel Storage Racks

To ensure the analysis followed a conservative approach and conformed to the general guidelines of criticality safety analysis, the calculations were performed using the following criteria:

1) The racks are assumed to contain the most reactive fuel authorized to be stored.

2) Moderator is pure, unborated water at a temperature corresponding to the highest reactivity (4°C, 39.2°F)

3) Criticality safety analyses are based upon the k_{eff} of an infinite array of storage cells, ie, no credit is taken for neutron leakage (except as necessary in the assessment of abnormal/accident conditions)

4) Neutron absorption in minor structural member is neglected, ie, spacer grids are replaced by water.

9.1.2.3.1.2.2 Calculational Models - Maximum Density Spent Fuel Storage Racks

Criticality analyses of the maximum density spent fuel storage racks were performed using both the CASMO-3 code (a two-dimensional multi-group transport theory code) and the KENO-5a code (a Monte Carlo code), using the 27-group SCALE cross-section library with NITAWL subroutine for U-238 resonance shielding effects (Nordheim integral treatment). SCALE is an acronym for the Standardized Computer Analysis for Licensing Evaluation, which is a standard cross-section set developed by the Oak Ridge National Laboratory for the USNRC.CASMO-3 was also used as a means of evaluating small reactivity increments associated with manufacturing tolerances. Benchmark calculations indicated a bias of 0.0000 $\pm$0.0024 for CASMO-3 and 0.0101 $\pm$0.0018 (95% confidence) for NITAWL-KENO-5a.

In the geometric model used in the calculations, each fuel rod and its cladding was described explicitly and reflecting boundary conditions (zero neutron current) were used in the axial direction and at the centerline of the Boral and stainless steel plates between storage cells. These boundary conditions have the effect of creating an infinite array of storage cells in the X and Y directions.

Since the cross section library in NITAWL is not valid below 20°C, a small correction factor (0.0026 δk, determined by CASMO-3) to 4°C was applied to the NITAWL-KENO-5a calculations.

9.1.2.3.1.2.3 Reference Case Calculations - Maximum Density Spent Fuel Storage Racks

a. Physical Parameters and Basic Storage Cell Geometry

The design basis storage rack cell consists of an egg-crate structure (Figure 9.1-41) with fixed neutron absorber material (Boral) of 0.0200 g/cm^2 boron-10 areal density (0.0185g/cm^2 boron-10 minimum) positioned between the fuel assembly storage cells. The storage cell design for analysis is based upon a nominal center-to-center lattice spacing of 6.244 inches. The 0.075 inch thick stainless steel box which defines the fuel assembly storage cell has a nominal inside dimension of 6.05 inches. This allows adequate clearance for inserting or removing the fuel assemblies, with or without the Zircaloy channel. Boral plates are not needed or used on the exterior walls of racks facing non-fueled regions, ie, the fuel pool walls. Manufacturing tolerances, used in evaluating uncertainties in reactivity, are listed in Table 9.1-26.

Along the outer periphery of racks facing another rack, the Boral is 4.70 inches wide rather than 5.0 inches wide. This small reduction in width is compensated by the water-gap between racks and by the thickness of the stainless steel. Therefore, the reactivity consequences of the slightly reduced Boral width in these locations are negligible.

b. Results of the Design Basis Case Calculations

Using the input data from Table 9.1-24 and Figure 9.1-42, the k_{eff} values of the design basis case at 4°C were calculated. The maximum reactivity calculated by the CASMO-3 code is 0.9444. The maximum reactivity calculated by the NITAWL-KENO-5a code is 0.9412.

c. Fuel Effect

Because the racks must be able to store various fuel types additional fuel types were evaluated using the data from Table 9.1-24. The results are summarized in Table 9.1-27.

9.1.2.3.1.2.4 Sensitivity and Tolerance Reactivity Calculations - Maximum Density Spent Fuel Storage Racks

a. Temperature Effect

Using the design basis storage rack geometry, the temperature of the fuel pool water was varied. The results are given in Table 9.1-25.

b. Void Effect

The effect of boiling was studied by varying the voids from 0% to 20% at a temperature of 252°F with the reference geometry. The results are given in Table 9.1-25. As indicated, k_{eff} decreases continuously as the void fraction increases. Boiling at the submerged depth of the racks would occur at approximately 250°F.

c. Effect of Boron Loading Variation

The Boral Absorber plates used in the storage cells are nominally 0.075 inches thick. With a boron-10 areal density of 0.0200 g/cgm^2. The manufacturing tolerance limit is ±0.0015 g/cm^2 in the boron-10 loading, which assures that the minimum boron-10 areal density will not be less than 0.0185 g/cm^2. Differential CASMO-3 calculations indicate that this tolerance limit results in an incremental reactivity uncertainty of ±0.0051 δk (Table 9.1-26).

d. Effects of Boral Width Tolerance Variation

The reference storage cell design uses a Boral plate width of 5.00 ±1/16 inches. For a reduction in width of the maximum tolerance, the calculated positive reactivity increment is +0.0018 δk (Table 9.1-26).

e. Effect of Storage Cell Lattice Pitch Variation

The design storage cell lattice spacing between fuel assemblies is 6.244 inches. For the manufacturing tolerance of ±0.040 inches, the corresponding uncertainty in reactivity is ±0.0027 δk as determined by the CASMO-3 code (Table 9.1-26).

f. Effect of Stainless Steel Thickness Tolerance

The nominal thickness of the stainless steel box and the stainless steel picture frame sheathing are 0.075 and 0.035 inches respectively. The maximum positive reactivity effect for a mean stainless steel thickness tolerance of ±0.008 inches is ±0.0004 δk as determined by the CASMO-3 code (Table 9.1-26).

g. Effect of Fuel Enrichment and Density Variation

The nominal design enrichment is 3.50 wt% U-235. CASMO-3 calculations of the sensitivity to an enrichment variation of ±0.05 wt% U-235 yielded an uncertainty in reactivity of 0.0033 δk.

The design basis calculation assumed a UO_2 stack density 95% theoretical density, corresponding to a density of 10.42 g/cm^3 . Calculations were also made to determine the sensitivity to a conservative tolerance in UO_2 fuel density of ±0.20 g/cm^3 in density or a maximum density of 10.62 g/cm^3. These calculations indicate that the storage rack k_∞ is increased by 0.0026 δk (Table 9.1-26). A lower fuel density would result in a correspondingly lower value of reactivity.

h. Effects of Zirconium Flow Channel

The design basis calculations assumed the presence of a flow channel. Elimination of the zirconium flow channel results in a decrease in reactivity of approximately 0.008 δk.

i. Effects of Water Gap Spacing Between Racks

For normal storage conditions with a water gap between racks, the array k_{eff} of a rack would be less than the reference design k_∞ and Boral plates along the wall of the racks facing the water gap would not be necessary. However, as an additional and precautionary measure, rack design provides for Boral plates on storage cells on one of the two rack walls along the water gap. With this conservative configuration, the design assures that, even under abnormal or accident conditions. the storage rack reactivity will remain less than the 0.95 k_{eff} regulatory limit.

9.1.2.3.1.2.5 Special Cases - Maximum Density Spent Fuel Storage Racks

a. Abnormal Location of a Fuel Assembly

It is theoretically possible to suspend a fuel assembly of the highest allowable reactivity outside and adjacent to the spent fuel storage rack. Neutron leakage, inherent along the rack edge, significantly reduces the reactivity consequences of an extraneous fuel assembly. Three dimensional KENO-5a calculations show that the k_{eff}, with an assembly outside of and adjacent to a rack, is less than the design basis k_∞ of an infinite radial array. Thus, the abnormal location of a fuel assembly will have a negligible reactivity effect.

b. Eccentric Fuel Assembly Positioning

The fuel assembly is normally located in the center of the storage rack cell with the bottom fittings and spacers that mechanically restrict lateral movement of the fuel assemblies. Nevertheless, calculations with the fuel assembly moved into the corner of the storage rack cell (four-assembly cluster at the closest approach), resulted in a substantial negative reactivity effect. Thus, the nominal case, with the fuel assembly positioned in the center of the storage cell, yields the maximum reactivity.

c. Dropped Fuel Assembly

For a drop of a fuel assembly on top of a rack, the fuel assembly will come to rest horizontally on top of the rack with a minimum separation distance from the fuel of more than 12 inches. A separation of 12 inches is sufficient to preclude neutron coupling (ie, an effectively infinite separation). Maximum expected deformation under seismic or accident conditions will not reduce the minimum

spacing between fuel assemblies to less than 12 inches. Consequently, fuel assembly drop accidents will not result in a significant increase in reactivity (<0.0001 δk) due to the separation distance.

d. Fuel Rack Lateral Movement

Normally, the individual racks in the spent fuel pool are separated by a water gap. Lateral motion of a rack, postulated as a consequence of the design basis earthquake, could reduce or eliminate this water gap. Since the exterior walls of one of the racks along the water gap contains a Boral plate, closing the gap would not result in any increase above the design basis reactivity.

9.1.2.3.1.2.6 Summary and Conclusion - Maximum Density spent Fuel Storage Racks

For the design basis reactivity calculations with uniform enrichment of 3.50 wt%, the nominal storage cell infinite multiplication factor, k_∞, is 0.9366 (CASMO-3 code). With a δk of 0.0078 for all known uncertainties statistically combined, the maximum k_∞ in the fuel rack is 0.944 which is below the design basis limit of 0.95 for k_{eff}. Independent calculations with NITAWL-KENO-5a (1,250,000 histories in 2500 generations) gave a k_∞ (including all uncertainties) of 0.9335 $\pm$0.0077 (95% confidence, maximum k of 0.941) which is in good agreement with the CASMO-3 calculations (Table 9.1-28).

9.1.2.3.2 Structural Analyses

9.1.2.3.2.6 Bases For Analyses - Maximum Density Spent Fuel Storage Rack

The maximum density spent fuel storage racks are seismic Category I equipment as defined in Regulatory Guide 1.13. These racks are designed to withstand the effects of a design basis earthquake and remain functional, in accordance with Regulatory Guide 1.29 and 10CFR50.

The physical properties for the materials used in the manufacture of the maximum density spent fuel storage racks are given in Table 9.1-29. The load combinations and allowable stresses for the maximum density spent fuel storage racks are given in Table 9.1-30.

The structure of the racks is designed to remain functional (although some permanent deformation may occur) and to maintain the required spacing between stored fuel assemblies in the event of impact of a "heavy fuel assembly (consolidated fuel assembly)" (1360 pounds) dropped on the rack from a height of 36 inches. In this case, local plastic deformation is allowed at the point of impact. The structure of the racks is also analyzed for effects of the impact of the fuel bundle dropped through an empty storage cavity. Local failure of the baseplate is acceptable, a gross structural failure is not permissible. A comparative analysis with impact conditions, as stated above, is also

conducted on a rack due to an uplift force of 4000 pounds on a stuck fuel bundle. No permanent deformation of the fuel cell in the active fuel region is allowed in this case. A force of 4000 pounds is well in excess of the maximum (controlled) uplift force from the refueling platform main hoist of 1200 pounds.

9.1.2.3.2.7 Seismic Analyses - Maximum Density Spent Fuel Storage Rack

A combination of time history and static seismic analysis was performed for the maximum density spent fuel storage racks by Holtec International. Rack dynamic simulations were performed using a 3-D single rack 22-degrees of freedom (DOF) model and a Whole Pool Multi-Rack (WPMR) model which considered all the racks in the pool.

a. 3-D 22-DOF Single Rack Model

The fuel rack motion is captured by modeling the rack as a twelve degree-of-freedom structure (Figures 9.1-43 through

9.1-45). Movement of the rack cross-section at any height is described by six degrees-of-freedom of the rack base and six degrees-of-freedom at the rack top. Rattling fuel assemblies within the rack are modeled by five lumped masses. Each lumped mass has two horizontal displacement degrees-of-freedom. Vertical motion of the fuel assembly mass is assumed to be equal to the rack vertical motion at the baseplate level. The centroid of each fuel assembly mass can be located off center, relative to the rack structure centroid at that level, to simulate a partially loaded rack.

Seismic motion of a rack is characterized by random rattling of the fuel assemblies in their individual storage locations. All fuel assemblies are assumed to move in-phase within a rack. This exaggerates computed dynamic loading on the rack structure and therefore yields conservative results.

Fluid coupling between the rack and fuel assemblies, and between the rack and the fuel pool wall, is simulated by appropriate inertial coupling in the system kinetic energy. Fluid coupling terms for rack-to-rack coupling are based on opposed-phase motion of adjacent modules.

Fluid damping and form drag is conservatively neglected. Sloshing is negligible at the top of the rack and is neglected in the analysis of the rack.

Potential impacts between rack and fuel assemblies are accounted for by appropriate "compression only" gap elements between the masses involved. The possible incidence of rack-to-wall or rack-to-rack impact is simulated by gap elements at the top and bottom of the rack in two horizontal directions. Bottom elements are located at the baseplate elevation.

Pedestals are modeled by gap elements in the vertical direction and as "rigid links" for transferring horizontal stress. Each pedestal support is linked to the fuel pool liner by two friction springs. Local pedestal spring stiffness accounts for floor elasticity and for local rack elasticity just above the pedestal.

Rattling of fuel assemblies inside the storage locations causes the gap between fuel assemblies and the cell wall to change from a maximum of twice the nominal gap to a theoretical zero gap. Fluid coupling coefficients are based on the nominal gap.

b. Whole Pool Multi-Rack (WPMR) Model

The single rack 3-D (22-DOF) model outlined in the preceding subsection is used to evaluate structural integrity physical stability, and to initially assess kinematic compliance of the rack modules. Prescribing the motion of the racks adjacent to the module being analyzed is an assumption in the single rack simulation. For closely spaced racks, demonstration of kinematic compliance is further confirmed by modeling all modules in one comprehensive simulation using a Whole Pool Multi-Rack (WPMR) model. In the WPMR analysis, all racks are modeled, and their correct fluid interaction is included in the model.

The presence of fluid moving in the narrow gaps between the racks and between the racks and the fuel pool walls causes both near and far field fluid coupling effects. A single rack simulation can effectively include only hydrodynamic effects due to contiguous racks when a certain set of assumptions is used for the motion of the contiguous racks. In a WPMR analysis, far field fluid coupling effects of all the racks are accounted for by using the correct model of pool fluid mechanics. The external hydrodynamic mass due to the presence of walls or adjacent racks is computed in a manner consistent with fundamental fluid mechanics principles using conservative nominal fluid gaps in the fuel pool at the beginning of the seismic event.

The friction coefficient is ascribed to the support pedestal/pool bearing pad interface is consistent with experimental data. Friction coefficients, developed by a random number generator with Guaussian normal distribution characteristics, are imposed on each pedestal of each rack in the pool. The assigned values are then held constant during the entire simulation in order to obtain reproducible results. Thus, the WPMR analysis can simulate the effect of different coefficients of frictions at adjacent rack pedestals.

In the WPMR analysis, a reduced degree-of-freedom (RDOF) set is used to model each rack plus contained fuel. The rack structure is modeled by six degrees-of-freedom. A portion of contained fuel assemblies is assumed to rattle at the top of the rack, while the remainder of the contained fuel is assumed as a distributed mass attached to the rack. The rattling portion of the contained fuel is modeled by two horizontal degrees-of-freedom.

Thus, the WPMR model involves all the racks in the spent fuel pool with each individual rack modeled as an eight degree-of-freedom structure. The rattling portion of the fuel mass, within each rack, is chosen to ensure comparable results from displacement predictions from the single rack analysis using a 22-DOF model and the 8-DOF analysis under the same conditions. Unit 1 spent fuel pool configuration is bounded by the Unit 2 analyses.

9.1.2.3.2.8 <u>Dropped Fuel Bundle Analysis - Maximum Density Spent Fuel Storage Rack</u>

Analysis were performed to evaluate the effects of a dropped fuel assembly. Two scenarios were evaluated, the deep drop and shallow drop.

In the deep drop scenario a "heavy fuel assembly (consolidated fuel assembly)" is postulated to drop from a height of 36 inches above the top of a storage location and impacts the baseplate of

the rack. While local failure of the baseplate is acceptable, a gross structural failure is not permissible. Also, the stored fuel array must remains subcritical. Results show that the spacing between cells is unaffected and the stored fuel array remains subcritical. Local baseplate deformation in the vicinity occurs, but the dropped fuel assembly does not impact the fuel pool liner. The impact results in a maximum baseplate movement toward the liner of less than 2.21 inches. The nominal baseplate height above the fuel pool liner is approximately 7.00 inches therefore, contact does not occur. If a fuel assembly drops through a cell located over a support leg, the impact load transmitted through the support leg to the fuel pool liner is less than the loads caused by a seismic event. Therefore, the concrete bearing pressures a calculated for the seismic event bound those due to a fuel drop accident.

In the shallow drop scenario a "heavy fuel assembly" is postulated to drop from a height of 36 inches above the top of the rack and impacts the top of the rack. Permanent deformation of the rack is acceptable, but it must be confined to the region above the top of the active fuel stored in the rack. The elevation of the top and bottom of active fuel must not be altered. Results show that the deformation caused by a dropped assembly will be less than or equal to 2.29 inches from the top of the rack. This region of deformation is less than the available cell length above the active fuel (over one foot). This load case bounds the scenario where the dropped fuel assembly rolls over after impact and impacts multiple locations.

9.1.2.3.2.9 Pool Interface Loads - Maximum Density Spent Fuel Storage Rack

The maximum density spent fuel storage load acting on the fuel pool were determined using the results of the 3-D 22-DOF model and the WPMR model described in Section 9.1.2.3.2.7. The results were determined to be acceptable and are summarized in Table 9.1-31.

9.1.2.3.2.10 Summary and Conclusions - Maximum Density Spent Fuel Storage Rack

The results of the structural analyses for the maximum density spent fuel storage racks are acceptable and summarized in Table 9.1-31.

9.1.2.3.3 Installation of New Maximum Density Racks

Racks are lifted individually from the refueling floor lay-down area and lowered into position in the pools using the 125 ton reactor enclosure crane and additional lifting devices provided by the rack vendor.

Each rack is aligned and leveled as it is placed in its proper pool. Each rack is a freestanding unit that rests on the pool floor using bearing pads attached to corner leveling screws. Leveling screws are adjusted by remotely controlled tools.

The requirements of 10CFR50, Appendix B, as included in the LGS Units 1 and 2 Quality Assurance Plan, Volume I, are implemented for receipt, storage, and installation of the spent fuel racks. Work is performed in accordance with procedures that are reviewed and approved prior to use. Inspections are performed and documented by personnel other than those who performed the work. Site activities are subject to audit by Nuclear Oversite.

9.1.2.4 Tests and Inspections

The spent fuel storage racks require no special periodic testing or inspection for nuclear safety purposes. However, test coupons may be installed in the Unit 1 and Unit 2 Spent Fuel Storage Racks. Test coupon analysis will only be performed on a discretionary basis based upon specific suspected degradation of neutron poisoning material. Spent fuel storage rack assignment in the spent fuel pool is surveyed at the time of installation.

9.1.2.4.1 Deleted

9.1.2.4.2 Deleted

9.1.2.4.3 Test Coupon Description and Installation

A typical test coupon is physically designed to simulate as nearly as possible, the actual in-service geometry, physical mounting, materials, and flow conditions of the neutron poison in the storage racks. The test coupons are mounted on a hanger assembly within the central eight feet of the fuel zone of the storage racks, where the gamma flux is expected to be reasonably uniform.

9.1.2.4.4 Test Coupon Inspection

Test coupon inspection is intended to identify changes in physical properties of the neutron poisoning material by performing various non-destructive and destructive testing.

9.1.3 FUEL POOL COOLING AND CLEANUP SYSTEM

The FPCC system is designed to remove the decay heat generated by the spent fuel assemblies stored in the fuel pool and to maintain the pool water at a clarity and purity suitable both for underwater operations and for the protection of personnel in the refueling area. The FPCC system has no function related to the safe shutdown of the plant.

9.1.3.1 Design Bases

a. The FPCC system piping is designed so that operator error or a loss of piping integrity cannot result in the draining of the spent fuel pool so that stored fuel would be uncovered.

b. The FPCC system is designed to provide a source of makeup water to ensure the maintenance of the fuel pool water level.

c. All piping and components of the FPCC system that form part of the flow path for makeup water from the ESW system, RHRSW system, and cooling water to and from the RHR system are designed to remain functional following an SSE.

d. The FPCC system is comprised of three pumps and three heat exchangers connected by a common header providing three approximately 50% capacity cooling trains. The Service Water System removes heat from the heat exchangers. Following an accident, two of the three pumps may be powered by emergency on-site power and any heat exchanger may be cooled by the Reactor Enclosure Cooling Water System. A precoat-type filter/demineralizer package is provided, through which a portion of the system flow can be diverted. As similar backup filter/demineralizer package common to both units is also provided.

e. The FPCC system was originally designed to maintain the bulk water temperature in the spent fuel pool at or below 140°F under normal operating conditions with two

FPCC pumps and two FPCC heat exchangers in operation. This is based on the normal heat load discharge history shown in Table 9.1-2A.

The Unit 1 FPCC system is capable of removing 1.61 x 10^7 BTU/hr and Unit 2 FPCC system is capable of removing 1.805 x 10^7 BTU/hr with any one train unavailable. The FPCC systems have been evaluated for increased spent fuel storage capacity and faster fuel transfer rate (6.7 vs. 10 days) resulting in a heat load of 1.805 x 10^7 BTU/hr. The results show that on Unit 2 with any two FPCC pumps and any two FPCC heat exchangers in operation, the spent fuel pool bulk temperature will peak at 143°F. The spent fuel pool bulk temperature will exceed 140°F for approximately 2.5 days. This is based on the normal heat load discharge history shown in Table 9.1-2B (reference 9.1-15). This analysis is not applicable to Unit 1, since Unit 1 has a smaller capacity FPCC system and the ADHR would be used for heat loads exceeding 1.61 x 10^7 BTU/hr.

Each refueling offload scenario is cycle specific and is likely to vary from Table 9.1-2B. Therefore, administrative controls are maintained to assure that the spent fuel pool heat load does not exceed FPCC heat removal capacity during shutdown, refueling and power operating conditions such that the FPCC system is capable of maintaining the spent fuel pool cooling temperature at a maximum of 143°F, assuming a single active failure during normal operating conditions. If the anticipated heat load exceeds the FPCC capability, the Residual Heat removal (RHR) System is placed in service and FPCC is secured. When the spent fuel pool and reactor refueling cavity well are connected, the combined decay heat load of the in-core fuel and spent fuel pool inventory is typically removed by the RHR system, alone, operating as an alternate decay heat removal method (ADHR).

f. The FPCC system was originally designed to permit the RHR system to be used, through a cross-tie, to maintain the bulk water temperature in the spent fuel pool at or below 140°F, with a maximum anticipated decay heat load of 3.64x10^7 Btu/hr. This is based on one full core offloaded from the reactor ten days after shutdown to fill the spent fuel pool, plus the previous normal refueling loads from 18 month refuelings as shown in Table 9.1-2A.

A bounding analysis of the FPCC system has been performed, which considered a maximum reactor power of 3527 MW, spent fuel pool increased storage capacity and a faster fuel transfer rate. This analysis results in a maximum anticipated heat load of 4.832 x 10^7 Btu/hr. This is based on one full core offloaded from the reactor vessel approximately 40 hours after shutdown plus the previous normal refueling loads from 24 month refuelings as shown in Table 9.1-2B (references 9.1-16 and 9.1-17) . A one-time per unit refueling cycle length extension to approximately 27 months (from a nominal 24 months) for Unit 1 Cycle 7 and Unit 2 Cycle 5 was evaluated. It was determined that the increase in decay heat generation due to each affected core's total operating period of 6.25 years (vs. 6 years) has no significant effect on maximum calculated fuel pool heat load.

The FPCC system cross-tie to RHR is normally used for the RHR ADHR method to maintain both the spent fuel pool and reactor water temperatures below 140°F during refueling. See Section 5.4.7 for further discussion of ADHR method.

Additionally, the FPCC system(s) or the RHR fuel pool assist mode can be used to remove decay heat from both the spent fuel pool(s) and the reactor vessel by cooling the spent fuel pool(s). Evaluations have shown that with the reactor cavity flooded up and the fuel pool gates removed, natural circulation will transfer decay and sensible heat from the reactor vessel to the fuel pool(s). The required cooling

capacity of the FPCC system(s) or the RHR fuel pool assist mode can be verified by calculation or demonstration to show that these systems are alternate methods of decay heat removal. Natural circulation will also induce reactor coolant circulation through the reactor core such that reactor core temperature can be accurately measured at an appropriate location.

g. The FPCC system is designed to maintain the optical clarity of the water in the spent fuel pool and other refueling area cavities (cask loading pit, reactor well, and dryer/separator pool) so that fuel handling and equipment handling operations are not hampered by limited visibility.

h. The FPCC system is designed to limit the fission product and activated corrosion product concentrations in the water of the spent fuel pool and other refueling area cavities to permit continuous occupancy of the refueling area by plant personnel.

The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the FPCC system are discussed in Section 3.2.

9.1.3.2 System Description

9.1.3.2.1 General Description

The FPCC system consists primarily of the pool water collection equipment, including wave suppression scupper and skimmer surge tanks, a cooling train with two heat exchangers, two pumps, a cleanup loop, and the discharge diffusers in the spent fuel pool. A backup heat exchanger and a backup pump are also included in the system.

9.1.3.2.2 Component Description

Design parameters for individual components of the FPCC system are listed in Table 9.1-1.

9.1.3.2.2.1 Skimmer Surge Tanks

Two skimmer surge tanks collect overflow water from the spent fuel pool and reactor well through skimmer drain openings, with adjustable weirs at the pool surface elevation. The skimmer surge tanks also collect overflow water from the cask loading pit and the dryer/separator pool via skimmer drain headers. A wave suppression scupper along one side of the spent fuel pool is drained via the skimmer drain headers. The skimmer surge tanks provide a suction head for the fuel pool cooling pumps and RHR pumps and serve as a buffer volume during transient flows in the normally closed-loop FPCC system.

9.1.3.2.2.2 Fuel Pool Heat Exchangers

Three fuel pool heat exchangers of the shell and straight tube-type are provided to transfer heat from the fuel pool water to the service water system (Section 9.2.1). Normally a maximum of two heat exchangers are in service and the third serves as a backup. The heat exchangers are arranged in parallel and are located in the reactor enclosure below the bottom of the skimmer surge tanks. Fuel pool water circulates through the shell side of the heat exchangers, and service water circulates through the tube side.

The service water side of the heat exchangers is maintained at a higher pressure than the fuel pool water side to minimize the possibility of radioactive contamination of the service water system from a tube leak.

Interconnecting piping is provided so that the heat exchangers can also be cooled by the RECW system in case the service water system is not available.

9.1.3.2.2.3 Fuel Pool Cooling Pumps

Three centrifugal pumps are provided to circulate water through the FPCC system. Normally a maximum of 2 pumps are in operation and the third serves as a backup. The pumps are arranged in parallel and take suction from the fuel pool heat exchangers through a common header. Two of the pumps are powered from Class 1E sources. The pumps can be operated from a panel located in the reactor enclosure and a panel located in the radwaste enclosure.

9.1.3.2.2.4 Fuel Pool Filter/Demineralizer Package

The cleanup loop of the FPCC system includes a filter/demineralizer package located separately in shielded cells in the radwaste enclosure. A spare filter/demineralizer package common to the two reactor units is also provided.

The fuel pool filter/demineralizer is a precoat-type, using powdered cation-anion resins as the coating media on the external surface of the filter elements. The filter elements are cylindrical stainless steel mesh, mounted vertically in a tube sheet and replaceable as a unit. The upper head of the filter/demineralizer vessel is removable for installing and replacing the filter elements. The ion exchange resin is a mixture of finely ground cation and anion resins, in proportions determined by service; this resin is referred to as precoat.

The precoat is applied to the surface of the filter elements by a flowing process called precoating. To maintain the filter medium on the filter elements during the interval between the precoating operation and the return-to-normal operation, or if there is an abnormal decrease in process flow, a centrifugal holding pump is provided with each filter/demineralizer to recirculate water through the unit.

The fuel pool filter/demineralizer system is designed to maintain water quality within the following limits:

a. Conductivity: $\leq$ 3 μmho/cm at 25°C

b. Chlorides: $\leq$ 0.5 ppm

c. pH: 5.3 to 7.5 at 25°C

d. Total Suspended Solids: $\leq$ 1 ppm

A strainer is provided in the effluent stream of each filter/ demineralizer to limit the migration of filter medium particles that pass through the filter elements. The strainer is capable of withstanding a differential pressure greater than the shutoff head of the fuel pool cooling pumps.

9.1.3.2.2.5 Backwash and Precoat Equipment

The backwash and precoat subsystem is common to the two reactor units and serves all three filter/demineralizer packages. Included in the subsystem are a backwash air accumulator, precoat tank, and filter precoat pump. Compressed air from the backwash air accumulator is used in conjunction with condensate water to backwash the spent filter medium from the filter elements with a minimum volume of water. Backwash slurry is drained to the waste sludge tank of the solid radwaste system (Section 11.4).

New ion exchange resin is mixed in the precoat tank and transferred as a slurry by the filter-precoat pump to the filter/demineralizer, where it is deposited on the filter elements. An agitator is provided with the precoat tank for mixing. Piping and valves associated with the precoat subsystem allow the precoat water to be recirculated to the precoat tank or the suction side of the filter precoat pump. The precoat subsystem can also be used for cleaning and decontamination of the filter/demineralizers.

9.1.3.2.3 System Operation

The FPCC system removes decay heat from fuel stored in the spent fuel pool and includes equipment to maintain the purity of the water in the system. The FPCC system heat removal capacity is shown in Table 9.1-2B. Water from the spent fuel pool flows through weirs and a wave suppression scupper at the pool surface into two skimmer surge tanks adjacent to the pool. Water in the skimmer surge tanks flows by gravity through the fuel pool heat exchangers to the suctions of the fuel pool cooling pumps. From the pumps, water is returned to the spent fuel pool through two return lines. A portion of the discharge flow of the pumps can be diverted through the cleanup loop before being returned to the pool. Heat is removed from the fuel pool heat exchangers by the service water system (drawing M-10).

The filter/demineralizer in the cleanup loop maintains pool water purity and clarity by a combination of filtration and ion exchange. Disposable ion exchange resins in the filter/demineralizer remove ionic fission product and corrosion product impurities and also serve as a filter for particulate matter. The ion exchange resins are replaced when the pressure drop across the filter/demineralizer is excessive (≥25 psid at rated flow) or when the resins are exhausted as indicated by discharge conductivity being above the limit for the spent fuel pool given in Section 9.1.3.2.2. The backwash and precoat operations are controlled from the radwaste enclosure.

The FPCC system is sampled monthly at the filter/demineralizer influent and effluent lines. These grab samples are analyzed by gamma isotopic analysis. The ratio of the influent activity to the effluent activity (decontamination factor) will be determined from this analysis. The fuel pool filter/ demineralizer will be regenerated on low decontamination factor.

The grab samples will also be analyzed for pH, chloride, conductivity, and turbidity. Turbidity is an indication of insolubles. The pH, conductivity, and chloride limits are given in Section 9.1.3.2.2.

During normal plant operation, the FPCC system serves only the spent fuel pool. During refueling operations, however, when the reactor well, dryer/separator pool, and/or cask loading pit are filled with water, the FPCC system can be aligned to recirculate and process the water in all these cavities. Water from the refueling water storage tank (Section 9.2.7) is used to fill the refueling area cavities. The refueling water pumps fill the cask loading pit through its drain line and fill the reactor well and the dryer/separator pool through diffusers in the reactor well. After refueling activities are completed, the refueling water pumps transfer water from the refueling area cavities back to the refueling water storage tank via a condensate filter/demineralizer if additional cleanup is

required. Gravity draining of the refueling water directly to the refueling water storage tank is also possible.

As the heat load on the spent fuel pool changes, the number of operating fuel pool cooling pumps and heat exchangers is adjusted to maintain the desired water temperature. The FPCC system has sufficient cooling capacity to maintain the spent fuel pool water at a temperature at or below 143°F, with a normal decay heat load of 1.61 x 10^7 Btu/hr on Unit 1 and 1.805 x 10^7 Btu/hr on Unit 2, with two pumps and two heat exchangers operating. The Unit 1 and 2 spent fuel pools can also be maintained cross connected as long as adequate spent fuel pool cooling capacity is verified.

If a heat load exceeding the capacity of the FPCC System is placed in the spent fuel pool, a cooling train of the RHR system (Section 5.4.7), consisting of an RHR pump and heat exchanger, can be substituted for the FPCC pumps and heat exchangers for cooling the pool water. A cross-connection between the drain line from the skimmer surge tanks and the RHR system allows one RHR pump to take suction from the skimmer surge tanks and pump fuel pool water through an RHR heat exchanger before returning it to the pool via return piping provided specifically for use with the RHR system Fuel Pool Cooling assist mode or via the normal Shutdown Cooling return path with RHR Alternate Decay Heat Removal method. The interconnecting piping between the RHR system and FPCC system is provided with either of two spool pieces, one with blind flanges for normal operation and one open spool piece for when the intertie is needed (drawing M-51). Administrative controls prevent the use of the RHR system intertie unless the associated reactor is shut down and is in the refueling mode. With the fuel pools cross-tied with one unit in refueling mode and RHR aligned to fuel pool cooling SST, there is no impact on the ability of refueling unit RHR system to perform its safety related functions. Also, there is no impact on the ability to safely shutdown the operating unit.

The conditions under which cooling of the spent fuel pool water by the RHR system alone would be required include the unloading of a full core load of irradiated fuel into the pool or isolation of fuel pool cooling system to support RHR ADHR operation or RHR Fuel Pool Cooling assist operation. The RHR system has sufficient heat removal capacity to maintain the spent fuel pool water at a temperature at or below 140°F, with a maximum anticipated decay heat load of 4.832 x 10^7 Btu/hr. The RHR system may also be used for cooling if the fuel pool cooling system should be unavailable. Connection of the RHR system requires:

a. Installation of RHR system spool pieces

b. Manual closure of normally open valve 053-✯007

c. Manual opening of normally closed valves 053-✯006, 053-✯024A and 053-✯024B

d. Adjustment of fuel pool overflow weirs, if required

e. Adjustment of Fuel Pool/SST water level to ensure adequate suction head for RHR pumps, if required

For Fuel Pool Cooling assist mode, the RHR supply and return lines and their associated valves are located in the fuel pool cooling pump and heat exchanger room at el 283' in the reactor enclosure.

The normal position of the above valves provides isolation of the safety-grade, seismic Category I RHR system from the FPCC system. The portion of the FPCC system downstream of valve 053-✯007 is designed to seismic Category I criteria (designated seismic Category IIA as discussed in Section 3.2.1) and would not be expected to fail due to a seismic event.

If normal fuel pool cooling should be lost as a result of a pipe break in the seismic Category IIA portion of the system, the quantity of water released would be limited to the inventory of the pool and reactor cavity above the overflow weirs, the skimmer surge tanks, and the pump suction piping. The flood height and environmental conditions resulting from this break would not prevent personnel access, which is required to take the manual actions described above. The maximum temperature (150°F) and pressure (31 psig) of the water in the line are not high enough to significantly affect the temperature, pressure, or humidity conditions in the room (the room is open at the top to the reactor enclosure access area at el 283'). The released fluid would not be highly radioactive. The water would drain out of the room at approximately the same rate as it flows from the break.

If there is a LOOP, the Class 1E buses are powered by the diesel generators, and the two FPCC pumps that receive Class 1E power can be restarted. Since normal service water is not available in this case, the FPCC heat exchangers can be cooled by the RECW system (which is in turn cooled by the ESW system) via interconnecting piping, after installation of normally removed spool pieces (drawings M-10, M-11 and M-13).

If there is a complete loss of capability to remove heat from the spent fuel pool using heat exchangers, heat can be removed by allowing the pool to boil and adding makeup water to maintain the pool water level. Makeup water requirements are shown in Table 9.1-2B. Makeup water is normally supplied to the skimmer surge tanks from the demineralized water makeup system (Section 9.2.5) by the actuation of a remote manually operated valve. If makeup water from this source is not available, makeup can be provided from the ultimate heat sink (spray pond) by either of two seismic Category I flow paths (drawings M-10, M-51 and M-53). The first of these backup makeup sources is a loop of the ESW system (Section 9.2.2) via a cross-connecting line to one of the RHR system return pipes in the spent fuel pool. The two ESW pumps in the ESW loop provide redundancy in motive power for this source of makeup supply. The manual valves that must be opened to initiate makeup from the ESW system are located in the control structure and are accessible after an accident. The second of these backup makeup sources is a loop of the RHRSW system (Section 9.2.3) via the piping of one RHR system loop and the cross-connecting piping leading to the RHR return piping in the spent fuel pool. The two RHRSW pumps in the RHRSW loop provide redundancy in motive power for this source of makeup supply. The manual valves that must be actuated and the spool piece that must be installed to establish this flow path are located in the reactor enclosure. These backup makeup water sources provide flow rates greater than the maximum makeup requirements shown in Table 9.1-2B. The spray pond design water volume includes its use as a source of makeup to the spent fuel pool for 30 days, without makeup to the pond during which time the cooling function of the FPCC system or RHR system can be established or an alternate makeup water supply can be established.

9.1.3.3 Safety Evaluation

The cooling water return lines to the spent fuel pool associated with both the FPCC system and RHR system penetrate the walls of the spent fuel pool within 4 feet of the normal pool water level. FPCC system cooling water return lines are provided with siphon breaker holes as close as possible to the normal water level to prevent the siphoning of pool water below the level of the holes. RHR system cooling water return lines terminate below the normal water level and above the minimum water level to prevent pool siphoning. The FPCC system takes suction from the spent fuel pool via the skimmer surge tanks through openings in the liner plate at the normal water level. There are no other piping penetrations in the pool liner plate. Therefore, there is no operator

error or FPCC system malfunction that could result in the draining of the spent fuel pool so that stored fuel would be uncovered.

The spent fuel pool is provided with redundant seismic Category I makeup capability to ensure an adequate supply of makeup water to the spent fuel pool under conditions of maximum anticipated evaporation associated with fuel pool boiling. The radiological consequences of a boiling spent fuel pool are discussed in Section 9.1.3.6. Makeup water is supplied from the spray pond using either the ESW system or RHRSW system. Redundant pumps in each loop of the ESW and RHRSW systems provide assurance of the availability of motive power to pump the makeup water.

The portions of the FPCC system that form part of the flow path during makeup from the ESW or RHRSW systems or spent fuel pool cooling by the RHR system, up to and including the boundary isolation valves, are designed in accordance with seismic Category I requirements as discussed in Section 3.2. The components (and supporting structures) of any system, equipment, or structure that is not seismic Category I and whose collapse could result in the loss of a required function of the FPCC system are analytically checked to determine that they will not collapse when subjected to seismic loading resulting from the SSE.

The design of the FPCC system with respect to the following areas is discussed in the indicated sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11

A failure mode and effects analysis of the FPCC system is provided in Table 9.1-3.

The water level in the spent fuel storage pool is maintained at a height sufficient to provide shielding for required building occupancy. Radioactive particulates removed from the fuel pool are collected in filter/demineralizer units in shielded cells. For these reasons, the exposure of station personnel to radiation from the FPCC system is normally minimal. Further details of radiological considerations are discussed in Chapter 12.

9.1.3.4 Inspection and Testing Requirements

The FPCC system is preoperationally tested in accordance with the requirements of Chapter 14. The safety-related systems that provide makeup water are periodically tested in accordance with the requirements of Chapter 16.

9.1.3.5 Instrumentation Applications

Instrumentation is provided to annunciate the high and the low spent fuel pool water levels in the control room. Skimmer surge tank level instrumentation provides level indication at the refueling floor control panel, both high and low level annunciation at the refueling floor control panel and the fuel pool cooling pump control panel, and by a common trouble alarm in the main control room panel. A low level alarm indicates that makeup to the FPCC system is needed.

The temperature of fuel pool cooling water at the common inlet and at the outlet of each fuel pool heat exchanger is recorded and high temperature is annunciated in the control room; high outlet temperature in the combined heat exchanger discharge is annunciated in the control room through the plant computer.

The discharge pressure of each fuel pool cooling pump is indicated locally. Low pump discharge and suction pressure is annunciated by a local alarm in the fuel pool cooling pump panel and by a common trouble alarm in the main control room. The pumps are tripped individually on low suction pressure.

High leakage rates through the refueling bellows or reactor well seals are annunciated at the refueling floor control panel and by a common trouble alarm in the main control room.

The equipment associated with the cleanup loop is controlled and monitored from panels in the radwaste enclosure. The parameters monitored include differential pressure across the filter/demineralizer, flow rate through the filter/demineralizer, and pressure differential across the strainer downstream of the filter/demineralizer.

9.1.3.6 Analysis for Nonseismic Fuel Pool Cooling and Cleanup System

The FPCC system is not designed as a seismic Category I or engineered safeguards system except for interconnections with safety-related makeup water sources. The following analysis examines the consequences of a loss of spent fuel pool cooling and the use of the seismic Category I makeup water source.

It is assumed that loss of cooling to both spent fuel pools occurs. In addition, to maximize both the heat loads and the iodine inventories in the pools, sequential refuelings are postulated. The loss of cooling is assumed during the eleventh refueling, just after the refueling cavity water level is lowered and the RHR system is not available for cooling the cavity and spent fuel pool. The analysis involves an evaluation of the time to pool boiling, the makeup water requirements if the pool boils, and the thyroid dose consequences at the LPZ outer boundary due to iodine releases from the boiling pools. This analysis is still bounding for all spent fuel storage rack configurations up to and including maximum storage configuration of maximum density storage racks.

The assumptions used in this analysis were consistently chosen to be the worst case design basis assumptions, similar to those in regulatory guides for design basis accidents (e.g., Regulatory Guides 1.3, 1.25, etc). The combination of all of these design basis assumptions occurring at the same time is extremely unlikely, making this accident, as analyzed, one of very low probability. Many of the assumptions are considered to be overly conservative; for example, operating experience with present BWR fuels (Reference 9.1-5) indicates that the assumption of 1% of the fuel with cladding failures is more conservative by at least a factor of 100 for 8x8 fuel bundles. Further, while some iodine release rate spiking factors of over 50 have been observed during startups and shutdowns, there are presently no data for the less severe temperature transients that would be associated with a boiling spent fuel pool. The assumption of 10% of the activity in the

fuel gaps is at least 30 times the gap activity used for a realistic accident analysis in Chapter 15. A more realistic evaluation of this accident would result in releases of radioactivity, if any, many orders of magnitude below the calculated values. Further, the realistic releases would be well below the 10CFR50, Appendix I technical specifications, indicating that such an incident is of little or no consequence.

This conservatively assumes that it would take 20 hours to place the reactor in cold shutdown, realign valves, adjust the spent fuel pool weir, and install the interconnecting piping between the RHR system and the fuel pool cooling system (Section 5.4.7.1.1). The conservative results show that the pools would not boil until at least 13.5 hours after the loss of cooling at the average water heatup rate of 5.33°F/hr. If cooling is not restored before the pool boils, then makeup water from the seismic Category I ESW system can be added to the pool to keep the fuel covered at all times.

As shown in Table 9.1-4 the thyroid dose consequences of releasing the water that would evaporate from the boiling pool are well below the guideline values of 10CFR100.

The following assumptions were used to calculate the heat generation and boiling rates in the two spent fuel pools:

a. Each pool contains the maximum inventory of assemblies with the discharges shown in Table 9.1-2A. The last one-third cores are from the just-completed sequential refuelings. For Unit 1, the fuel has decayed for 47 days. For Unit 2, the decay time is 21 days, the length of time from shutdown until the water level in the refueling cavity has been lowered, and the RHR system would not be able to cool the refueling cavity and spent fuel pool. The minimum time to complete fuel unloading and loading for Unit 1 is 26 days. These decay times result in the maximum heat generation rates and maximum evaporation rates at times when the RHR system is not available.

b. The decay heat is calculated by using the decay heat equations presented in BTP APCSB 9-2. The decay heat generation rate for each pool is given in Table 9.1-5 for various times after the postulated loss of cooling.

c. All heat generated by the fuel is assumed to be absorbed by the water, to minimize the time to boiling. No heat is assumed to be lost to the surroundings by conduction through the concrete and steel or by evaporation. The temperature gradients from the fuel at the bottom of the pool to the cooler water at the top create convective water and heat currents that should thoroughly mix the water and promote an even distribution of heat, rather than localized points of surface boiling .

This does not preclude the performance of non-sequential outages less than 26 days in length.

The following assumptions were used to calculate the offsite doses for the loss of cooling to the spent fuel pools:

a. The saturation inventory of I-131 in the 3458 MWt core is 8.66×10^7 Ci.

b. During refueling, 276 fuel elements (one-third core) are transferred to the spent fuel pool. Iodine in fuel from past refuelings is negligible, due to the long times for decay.

c. It is assumed that 1% of the fuel rods in the core are defective and that this 1% is in the one-third core transferred to the spent fuel pool.

d. The iodine activity in the spent fuel pool water at the initiation of boiling is assumed to be negligible compared to the activity released from the fuel during pool boiling. Activity in the core coolant or from a shutdown spike would have been cleaned up to acceptably low levels by the RWCU and spent fuel pool cleanup systems before fuel transfer begins.

e. The spent fuel pool cooling systems are assumed to fail 47 days after shutdown for the first reactor and 21 days after shutdown for the second reactor. The 26 day difference is the minimum time to refuel the first unit. The 21 days is the time, after a complete fuel transfer, during which the water level in the refueling cavity is lowered, and the RHR system would not be able to cool the refueling and spent fuel pools in case of an accident.

f. The gap activity, or 10% of the rod activity, is available for leakage from the defective 1% of the rods. The leakage rate is assumed to be 2.9×10^{-8} per sec, which corresponds to a release rate of 2.6×10^{-3} Ci/sec for I-131 or 3.5×10^{-1} Ci/sec at 30 minutes for noble gases. This is the full power design fuel leak rate. It should be noted that the available activity in the gaps of the defective fuel rods may have already been significantly depleted by the shutdown spike.

g. A constant spike factor of various magnitudes up to 50 was applied to the I-131 leakage rate from the fuel to account for the potential spiking effects during the temperature transient. The leakage rate returns to the normal full power unspiked rate of 2.9×10^{-8} per sec when boiling begins, since the fuel should now be close to its new steady-state temperature. Although analyses were performed for release rate spike factors of up to 50, there are presently no data to support the spiking phenomena in the spent fuel pool boiling situation. Spikes have been observed for the large, rapid temperature and pressure changes associated with shutdowns and startups, but such significant spiking effects would not be expected during the long, slow temperature change of less than 65°F that would be associated with a loss of cooling. A comparison with the Eickelpasch and Hock paper, "Fission Product Releases After Reactor Shutdown," IAEA Sm 178/19 (1974), shows that the measured I-131 release rate at 9 days after shutdown is approximately 0.2 to 0.3 of the release rate at power. Since the temperature of the fuel during boiling is expected to be well below operating temperature, the use of the power leakage rate is considered to be extremely conservative.

h. The activity released from the fuel is assumed to be uniformly mixed in the 40,600 ft^3 (2.53×10^6 lb_m) of water in each spent fuel pool. The temperature gradients created in the pool by the fuel maintains the mixing process.

i. The normal spent fuel pool design maximum temperature is 140°F. For conservatism this is assumed to be the pool temperature at the time of loss of cooling.

j. The activity release rate from the pool depends on the evaporation (boiling) rate. No evaporation is assumed during the heatup period until the pool water reaches 212°F. All heat generated by the fuel is assumed to be absorbed by the water, and no losses through the concrete and steel are assumed. This results in the shortest time to boiling. The heat generation and evaporation rates after boiling starts are given as a function of time in Table 9.1-5.

k. The iodine partition factor at the pool surface is varied between 0.1 and 0.01 to determine the effects on the total release. Although the partition factor would vary as a function of time due to changing temperatures and iodine concentrations, a value greater than 0.1 should not be expected for this nonviolent evaporating process at the pool surface.

l. No credit is taken for iodine plateout on walls and equipment or for washout by condensing water vapor in the refueling area.

m. It is assumed that all activity in the steam released to the air in the refueling area is instantaneously released to the atmosphere without filtration or condensation in the ventilation system.

n. The atmosphere dispersion factors for dilution of the radioactive releases are the 5th percentile ground level X/Qs given below for the LPZ boundary distance. The time "0" is assumed to be the start of the accident when pool cooling is lost.

TIME	X/Q (sec/m^3)
0 - 8 hrs	4.0×10^{-5}
8 - 24 hrs	2.9×10^{-5}
1 - 4 days	1.4×10^{-5}
4 - 30 days	5.4×10^{-6}

o. The thyroid dose models and breathing rates given in Regulatory Guide 1.3 are used.

The following model was used to calculate the offsite thyroid doses from the release of radioiodine from the fuel:

a. The activity in the fuel available for leakage at the time of loss of cooling, S(0), is calculated using the reactor inventory equation from TID-14844, with the appropriate decay from shutdown until the loss of the cooling and the fractions of iodine available for release. During the pool heatup and boiling phases, the activity in the fuel gaps available for leakage, S(t), is adjusted for decay and losses by leakage to the pool.

$$S(t_n) = S(t_{n-1})\ e^{-(\lambda_d + \lambda_1)\Delta t} \quad (Ci) \qquad \text{(EQ. 9.1-1)}$$

where:

λ_d = decay lambda (1/sec)

λ_1 = leakage rate from the fuel (1/sec)

Δt = $t_n - t_{n-1}$ = time increment (sec)

b. The activity in the spent fuel pool as a function of time, A(t), is given by the solution to the following:

$$A(t_n) = A(t_{n-1})e^{-\lambda_d \Delta_t} - \lambda_{ev} A(t_{n-1})\Delta t + \lambda_1 S(t_n)\left[1 + (SF - 1)(1 - \varepsilon(t_n))\Delta t / V\right] \qquad \text{(EQ. 9.1-2)}$$

where:

λ_{ev} = evaporation lambda from the pool (1/sec) x PF

PF = iodine partition factor at the pool surface

SF = spiking factor

ε = step-function = $\varepsilon = 0$ for $t_n \le$ time to boil
$\varepsilon = 1$ for $t_n >$ time to boil

V = pool volume (ft^3)

A = activity in spent fuel pool (Ci/ft^3)

Since spent fuel pool makeup water will be available, the evaporation lambda is found by dividing the evaporation rate (ft^3/sec) by the constant pool water volume (ft^3).

c. The activity released to the atmosphere at any incremental time t_n is given by the following equation:

$$R(t_n) = R(t_{n-1}) + \lambda_{ev}\ V\ A(t_n)(1-f)\Delta t \qquad \text{(EQ. 9.1-3)}$$

where:

R = activity released (Ci)

f = SGTS filter efficiency fraction (assumed to be zero)

The above equations are solved iteratively, using time steps of 450 seconds.

d. The thyroid dose at the LPZ is calculated using the equations and models from Regulatory Guide 1.3.

9.1.4 FUEL HANDLING SYSTEM

9.1.4.1 Design Bases

The fuel handling system is designed to provide a safe and effective means for transporting and handling fuel from the time it reaches the plant until it leaves the plant after postirradiation 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 are provided in Tables 9.1-7 through 9.1-9, which list the safety class, quality group, 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. The equipment discussed in this section was also reviewed to verify compliance with the guidelines of ANS 57.1 and ANS 57.2 (1976). There were no deviations identified except those discussed in Section 9.1.5.2 for the reactor enclosure crane and for the new fuel inspection/channeling stand and the upending platform.

The reactor enclosure crane main hoist or auxiliary hoist is used with a general purpose grapple to transfer new fuel from the new fuel inspection stand to the fuel prep machines in the fuel storage pool. From this point on, the fuel is handled by the telescoping grapple on the refueling platform.

The refueling platform is seismic Category I from a structural standpoint, in accordance with 10CFR50, Appendix A and 10CFR50, Appendix B. The allowable stress due to SSE loading is 120% of yield or 70% 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 RMS 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 main hoist so that no single component failure could result in a fuel bundle drop. Maximum deflection limitations are imposed on the main structures to maintain the relative stiffness of the platform. The welding of the platform is in accordance with AWS D14-1 or ASME Section IX. Gears and bearings meet AGMA Gear Classification Manual and ANSI B3.5 requirements. Materials used in the construction of load-bearing members meet ASTM specifications. For personnel safety, OSHA (29CFR1910.179) is applied. Electrical equipment and controls meet ANSI C-1, National Electric Code, and NEMA Publication No. ICI, MGI requirements.

The general purpose grapples and the main telescoping fuel grapples have redundant hooks. The main fuel grapple has an indicator that 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. At its normal up position, adequate shielding is still maintained over the fuel.

Redundant electrical limit switches are a part of the fuel grapple to preclude the possibility of raising radioactive material out of the water. The cables on the auxiliary hoists incorporate an adjustable, removable stop that jams the hoist cable against the hoist structure to prevent hoisting when the free-end of the cable is at a preset distance below water level.

The provision of a separate cask loading pool, capable of being isolated from the fuel storage pool, eliminates the potential for accidental dropping of the cask and rupturing of the fuel storage pool. See Chapter 15 for accident considerations.

9.1.4.2 System Description

Table 9.1-6 is a listing of typical tools and servicing equipment supplied with the nuclear system. The following paragraphs 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 Cask

The spent fuel cask is used to transfer spent reactor fuel assemblies from the spent fuel pool, via the cask pit to a fuel storage or fuel reprocessing facility. The cask can also be used for offsite shipment of irradiated reactor components such as control rod blades, incore monitors, etc.

The maximum loaded weight and hence the capacity of the cask is determined by the 125 ton lifting capacity of the reactor enclosure crane. The maximum loading height, ie, height of the open cask in the storage pit, is determined by the depth of the shipping cask pit from the gate bottom. This allows for a constant water depth over the fuel in transit from the reactor to the fuel pool and into the shipping cask.

It further allows underwater replacement of the lid and other operations that may pose unacceptable radiation hazards to personnel. Considerations facilitating decontamination of the cask are given in the design. The design of the cask meets all applicable regulations of the DOT and 10CFR71.

No specific type of cask has been chosen. Over the lifetime of the plant, several different sizes and models that the fuel handling facilities can accommodate may be used.

Additionally, an Independent Spent Fuel Storage Installation Transfer Cask has been chosen, as described in the Updated Final Safety Analysis Report for the Standardized NUMOS® Horizontal Modular Storage System for Irradiated Nuclear Fuel Rev 10, Transnuclear, Inc., NUH003.0103 and its NRC Certificate of Compliance No. 1004.

9.1.4.2.2 Cask Crane

The reactor enclosure crane is discussed in Section 9.1.5.

9.1.4.2.3 Fuel Servicing Equipment

The fuel servicing equipment described below is designed in accordance with the criteria listed in Table 9.1-7.

9.1.4.2.3.1 Fuel Prep Machine

The fuel preparation machine (Figure 9.1-5) is mounted on the wall of the fuel storage pool and can be used for stripping reusable channels from the spent fuel and for channeling the new fuel. The machine is also used with the fuel inspection fixture to provide an underwater inspection capability and with the defective fuel storage container to contain a defective fuel assembly.

The fuel preparation machine consists of a work platform, a frame, and a movable carriage. The frame and movable carriage are located below the normal water level in the fuel storage pool, thus providing a water shield for the fuel assemblies being handled. The fuel preparation machine carriage has an uptravel stop to prevent raising irradiated fuel above the safe water shield level. The uptravel stop can be adjusted to allow new fuel to be transferred from the reactor enclosure overhead crane to the fuel prep machine carriage without submerging the crane hook in the fuel pool water. The movable carriage is operated by a foot pedal controlled air hoist.

9.1.4.2.3.2 New Fuel Inspection/Channeling Stand

The new fuel inspection/channeling stand serves as a support for a new fuel bundle undergoing receipt inspection and provides a working platform for technicians engaged in performing the inspection.

The new fuel inspection/channeling stand consists of a vertical column with a bearing seat, a lift unit to position the work platform at any desired level, and upper clamp to hold the fuel bundle in position. Bolted to the upper portion of the column is an articulating hoist mechanism consisting of two square tubes connected by a hinge pin. The articulating piece is normally lowered to avoid interference with the reactor enclosure crane. When channeling is being performed the articulating piece is raised by a double-acting air cylinder to its full height, and an electric hoist mounted on the piece that lowers the channel over the fuel bundle.

9.1.4.2.3.3 Channel Bolt Wrench

The channel bolt wrench (Figure 9.1-7) is a manually operated device approximately 12 feet (3.6 meters) in overall length. The wrench is used for removing and installing the channel fastener assembly while the fuel assembly is held underwater in the fuel preparation machine.

The channel bolt wrench has a socket that mates and captures the channel fastener cap screw.

9.1.4.2.3.4 Channel Handling Tool

The channel handling tool (Figure 9.1-8) is used in conjunction with the fuel preparation machine to remove, install, and transport fuel channels in the fuel storage pool.

The tool is composed of a handling bail, actuating knob, actuating shaft, angle guides, and jaws that engage the fuel channel. The jaws are actuated (extended or retracted) by manually rotating the actuating knob.

The channel handling tool is suspended by its bail from a spring balancer on the channel handling boom located on the fuel floor.

9.1.4.2.3.5 Fuel Pool Sipper

The fuel pool sipper (typical unit shown in Figure 9.1-9) provides a means of isolating a fuel assembly in demineralized water to concentrate fission products in relation to a controlled background.

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

9.1.4.2.3.6 Fuel Inspection Fixture

The fuel inspection fixture (typical unit shown in Figure 9.1-10) is used in conjunction with the fuel preparation machine to permit remote inspection of a fuel bundle or assembly. The fixture consists of two parts: a lower bearing assembly and a guide assembly at the upper end of the carriage. The fuel inspection fixture permits the rotation of the fuel bundle or assembly in the carriage and provides, in conjunction with the vertical movement of the carriage, complete access for inspection.

9.1.4.2.3.7 Channel Gauging Fixture

The channel gauging fixture (Figure 9.1-11) is a go/no-go gauge which can be used to evaluate the condition of a new fuel channel before channeling.

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 the lower end of a usable fuel channel.

The channel gauging fixture is installed vertically between the two fuel preparation machines, and hangs from the fuel storage pool curb when in use. When not in use, the channel gauging fixture may be stored elsewhere in the fuel storage pool or on the fuel floor.

9.1.4.2.3.8 General Purpose Grapple

The general purpose grapple (Figure 9.1-12) is a handling tool used generally with the fuel. The grapple can be attached to the reactor enclosure main hoist, auxiliary hoist, jib crane, and the auxiliary hoists on the refueling platforms. The general purpose grapple is used to place new fuel in the inspection stand and to transfer the new fuel to the fuel pool. It can be used to handle fuel during channeling.

9.1.4.2.3.9 New Fuel Upending Platform

The upending platform is a structural steel frame that supports a 1 1/2 ton jib crane that has two hoists mounted on it. There is a 1-ton electric hoist and a 1/2 ton hand hoist. Only one hoist will be used at a time. The platform is a Seismic Category II structure.

The jib crane and electric hoist are used to raise the metal container into a vertical position and set it into the upending stand of the platform.

It is also possible to use the reactor enclosure crane to transfer the metal container into the unloading area.

The jib crane and the hand hoist are used to transfer the fuel bundles into one of the new fuel inspection/channeling stands which are located on either side of the platform.

9.1.4.2.3.10 Roller Conveyer

A gantry crane or the reactor enclosure crane will be used to transfer the metal container from a predesignated storage area to a roller conveyer. The roller conveyer is located adjacent to the upending platform and is used to position the metal container under the jib crane.

9.1.4.2.3.11 Gantry Crane

The 2-ton gantry crane can be used to transfer the metal container from the predesignated storage area to the roller conveyer. The gantry crane is designed to meet the requirements of the Limerick heavy loads program.

9.1.4.2.4 Servicing Aids

General area underwater lights are provided, with a suitable reflector for illumination. Suitable 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, independently 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 may also be equipped with a right-angle lens to allow viewing at 90°.

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 if it fills with water and sinks. A portable, submersible, 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 the 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, the water sample is radiochemically analyzed to determine possible fuel bundle leakage.

9.1.4.2.5 Reactor Vessel Servicing Equipment

The essentiality, the quality group, and the seismic category for this equipment are listed in Table 9.1-8. The 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.

9.1.4.2.5.2 Steam Line Plug

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 lines during servicing of SRVs, MSIVs, or other components of the main steam lines, while the reactor water level is raised to 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. Steam line plugs of various designs are utilized. Plug designs weighing more than a fuel bundle meet the requirements of NUREG-0612. Current steam line plugs including handling tool weigh less than 1200 pounds and do not constitute heavy loads.

9.1.4.2.5.3 Shroud Head Bolt Wrench

This is a tool for the operation of the shroud head bolts. It is designed for a 40 year life, and is made of corrosion resistant materials for easy handling and corrosion resistance. Testing has been performed to confirm the design.

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. The flange surface rests on replaceable wear pads made of aluminum. When resting on the pedestals, the head flange is approximately 3 feet 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. The structure is designed in accordance with AISC Manual of Steel Construction.

9.1.4.2.5.5 Head Nut and Washer Rack

The RPV head nut and washer rack maybe used for transporting and storing up to six nuts and washers. The rack is a box-shaped non-corrosive structure with dividers to provide individual compartments for each nut and washer. Each corner has a lug and shackle for attaching a four leg lifting sling.

The rack is designed with a safety factor of 5.

9.1.4.2.5.6 Head Stud Rack

The head stud rack may be used for transporting and storing six reactor pressure vessel studs. It is suspended from the reactor enclosure crane auxiliary hoist for lifting studs from the reactor well to the operating floor.

The rack is made of a non-corrosive material.

9.1.4.2.5.7 Dryer and Separator Sling

The dryer and separator sling 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 sling consists of a cruciform structure, which is suspended from a hook box with four wire ropes and turnbuckles. The hook box, with two hook pins, engages the reactor enclosure crane main hook extension or sister hook, depending on wet or dry transfer method. Synthetic slings are an approved equivalent alternate to the wire ropes. When synthetic slings are used they are

designed to be attached directly to the reactor enclosure crane sister hook. On the end of each arm of the cross is a socket with a pneumatically operated pin for engaging the four lifting eyes on the steam dryer or shroud head. The hook extension may be used when the dryer or shroud head is transferred underwater.

The sling is designed so that one hook pin and one main beam of the cross 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 safety factor of the lifting members is 5 or greater for the ultimate breaking strength of the material. The structure is designed in accordance with AISC Manual of Steel Construction. The completed assembly is proof-tested at 125% or greater of rated load, and all structural welds are magnetic particle inspected after the load test.

9.1.4.2.5.8 Reactor Pressure Vessel Head Strongback/Carousel

The Reactor Pressure Vessel (RPV) head strongback/carousel is used for lifting the vessel head. The 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 three pins in the center for engagement with the reactor building crane main hoist hook. Each arm has a liftrod 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 serves to suspend the stud tensioners and the nut storage tray. Each tensioner has an air-operated hoist with individual controls.

The strongback carousel is considered to be single-failure proof, since failure of a single load arm or load pin will not release the load. It is designed in compliance with NUREG-0612, and the AISC manual of steel construction. The RPV strongback carousel is also designed in compliance with ANSI N14.6 with the exception of material testing of the hook pins, clevis pins, and clevis rods. The lack of material testing does not affect the function or safety of the RPV strongback carousel as the assembly is load proof testing and undergoes pre-service NDE to ensure its continued integrity. The design load capacity for the equipment will be 135 tons.

9.1.4.2.5.9 Service Platform

The text is this section described features of the reactor service platform. The reactor service platform is obsolete equipment that has been permanently removed from the facility. The information in this section was removed.

9.1.4.2.5.10 Service Platform Support

The text is this section described features of the reactor service platform support. This equipment is obsolete equipment that has been permanently removed from the facility. The information in this section was removed.

9.1.4.2.5.11 Steam Line Plug Installation Tool

The steam line plug installation tool is suspended from the reactor enclosure crane, auxiliary platform, or refueling platform for transporting and installing the steam line plugs in the steam line

nozzles of the reactor vessel. This tool is made of aluminum; it is designed for a safety factor of 5 and is in accordance with the Aluminum Construction Manual by the Aluminum Association.

9.1.4.2.5.12 Fuel Floor Auxiliary Platform (FFAP)

The FFAP or auxiliary platform provides worker access and component hoisting capability in the Unit 1 and 2 reactor cavities, fuel pools, and cask pit areas to perform maintenance activities during, but not limited to, refueling outages. The auxiliary platform is constructed of steel framing using materials in accordance with ASTM Standards. Welding is in accordance with AWS D1.1 structural welding. The auxiliary platform is not designed to perform movements of reactor fuel, irradiated components, and heavy loads.

9.1.4.2.5.13 Reactor Cavity Work Platform (RCWP)

The Reactor Cavity Work Platform (also known as the GE "Scorpion" RCWP) is approved for use at Limerick. The descriptive statements below apply to GE RCWP.

The RCWP provides workers access to in-vessel components for inspections and repairs concurrent with irradiated component handling activities. The RCWP is assembled on the refuel floor and then placed into the reactor cavity after flood-up and is removed from the cavity while it is still flooded up. Procedural controls will assure that cavity water level is maintained within the required range as the RCWP is inserted into and removed from the water.

The RCWP displaces some cavity water since the bottom of the GE RCWP work trough is located at approximately elevation 348 feet 10 inches, with hollow supporting beams extending approximately 10 inches below the bottom. This reduces shielding provided between irradiated components and the surface of the water (directly above the irradiated component). Radiation controls will be in place to ensure personnel are not inadvertently overexposed in the event of unexpected increases in dose rated on the RCWP. At the normal uptravel limit of the Refueling Platform hoists, the water shielding provided for the RCWP workers, in combination with radiation protection program controls and protective measures, is adequate.

The GE RCWP may be equipped with two jig cranes each de-rated to a load rating of 500 lbs and each weighing approximately 500 lbs. The RCWP is not designed to handle fuel, irradiated components or heavy loads. The GE RCWP jib cranes are permitted to extend into the boundary zone during fuel handling based on a determination in a GE analysis that a collision between a loaded fuel grapple and the GE RCWP would not result in dropping the fuel bundle or mast fuel grapple assembly onto the core; and therefore the original FHA remains bounding.

Additional administrative controls will be in place during handling of irradiated components in the reactor cavity to assure that irradiated components are not inadvertently raised in close proximity to personnel on the RCWP. Additional administrative controls will be in place during fuel handling to minimize the likelihood of a collision of the fuel grapple assembly with the GE RCWP jib crane. Administrative controls similar to those implemented for fuel movement when the boundary zone limit system is not available will also be implemented for fuel movement when the RCWP jib crane is extended into the boundary zone.

The RCWP was constructed in accordance with AISC Manual of Steel Construction using materials in accordance with ASTM standards. Welding is in accordance with ANSI/AWS D1.6 , Structural Welding Code for Stainless Steel, and ANSI/AWS D1.1, Structural Welding Code for Carbon Steel. The RCWP meets Seismic IIA criteria and will not fall into the reactor vessel during an SSE. The GE RCWP does not rely on buoyancy to maintain its seismic qualification.

9.1.4.2.6 In-Vessel Servicing Equipment

The instrument strongback attached to the reactor enclosure crane is used for servicing neutron monitoring incore detectors as they require replacement. The strongback initially supports the incore detectors into the reactor cavity. The incore detectors are then decoupled from the strongback and is guided into place while being supported by the instrument handling tool. The instrument handling tool is attached to a refueling platform auxiliary hoist and is used for removing and installing fixed incore detectors, as well as for handling neutron source holders and the source range monitor/intermediate range monitor dry tubes. The auxiliary platform may be used to install new local power range monitors and new source range monitor/intermediate range monitor dry tubes.

Each incore instrumentation guide tube is sealed by an O-ring on the flange. If 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.

The auxiliary hoists on the refueling platform are used with appropriate grapples to handle control rod blades, incore detector dry tubes, sources, and other reactor vessel internals. Interlocks on both the grapple hoists and auxiliary hoist are used to provide safety; the refueling interlocks are described and evaluated in Section 7.7.

9.1.4.2.7 Refueling Equipment

Fuel movement and reactor servicing operations are performed from a platform that spans the refueling, servicing, and storage cavities.

9.1.4.2.7.1 Refueling Platform

The refueling platform is a gantry crane that is used to transport fuel and reactor components to and from the fuel storage pool and the reactor vessel. The platform spans the fuel storage pool and reactor cavity on rails bedded in the refueling floor. A telescoping mast and grapple suspended from a trolley is used for transporting and orienting fuel assemblies for placement into the core, storage rack, or shipping cask. The platform is controlled from an operator station on the main trolley, with a position indicating system provided to position the grapple over core locations. The platform control system includes interlocks to verify the grapple load, prevent unsafe operation over the vessel during control rod movements, and limit vertical travel of the grapple. The grapple in its normal up position provides 8 feet minimum water shielding over the top of active fuel (6 feet 6 inches shielding over the top of the fuel assembly) during transit. The fuel grapple hoist has a redundant load path so that no single component failure results in a fuel assembly drop.

A refuel platform is provided for each reactor unit. Due to the common refueling area for both units, the refuel platforms can be operated over either unit's spent fuel pool to move fuel assemblies. Administrative controls have been established to assure that both platforms are not operated in close proximity when both platforms are transporting fuel.

Two 1000 pound capacity auxiliary hoists, administratively limited to 500 pounds for the handling of control rod blades within the reactor pressure vessel, one main trolley-mounted and one monorail mounted, are provided for servicing, such as LPRM replacement, fuel support piece replacement,

jet pump servicing, control rod blade replacement, main steam line plug installation and removal, and shroud head bolt latching and unlatching. The two auxiliary hoists mounted on the refueling platform are not intended for fuel handling. The main trolley auxiliary hoist and the monorail auxiliary hoist are each provided with a geared rotary limit switch that provides normal up and down limit stops. In addition, a stop block fastened to the hoist cable will operate a safety limit switch if the normal up limit should fail.

The auxiliary platform may be used to assist the refueling platform efforts, such as, installing new LPRMs, installing and removing main steam line plugs, and latching and unlatching shroud head bolts. The auxiliary platform is not designed to perform movements of reactor fuel, irradiated core components, and heavy loads.

If the motor is not stopped by either up limit, the stop block will jam against the hoist frame and trip the motor on (a) the load cell switch sensing of a jam condition, or (b) stalling of the hoist motor. In either event, there will be no resulting impact load on the cable because the block stops against the energy-absorbing portion of the hoist (i.e., spring-loaded plate or pivoted sheave arm).

Each cable is inspected by procedure prior to every refueling outage.

A Service Pole Caddy platform is attached on the rear side of the refueling platform at LGS. The platform provides an auxiliary work station for unlatching and latching the steam separator head bolts during refueling activities. The platform can also be utilized for other underwater servicing needs such as jet pump beam bolt untorquing and steam line plug installation. The platform is provided with high torque service poles and a motorized hoist to handle the poles.

9.1.4.2.8 Storage Equipment

Specially designed equipment storage racks are provided. Additional storage equipment is listed on Table 9.1-6. For fuel storage rack description and fuel arrangement, see Sections 9.1.1 and 9.1.2.

Defective fuel assemblies may be placed in defective fuel storage containers, which in turn are stored in a suitable storage rack. Defective fuel assemblies are assemblies that are unable to contain the fuel pellets and cannot be handled with normal fuel handling equipment. These may be used to isolate leaking or defective fuel while in the fuel pool and during shipping. Channels can be removed from the fuel bundle while in a defective fuel storage container.

The storage racks which hold control rod blades and/or defective fuel assemblies are special storage racks designed to hold various core components that cannot fit in the spent fuel storage racks. Control rod blades, incore detectors and dry tubes may also be stored on fuel pool walls (see Section 11.4.2.1.4). The storage rack is designed to hold control rod blades, control rod guide tubes, sipping containers and spent local power range monitor (LPRM) containers in any of its 49 storage cavities and defective fuel containers (with spent fuel) in any of 5 specially designed cavities. The special storage rack is nominally 83 inches square and 159.25 inches high. The empty, dry weight of the rack is approximately 12,190 pounds. The storage rack is placed in the fuel pool as indicated in Figures 9.1-34 and 9.1-36.

The storage rack's cavities are formed by a checker board placement of canisters. The canisters, stainless steel plate material bent in a rectangular shape, are welded to the bottom grid assembly such that the distance between cavity centers (i.e., canister centerline to intermediate cavity centerline) is approximately 11.665 inches. Storage cavities along the rack periphery will have their

outer wall made from stainless steel plate welded to the outer walls of adjacent canisters. Along the top of the rack is a 0.187 inch thick 3.50 inch wide stainless steel perimeter bar. The perimeter bar allows lateral loads to be shared by all canisters and helps to maintain the specified center-to-center cavity spacing.

The bottom grid assembly is made from stiffened stainless steel plate. For each cavity, a 3.625 inch diameter chamfered hole in the bottom load support plate of the grid assembly acts to center rack stored items and accommodates cavity cooling water flow.

The five cavities designed to hold defective fuel containers have a bottom load support that is 3.75 inches lower in the bottom grid assembly than the other 44 rack cavities.

The rack is supported by 4 foot assemblies (foot pad and foot adjusting screw), one centered under each of the four corner cells. The foot assembly will accommodate slight variations in the pool floor liner surface and is adjustable over a 1-inch band to facilitate rack leveling. The upper surface of the bottom grid assembly will be 9.75 (± 0.50) inches above the pool floor. This will allow at least 22 feet 8 inches of water above a fuel assembly placed in any one of the rack cavities. Ample space will exist under the rack for the flow of water to each of the cells.

The rack is seismic Category I and qualified structurally by detailed dynamic and static analyses. The rack is designed to withstand the effects of a Safe Shutdown Earthquake (SSE) and remain functional in accordance with NRC Regulatory Guide 1.29 and the Code of Federal Regulations Title 10, Part 50, Appendix A.

The dynamic evaluation for seismic loads used the non linear transient analysis computer program ANSYS. The transient boundary conditions (time histories) for the analysis were generated artificially utilizing the computer program SIMQKE with design response spectra characteristics provided by Limerick Specification 8031-G-19. The maximum calculated rack stress levels and displacements occurred during the Safe Shutdown Earthquake load analysis. The analysis determined that all computed stress levels were within appropriate limits for the rack structure and its individual constituents. Maximum potential displacements have been analyzed and determined to be acceptable.

The static evaluation determined rack suitability as a result of stress due to static load applications and fuel drop accident impact loads. All static load stresses are within appropriate limits for the rack structure and its individual constituents. The equivalent static load resulting from a dropped fuel assembly was obtained through an energy analysis. The impact damage resulting from the fuel drop accident is confined to a small area near the impact point. Stresses away from the impact point are low; therefore, the overall rack structure will not be adversely affected and no change in k_{eff} will be realized due to the rack structure realignment.

The fuel pool sipper may be used for out-of-core wet sipping at any time. It is used to detect a defective fuel bundle while circulating water through the fuel bundle in a closed system. The containers cannot be used for transporting a fuel bundle. The bail on the container head is designed not to fit into the fuel grapple.

9.1.4.2.9 Under-Reactor Vessel Servicing Equipment

The functions of the under-reactor vessel servicing equipment are as follows:

a. Remove and install CRDs

b. Remove and install the thermal sleeve

c. Install and remove the neutron detectors. Table 9.1-9 lists the equipment and tools required for servicing. Of the equipment listed, the equipment handling platform and the CRD handling equipment are powered electrically and/or pneumatically.

The CRD handling equipment is used to perform a CRD exchange (i.e. remove and install) from the CRD housing. The CRD handling equipment is designed in accordance with the following requirements:

- American Institute for Steel Construction (AISC) - Steel Construction Manual, 8th Edition;

- Aluminum Association - Specifications for Aluminum Structures, 5th Edition;

- American Welding Society, Specifications D1.1 and D1.2;

- Federal Specification on MIL-W-83420D, Wire Rope, Flexible for Aircraft Control;

- American National Standard ANSI B30.9-1971 (Wire Ropes);

- AGMA - American Gear Manufacturer's Association - Services Factors and Lead Classifications;

- NEMA - National Electric Manufacturer's Association (standards).

The equipment used to perform a CRD exchange is capable of inserting a force of approximately 1300 pounds. Also, all of the lifting components are equipped with adequate brakes or gears to prevent uncontrolled movement on a loss of air or component failure. The equipment is capable of re-inserting a CRD if it is still coupled to its control rod.

The equipment handling platform provides a working surface for equipment and personnel performing work in the under-vessel area. It is a polar platform capable of 360° rotation. This equipment is designed in accordance with the applicable requirements of OSHA (Volume 37, No. 202, Part 191 ON), AISC, and ANSI C-1 (National Electric Code).

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

The incore flange seal test plug can be 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 install and remove the antirotation key that is used on the thermal sleeve.

9.1.4.2.10 Description of Fuel Transfer

9.1.4.2.10.1 Arrival of Fuel Onsite

New fuel is delivered by truck (or by rail) and moved into the refueling hatch at grade level. Secondary containment can be maintained while the new fuel is being hoisted to the refueling floor.

9.1.4.2.10.2 Refueling Procedure

The general refueling floor layout is shown in drawings M-122 and M-137. Component drawings of the principal fuel handling equipment are shown in Figures 9.1-5 through 9.1-12.

The fuel handling process takes place primarily on the refueling floor above the reactor. The principal locations and equipment are shown in drawings M-122 and M-137. The reactor cavity, fuel pool, and cask storage pit are connected to each other by canals. The fuel transfer canal is open during reactor refueling, and the cask pit canal is open during spent fuel and ISFSI transfer cask handling in the Reactor Enclosure. The canals can be closed by redundant gates, which make watertight barriers. However, gates between the cask pit and the spent fuel pool will normally remain open during the transfer cask handling in the Reactor Enclosure.

New fuel, in shipping crates, is brought up to the refueling floor through the hatches, and spent fuel, in a shipping cask, is lowered through the hatches to a truck or rail car near grade level. The new fuel is placed in predesignated storage areas where it remains until it is processed and put in the spent fuel pool.

The method for transferring the fuel bundles between the crate, the new fuel inspection/channeling stand and spent fuel storage pool is accomplished by using a gantry crane or the reactor enclosure crane (125 ton main or 15 ton auxiliary hoist). The fuel is transferred from a predesignated storage area to a roller conveyer. The roller conveyer is located adjacent to the upending platform. At this point, the top is upended and placed into a vertical upending stand. After the fuel is unloaded, it is inspected and transferred to the fuel preparation machine.

The main or auxiliary hoist is used with a general purpose grapple to transfer a new fuel assembly to a fuel preparation machine. The fuel preparation machine lowers the new fuel into the pool, and henceforth, the fuel is positioned in a storage rack by the telescoping grapple on the refueling platform. It should be noted that secondary containment must be established when moving new fuel over recently irradiated fuel (i.e., fuel that has occupied part of a critical reactor core within the previous 24 hours).

The storage racks in the fuel pool hold the fuel bundles or assemblies vertically, in an array that is subcritical under all possible conditions.

The new fuel inspection/channeling stand holds one bundle vertically. The inspector(s) rides up and down on a platform, and the bundle is manually rotated on its axis. Thus the inspectors can see all visible surfaces.

The refueling platform uses a grapple on a telescoping mast for lifting and transporting fuel bundles or assemblies. The telescoping mast can extend to the proper work level, and, in its normal up position, adequate water shielding is maintained over the fuel being handled.

The refueling platform moves over the fuel pool, lowers the grapple on the telescoping mast, and engages the bail on a new fuel assembly that is in the fuel storage rack. The assembly is lifted clear of the rack and moved through the transfer canal and over the appropriate empty fuel location in the core. The mast then lowers the assembly into the location, and the grapple releases the bail.

The operator can then move the platform until the grapple is over a spent fuel assembly that is to be discharged from the core. The assembly is grappled, lifted, and moved through the transfer canal to the fuel pool. Here it can be placed in a spent fuel storage rack, fuel prep machine or a fuel bundle sipping container.

If channeling is to be performed, an operator working at the fuel prep machine using the channel bolt wrench, removes the channel fastener from the top of the channel. The channel is then held, while a carriage lowers the fuel bundle out of the channel. The channel is then moved aside, and the refueling platform grapple carries the bundle and places it in a storage rack. The channel handling boom hoist moves the channel to storage, if appropriate.

In actual practice, channeling and dechanneling may be performed in many sequences, depending on whether a new channel is to be used or a used channel is to be installed on a new bundle and returned to the core. A channel storage rack is conveniently located near the fuel prep machines for temporary storage of channels that are to be reused.

To preclude the possibility of raising radioactive material out of the water, redundant electrical limit switches are incorporated in the main hoist and interlocked to prevent hoisting above the preset limit. In addition, the cables on the auxiliary hoists incorporate adjustable stops that jam the hoist cable against the hoist structure, which prevents hoisting if the limit switch interlock system fails.

When spent fuel is to be shipped, it is placed in a cask. The refueling platform grapples a fuel bundle from the storage rack in the fuel pool, lifts it, carries it through the cask pit canal into the cask storage pit, and lowers it into the cask. When the cask is loaded, the crane sets the cask cover on the cask and then lifts the cask out of the pool. The cask is then decontaminated, sealed and lowered through the open hatchway to the truck or rail car at near grade level.

The provision of a separate cask storage pit, capable of being isolated from the spent fuel pool, eliminates the potential for accidental dropping of the cask and rupturing of the fuel storage pool.

Additional detailed information is provided below.

a. New fuel preparation

1. Receipt and inspection of new fuel

The incoming new fuel is delivered to the station where it is unloaded in a designated receiving area. The new fuel is shipped inside of a dual container system. The system consists of an inner metal container and an outer metal container. Each set of containers holds two fuel bundles. The shipping weight of each unit is approximately three-thousand (3000) pounds. After the fuel is unloaded, the outer metal containers are first examined for damage received during shipment. The containers are transferred to the refueling hoist-way. The main or auxiliary hoist of the reactor enclosure crane will hoist the containers to the refueling floor where they are placed in a predesignated area.

A gantry crane or the reactor enclosure crane will transfer the inner metal containers to a roller conveyer. The roller conveyer is located adjacent to the upending platform. At this time, the top and front of the metal container are removed. Using a jib crane and an electric hoist, mounted on the

upending platform, the metal container is upended and placed into the unloading stand. Using the hand hoist, which is also attached to the jib crane, the fuel is removed from the metal container and placed into the new fuel inspection/channeling stand (one of the two).

2. Channeling

Channeling of the fuel bundle takes place in the new fuel inspection/channeling stand. The channel is first examined for damage or defects. The new channel is raised over the fuel bundle and slowly lowered onto the fuel bundle. Once the channel is around the fuel, a channel fastener is used to clamp the channel to the fuel bundle, creating a fuel assembly. The complete fuel assembly is transferred to the fuel prep machine using the main or auxiliary hoist of the reactor enclosure overhead crane with a general purpose grapple. Once in the fuel prep machine, it is then lowered into the fuel pool and transferred to the fuel pool racks using the refueling platform.

3. Equipment preparation

Before the plant shutdown for refueling, all necessary equipment must be placed in readiness. All necessary tools, grapples, slings, strongbacks, stud tensioners, etc are given a thorough check, and any defective (or well worn) parts are replaced. Air hoses on grapples are routinely leak tested. Crane cables are routinely inspected. All necessary maintenance and interlock checks are performed to ensure that there is no extended outage due to equipment failure.

The incore flux monitors, in their shipping container, are on the refueling floor. The channeled new fuel and the replacement control rod blades are ready in the fuel pool.

b. Reactor shutdown

The reactor is shut down according to a prescribed procedure. During cooldown the RPV is vented and filled to above flange level to equalize cooling. The reactor well shield plugs can be removed. The upper layer of shield plugs may be removed once reactor power is lowered to less than or equal to 100%. The lower layer of shield plugs may be removed after the reactor has achieved hot shutdown. Prior to the removal of shield plugs in other than cold shutdown, there are specific conditions required to be satisfied per the general plant procedures. This is accomplished with the reactor enclosure crane and the lifting strongback. There are 12 pieces to handle.

This operation also includes the removal of the canal plugs and the slot plugs. A total of 16 separate plugs must be removed and placed on the refueling floor. Removal of these plugs may be performed out of sequential order as conditions permit. The outer fuel pool gate may also be removed at this time. A sling is attached to the gate lifting lugs, and the reactor enclosure crane lifts the gate and places it on the fuel pool storage lugs.

1. Drywell head removal

Immediately after removal of the lower layer of reactor well

shield plugs, the work to unbolt the drywell head can begin. The drywell head is attached by removable studs. The studs are unscrewed from the captive nut on the drywell and supported on the lip of the head.

The unbolted drywell head can be lifted by the overhead reactor enclosure crane attached by a hook box and transferred to its designated storage space on the refueling floor. The drywell seal surface protector can then be installed, if required.

2. Reactor well servicing

When the drywell head has been removed, an array of piping is exposed that must be serviced. Various vent piping penetrations through the reactor well must be removed and the penetrations made watertight. Vessel head piping and head insulation must be removed and transported to storage on the refueling floor.

The water level in the vessel is now brought to flange level in preparation for head removal.

c. Reactor vessel opening

1. Vessel head removal

The stud tensioners, as part of the strongback/ carousel assembly, are transported by the reactor enclosure crane and positioned on the reactor vessel head. Each stud is tensioned and its nut is loosened sequentially. When the nuts are loose, they are backed off using a nut runner until only a few threads engage. The nut is then rotated free from the stud. The nuts and washers are placed in the racks provided for them and can be transported to the refueling floor for storage. Alternately, the nuts and washers may be placed in the carousel storage compartments and stored with the carousel. With the nuts and washers removed, the vessel stud protectors and vessel head guide caps are installed.

The head strongback/carousel, transported by the reactor enclosure crane, is attached to the vessel head, and the head is transported 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.

The studs in line with the fuel transfer canal are removed from the vessel flange and can be placed in the rack provided. The loaded rack can be transported to the refueling floor for storage. Alternatively, the studs can be transported with the vessel head. The studs opposite the cattle chute are also removed to maintain balance when the studs are transported with the vessel head.

2. Dryer removal

The dryer/separator sling is lowered by the reactor enclosure 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/separator storage pool adjacent to the reactor well. Since the dryer is anticipated to be highly contaminated, the reactor well and storage pool is flooded and a wet transfer effected. An in-air transfer may be used if the dryer is kept wet to reduce the potential for airborne contamination.

3. Separator removal

From the auxiliary platform, or refueling platform work area, the four main steam lines are plugged from inside the vessel using the furnished plugs for this duty. The servicing of the main steam line isolation or safety relief valves can thus be accomplished without adding to the critical refueling path time. The separator is unbolted using shroud head bolt wrenches. This is accomplished by working from the auxiliary platform, or refueling platform.

The dryer/separator sling is lowered into the vessel and attached to the separator lifting lugs. If not already done, the water in the reactor well and in the dryer/separator storage pool is equalized with the fuel pool water level. This may be accomplished by raising the skimmer surge tank water levels, which communicates with both the spent fuel pool and reactor cavity. The separator is transferred underwater to its allotted storage place in the adjacent pool.

4. Fuel bundle sampling

During reactor operation, the core offgas radiation level is monitored. If a rise in offgas activity has been noted, fuel assemblies can be sampled during shutdown to locate any leaking fuel. Fuel sipping or sampling may be performed in the reactor vessel or the fuel storage pool in accordance with appropriate procedures. If a defective bundle is found, it can be stored in a special defective fuel storage container to prevent the spread of contamination in the fuel storage pool.

d. Refueling and reactor servicing

The remaining gate(s) isolating the fuel pool from the reactor well can be removed after the water level in the reactor well and dryer/separator storage pool is raised to the fuel pool water level, thereby interconnecting the fuel pool, the reactor well, and the dryer/separator storage pool. If required, the fuel pools can be cross-connected, at any time, through the cask storage pit to support refueling and reactor service. The actual refueling of the reactor can now begin.

1. Refueling

During a normal equilibrium outage, approximately one-third of the fuel is removed from the reactor vessel, two-thirds of the fuel is shuffled in the core (generally from peripheral to center locations), and one-third new fuel is installed. A full core off-load and reload may also be performed. The actual

fuel handling is done with the fuel grapple, which is an integral part of the refueling platform. The platform runs on rails over the fuel pool and the reactor cavity. In addition to the fuel grapple, the refueling platform is equipped with two auxiliary hoists that can be used with various grapples to service other reactor internals.

To move fuel, the fuel grapple is aligned over the fuel assembly, lowered, and grappled to the fuel assembly bail. The fuel assembly is manually raised out of the core, then may be automatically moved through the fuel transfer canal to the fuel pool, positioned over the storage rack, and lowered to its new storage location. Fuel is shuffled, and new fuel is manually grappled then moved (automatically or manually) from the storage pool to the reactor vessel in the same manner. The fuel movements outside of fuel entry zones may be accomplished in either the manual or automatic modes of operation for the refueling platform. Fuel movements inside the fuel entry zone may only be completed in the manual mode of operation.

A portable refueling shield is provided to reduce radiation dose rates in the drywell that are due to the transfer of spent fuel assemblies from the reactor vessel to the spent fuel pool. During refueling, the lead and steel shield is located in the reactor well, between the reactor vessel and the spent fuel pool, which permits continuous personnel occupancy of the drywell.

e. Vessel closure

The following steps, when performed, return the reactor to operating condition. In general, the procedures are the reverse of those described in the preceding sections. Many steps may be performed out of sequential order as conditions permit.

1. Install fuel pool gates and install cask pit gates as required. Restore operating unit skimmer surge tank as required.

2. Core verification: the core position of each fuel assembly must be verified to ensure that the desired core configuration has been attained.

3. CRD tests: the CRD timing, friction, and scram tests are performed.

4. Remove main steam line plugs.

5. Replace separator and latch.

6. Replace steam dryer.

7. Drain dryer/separator storage pool and reactor well and restore the outage unit skimmer surge tanks to normal operating levels as required.

8. Decontaminate reactor well.

9. Remove and store portable refueling shield.

10. Deleted.

11. Remove drywell seal surface covering, if used.

12. Open drywell vents.

13. Decontaminate dryer/separator storage pool.

14. Replace vessel studs.

15. Replace slot plugs.

16. Install reactor vessel head.

17. Install vessel head piping and insulation.

18. Replace dryer/separator canal plugs.

19. Hydro test vessel, if necessary.

20. Install drywell head.

21. Install reactor well shield plugs. Installation of the lower layer of the reactor cavity shield plugs must be completed prior to the reactor exceeding 1% reactor power. The upper layer of shield plugs and associated sealant material around the upper plugs must be installed prior to exceeding 25% reactor power.

22. 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.

9.1.4.2.10.3 Departure of Fuel from Site

The spent fuel shipping cask arrives by rail car or truck in the refueling hatch at grade level. It is lifted from there by the 125 ton hook of a reactor enclosure crane to the refueling floor and placed in the shipping cask washdown area between the fuel pools of Units 1 and 2.

The cask outside is decontaminated of road dirt, the lid is removed by the reactor enclosure crane, and the cask is placed in the shipping cask pit. The loading of the cask with irradiated fuel commences. The refueling platform is used to transfer fuel bundles of sufficiently low decay heat level from the spent fuel storage racks underwater into the shipping cask.

Following underwater replacement of the cask lid, the cask is lifted for decontamination. The reactor enclosure crane then transfers the cask from the storage pit onto the shipping vehicle. At no time will the cask be lifted or carried over spent fuel.

9.1.4.3 Safety Evaluation

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 9.1.4.2.10. In addition, the following summary safety evaluation of the fuel handling system is provided below.

The fuel prep machine removes and installs channels with all parts remaining underwater. Mechanical stops prevent the carriage from lifting the irradiated fuel bundle or assembly to a height where water shielding is less than 7 feet. Irradiated channels, as well as small parts such as bolts and springs, are stored underwater. The spaces in the channel storage rack have center posts that prevent the loading of fuel bundles into this rack.

During the course of the controlled fuel inspection irradiated fuel components, no fuel assemblies or bundles, may be raised such that there is less than 7 feet of water shielding above individual fuel pins (or rods).

While an entire irradiated fuel bundle will not be raised above the minimum 7 feet shielding level, fuel inspection activities may require individual fuel rods to be raised to a height maintaining no less than 6 feet water coverage.

A pair of rails which guide an instrument holder may be installed between the fuel preparation machine handrail and the lower fuel inspection fixture to permit remote inspection of fuel bundles.

There are no nuclear safety problems associated with the handling of a single new fuel bundle or a pair of new fuel bundles. Equipment and procedures prevent an accumulation of more than two bundles in any location.

The refueling platform is designed to prevent it from toppling into the fuel pool or core during an SSE. Redundant interlocks are provided to prevent the following:

a. Travel of the refueling platforms over the reactor core while in the startup mode,

b. Lifting a fuel bundle over the reactor core with one or more control rods withdrawn from core cells containing fuel assemblies, and in the refuel mode, and

c. Withdrawing one or more control rods with the refueling platform carrying a fuel bundle over the reactor core while in the refuel mode, unless all four fuel assemblies have been removed from the core cell(s) with rod(s) withdrawn.

A boundary zone limit system is normally available to assist the refueling platform operator, who is responsible to prevent collision of the fuel grapple with the spent fuel pool or reactor cavity walls during movements of spent fuel. In its normal up position, the grapple is minimal 6 feet 6 inches below the water surface; therefore, a fuel assembly will not be raised to a point where it will not be adequately shielded by water during normal refueling conditions. The grapple is hoisted by redundant cables inside the mast and lowered by gravity. A digital readout is displayed to the operator, showing the exact coordinates of the grapple over the core.

The mast is suspended and gimballed from the trolley, near its top, so that the mast can be swung about the axis of platform travel, to remove the grapple from the water for servicing and storage.

The grapple has two independent hooks, operated by an air cylinder. Engagement is indicated to the operator.

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 interlocks that prevent the hoists from moving anything classified as a heavy load.

The two auxiliary hoists have electrical interlocks that prevent the lifting of their loads higher than 6 feet 6 inches underwater at the normal up position. Adjustable mechanical jam stops and redundant electrical interlocks on the cables back up these interlocks.

In summary, the fuel handling system complies with GDC 2, GDC 3, GDC 4, GDC 5, GDC 61, GDC 62, and GDC 63, and other applicable portions of 10CFR50.

A system level, qualitative-type FMEA relative to this system is discussed in Section 15.9.

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

The safety considerations of the Control Rod Blade and Defective Fuel Storage Rack are presented in Section 9.1.4.2.

Regulatory Guide 1.13 (Rev 1) is applicable to the refueling platform within GE's scope of supply for this plant. The refueling platform is designed to prevent it from toppling into the fuel pool or core during an SSE.

9.1.4.4 Inspection and Testing Requirements

9.1.4.4.1 Inspection

Refueling and servicing equipment is subject to the strict controls of quality assurance, incorporating the requirements of 10CFR50, Appendix B. Components defined as essential to safety, such as the fuel storage racks and fuel prep machine, have an additional set of engineering specified "quality requirements" that identify safety-related features that require specific QA verification of compliance to drawing requirements.

Before shipment, every safety-related component inspection item is reviewed by QA supervisory personnel and combined into a summary product quality checklist. By issuance of the product quality checklist, 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 before multiunit production. Test specifications are defined by the responsible design engineer and may include the 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, calculation, or design review.

Functional tests are performed in the shop before 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 ensure that 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 before use.

9.1.4.5 Instrumentation Requirements

Most of the refueling and servicing equipment is manually operated and controlled by the operator's visual observations. This type of operation does not necessitate a dynamic instrumentation system.

However, there are several components that do have instrumentation and control systems.

9.1.4.5.1 Refueling Platform

The refueling platform has a nonsafety-related X-Y-Z position indicator system that informs the operator which core fuel cell the fuel grapple is accessing. The refueling platform controls in conjunction with the X-Y-Z position indicator system can automatically position the fuel grapple over any valid fuel cell location. An interlock status display is provided to the refueling platform operator. See Section 7.7 for a discussion of refueling interlocks.

Additionally, there is a series of mechanically and electronically activated switches and relays that provides monitor indications on the operator's console for grapple limits, hoist and cable load conditions, and confirmation that the grapple's hook is engaged.

A series of load cells is installed to provide automatic shutdown whenever threshold limits are exceeded on either the fuel grapple or the auxiliary hoist units.

9.1.4.5.2 Fuel Support Piece Grapple

Although the fuel support piece grapple is not essential to safety, it has an instrumentation system consisting of mechanical switches and indicator lights. This system can provide the operator with a positive indication that the grapple is properly aligned and oriented and that the grappling mechanism is either extended or retracted. The operator may elect to perform manual manipulations to determine grapple engagement.

9.1.4.5.3 Other Equipment

See Table 9.1-6 for additional refueling and servicing equipment not requiring instrumentation.

9.1.4.5.4 Radiation Monitoring

The radiation monitoring equipment for the refueling and servicing equipment is evaluated in Section 7.6.

9.1.5 REACTOR ENCLOSURE CRANE

The reactor enclosure crane is a bridge crane mounted on runway rails that are supported by the secondary containment superstructure. The crane serves both units and is designed to be used normally during maintenance and refueling operations.

9.1.5.1 Design Bases

a. The reactor enclosure crane is designed to move loads from one location to another in the refueling area and also between plant grade level and the refueling area level.

b. The reactor enclosure crane is designed to handle loads with a maximum weight of 125 tons while maintaining a minimum safety factor of 5.

c. The main hoisting system of the reactor enclosure crane is designed so that the failure of any single component does not result in a sudden displacement or dropping of the load.

d. The reactor enclosure crane is designed to prevent movement of the crane over the new fuel and spent fuel storage areas in the absence of specific action by the crane operator to allow such movement.

e. The reactor enclosure crane is designed to maintain its structural integrity in the event of an SSE.

9.1.5.2 Equipment Design

The reactor enclosure crane is a bridge crane mounted on runway rails that are supported by the secondary containment superstructure. The bridge consists of two welded box girders held together with structural end beams. These two end beams are supported by wheeled trucks that travel on top of the runway rails. Two trucks, each consisting of two wheels, are located at each end of the bridge.

The structural frame support for the reactor enclosure crane hoisting machinery is the trolley, which moves by tractive power on trucks over rails secured to the top of the two crane girders. Two hoists are provided, a main hoist with a design capacity of 125 tons and an auxiliary hoist with a design capacity of 15 tons (design rated load). The maximum critical load (MCL) for the main hoist is 125 tons and for the auxiliary hoist is 6.75 tons. The electric-powered hoists raise and lower loads by wire rope reeving through upper and lower sheaves, the lower sheaves being an integral part of the load block. Each hoist is equipped with a hook attached to its respective load block.

Design parameters for the reactor enclosure crane are listed in Table 9.1-10.

The fuel handling function of the reactor enclosure crane is to transport new fuel assemblies to the fuel preparation machines and to handle the spent fuel shipping casks. The crane was purchased prior to the issuance of ANS 57.1, and thus the requirements of this standard were not explicitly followed in the design and manufacture of the crane. The crane has been reviewed against the applicable requirements of ANS 57.1; these requirements and the results of the review are summarized in Table 9.1-22. ANS 57.1 guidelines not listed in Table 9.1-22 are either not

applicable to the reactor enclosure crane during fuel handling or are recommendations rather than requirements.

All of the applicable guidelines of ANS 57.2 (1976) are met for the cask handling function of the reactor enclosure crane, except that the crane bridge is not prevented from passing over the spent fuel pool. The hoists, however, are prevented from lifting loads heavier than a fuel assembly over stored spent fuel by interlocks and an administrative control system. Restrictions on heavy loads carried near the spent fuel pool are discussed in Reference 9.1-1.

The design of the reactor enclosure crane includes the following features:

a. Structural components

All the structural components and machinery of the reactor enclosure crane are designed for a full capacity of 125 tons on the main hoist or 15 tons on the auxiliary hoist (design rated load). The maximum critical load (MCL) for the main hoist is 125 tons and for the auxiliary hoist is 6.75 tons, with a minimum safety factor of 5 against ultimate failure for the load-carrying parts and the machinery. The structural components, except for the bridge girders, have a design safety factor of 2.5 against yield. For the hoisting mechanism, all load-carrying parts except structural members are designed with a minimum safety factor of 5 against ultimate failure. The calculated stresses of all load-carrying parts are in accordance with the requirements of Crane Manufacturer's Association of America Specification 70.

The structural members of the reactor enclosure crane are designed for a fatigue loading of 20,000-100,000 cycles, with each completed lift representing one cycle. The rotating machinery is designed for a fatigue life expectancy of 2,000,000 cycles, with each rotating component cycle represented by one revolution. Any load below 50% of the crane rated capacity does not reduce the life expectancy of the crane.

b. Mechanical components

The crane is of a single-trolley, indoor, electric overhead, bridge crane design. The trolley layout is shown in Figure 9.1-18.

The main hoist consists of two balanced, eight-part reeving systems to provide redundancy. The arrangement consists of two separate and redundant wire cables reeved side-by-side through the upper and lower sheaves, as shown in Figure 9.1-19. Each cable passes through a paired equalizer unit that adjusts for unequal cable length and is used as a load transfer safety system. This energy-absorbing device eliminates sudden load- displacement and shock to the crane system in the unlikely event of a cable break. The factor of safety (static) is halved when a cable breaks, but no swinging action occurs because each cable is reeved to both sides of the upper and lower sheaves.

The auxiliary hoist is provided with a two-part reeving system as shown in Figure 9.1-20.

The main functions of the main hoist equalizer system are to continually adjust the hook load so that any load under normal operation is shared equally by the redundant reeving systems and to transfer the shock of a cable break in an acceptably safe dynamic fashion to the remaining cable. The equalizer assembly is shown in Figure 9.1-21. The main hoist uses a redundant equalizer shaft that consists of a solid rod within a hollow tube; either shaft can support the full load if there is a failure of the other. If there is an exaggerated displacement of the equalizer assembly caused by a cable break, either of two proximity limit switches would be activated. The equalizer system of the main hoist uses vane-type limit switches that stop the hoisting motion if the hoisting rope length needs adjustment. The hoisting motion also stops if one set of reeving fails, so that the broken cable can be removed before it becomes entangled with the other reeving system. This equipment protection mechanism stops the hoisting motion by cutting power to the hoist motor and setting the hoist brakes. Before making a series of lifts the equalizer bar can be visually inspected, and adjusted if necessary, so that an unnecessary power shutoff does not occur. If the equalizer bar needs to be adjusted during a lift, the load can be lowered and the adjustment made at the cable drum anchors. If the equalizer bar reaches the limits of its travel, which should occur only if one of the cables had already failed, the load can be safely lowered with the remaining cable so that a new cable can be installed.

The main hook is a two-pronged sister hook with safety latches and a cored bail hole. Redundancy is provided in the main hook by incorporating a coaxial "hook within a hook" design. The safety latches are required when handling loads using “flexible” rigging (such as slings) in order to prevent rigging from coming off the main hook when the rigging is slack. The shaft of the outer hook is bored out to accommodate the inner hook shaft as shown in Figure 9.1-22. Each hook is independently supported by its respective crosshead and antifriction bearings that are in turn supported by the load block, as shown in Figure 9.1-23. The bail hole and each set of prongs have a design rated capacity of 125 tons, with a conservative safety factor to ultimate strength greater than 5.

The main hoist mechanism is equipped with one load brake and three redundant holding brakes. The load brake is a dc-actuated, eddy current, control-type brake and is used to regulate load lowering and raising speed. The holding brakes are dc magnet brakes that employ rectifiers to permit the use of ac power supply. Two of the holding brakes are applied immediately when power is interrupted to the main and creep motors. The third holding break is applied after a short time-delay. All three holding breaks are released when power is supplied to either the main or creep motor with no time delays. The torque rating of each of the four hoist brakes is at least 150% of rated full load hoist motor torque.

c. Crane controls

An operator's cab is provided at the south end of the reactor enclosure crane. The crane can be controlled from the cab or from a radio controller.

Movements of the bridge, trolley, main hoist, and auxiliary hoist can be controlled from either the cab or the radio controller. Both the radio controller and cab controls include a main power control switch that will interrupt all power to the crane except

for the utility lights and heaters. Motion control push buttons in the cab are of the momentary contact-type that return to the OFF position when released.

The radio controller uses levers for bridge, trolley, main hoist and auxiliary hoist motion. They are spring return to off position when released.

d. Hoist limit switches

The extent of travel for both the main hoist and the auxiliary hoist is limited for both the raising and lowering directions by a combination of limit switches. Redundant limit switches are provided for both hoists in the raising direction and for only the main hoist in the lowering direction. The primary protection for both hoists for both directions are geared limit switches coupled to the hoist drum shafts and interrupt power to the hoist motors via the control circuitry. The secondary protection for the auxiliary hoist in the raising direction is a weighted limit switch which also interrupts power to the auxiliary hoist motor via the control circuitry. The secondary protection for the main hoist in the raising direction for both the main and creep drive motors are weighted limit switches which interrupt power to each drive motor directly. The secondary protection for the main hoist in the lowering direction is a geared limit switch coupled to the gear case output shaft which interrupts all power to the crane except for the utility lights and heaters. When the power to any of the three hoist motors is interrupted, the breaks for that hoist will automatically set. The primary and upper redundant limit switches are wired so that the motor can be energized in the reverse direction after a limit switch has been tripped.

Both the main hoist and the auxiliary hoist are equipped with a centrifugal-type limit switch, located on the drum shaft, to provide automatic shutdown protection (hoist motor trip and setting of the holding brakes) against any control or motor malfunction that might result in a runaway condition of the load. The trip setting is at 120% or less of hoist motor synchronous speed.

A load-sensing system is provided for the main hoist, using a load cell mounted under the equalizer shaft. Digital readout of the load is provided in the operator's cab. Overload protection is provided by automatic shutdown (hoist motor trip and setting of the holding brakes), when the overload setpoint (100% to 115% of rated load) is exceeded.

The response time to stop the main hoist motion if there is actuation of a hoist overspeed, overload, or overtravel limit switch is such that the load block movement is less than 3 inches following actuation of one of the hoist limit switches.

e. Bridge and trolley drives and controls

The bridge and trolley have static stepless control on travel speed from minimum to maximum speed. Both the bridge and trolley have braking systems that must be energized to release and that automatically set if there is a power loss. The bridge is equipped with two electric brakes and two hydraulic brakes, each of which has a torque rating equal to 125% of maximum torque of one bridge drive motor. The trolley is equipped with two magnetic brakes, each of which has a torque rating equal to 50% of the maximum torque of the trolley drive motor.

The programmable limit system will provide protection to both the bridge and trolley near the ends of their respective rails to stop bridge or trolley movement before bumper contact occurs. In addition, the crane is equipped with zone travel programmable limit switches to prevent passage of the load over or near the spent fuel pool or the new fuel storage vault. These protected areas are shown in Figure 9.1-24. The tripping of the travel limit switches or motor overloads cuts off power to the bridge and trolley drive motors and sets the brakes. A key-locked bypass switch is provided in the crane controls so that the operator may consciously override the zone travel limitations.

f. Thermal overload protection

Thermal overload protection is provided for motors on the crane to prevent continuation of motor-stalling torque. In addition, a thermal overload warning indication for the main hoist motor is provided in the operator's cab.

9.1.5.3 Loads

Refueling operations and spent fuel shipping cask handling are discussed in Section 9.1.4. The following is a listing of specific items, and their approximate weights, that are handled by the reactor enclosure crane during and after each reactor refueling.

Drywell head		104 tons
Reactor vessel head		88 tons
Steam separator assembly		82 tons
Steam dryer		39 tons
Reactor well shield plugs	No. 1 & 2	61 tons each
	No. 3 & 4	69 tons each
	No. 5 & 6	85 tons each
	No. 7 & 8	82 tons each
	No. 9 & 10	85 tons each
	No. 11 & 12	12 tons each
Reactor refueling shield		22 tons
Dryer/separator canal plugs	2 of No. 3	59 tons each
	No. 14	59 tons
Refueling slot plugs	No. 15	38 tons
	No. 16	38 tons
Spent fuel shipping cask		100 tons
Reactor Cavity Work Platform		38 tons

Independent Spent Fuel Storage Installation Transfer Cask *(115 tons assumed for conservatism)	107.6* tons

9.1.5.4 Safety Evaluation

Complete redundancy is provided for the main hoist load-bearing and load-holding equipment of the reactor enclosure crane, including sheaves, ropes, equalizer assembly, reducing gears, and holding brakes, so that no single component failure results in an uncontrolled lowering or dropping of a load within the rated capacity of the crane. The equalizer assembly is an energy-absorbing device that eliminates sudden load-displacement and shock to the crane system in the unlikely event of a rope break. This single failure proof design conforms to NUREG-0554 and NUREG-0612, as further discussed in Reference 9.1-1.

Load-bearing members and main hoist equipment of the reactor enclosure crane are designed in accordance with seismic Category I criteria so that the crane can structurally withstand the SSE and maintain the fully rated load in a static position during and following an SSE. Antiderail devices are installed to preclude derailment of the bridge or trolley under seismic loading.

The crane bridge and trolley are equipped with zone travel programmable limit switches to prevent passage of the load over or near the spent fuel pool and the new fuel storage vault. The travel limitations can be bypassed only by conscious operator action. Figure 9.1-24 illustrates the area on the refueling floor over which crane movement is prevented without such deliberate bypass. The spent fuel shipping cask is described in Section 9.1.4. A spent fuel shipping cask drop accident analysis is discussed in Section 15.7.5.

The cask storage pit is separated from the spent fuel pool to minimize the proximity of the spent fuel shipping cask to the fuel storage racks during cask handling operations. The layout of the refueling area is such that the cask is moved in a single straight line between the cask storage pit and the refueling hatch. Both the cask storage pit and the refueling hatch are located on the plant centerline, which allows cask handling to be performed without moving the bridge.

A FMEA for the reactor enclosure crane is presented in Table 9.1-11. Although it has been withdrawn, for purposes of information presentation, conformance with Regulatory Guide 1.104 is discussed in Table 9.1-12.

9.1.5.5 Inspection and Testing

Magnetic particle inspection of reactor enclosure crane components during fabrication is performed in accordance with ASTM E 109 and ASTM E 138 for dry and wet processes, respectively. Ultrasonic inspection is performed in accordance with ASTM A 388. NDT procedures for testing plate, shafts, and for groove welds and radiographic examination of groove welds are based on applicable ASTM and AWS D1.1 specifications.

9.1.5.5.1 Structural Members

The following welds are 100% examined by the magnetic particle method:

a. Girder top and bottom cover plate splice butt welds

b. Girder web plate splice butt welds

c. Girder top and bottom cover plate to web plate fillet welds

d. Girder notch shelf plate to web plate fillet welds

e. End truck top and bottom cover plate to web plate fillet welds

f. Trolley side, top and bottom cover plate to web plate fillet welds

g. Trolley side to girt plate fillet welds

h. Load block frame fillet welds as accessible

i. End tie top plate to web plate fillet welds

9.1.5.5.2 Load-Bearing Components

All gears, pinions, swivels, hoist shafts, and hook trunnions in both the main and auxiliary hoist assemblies are 100% nondestructively examined by the magnetic particle method, in addition to 100% ultrasonic examination of swivels.

9.1.5.5.3 Hooks

Following forging, both the main and auxiliary hooks are examined by both the ultrasonic and magnetic particle methods. Each hook is then given a load test by the crane manufacturer according to the following procedure: A dimensional check of the hook is performed and the dimensions recorded. The hook is then proof-tested at 200% of its rated capacity. After the test, the hook is given a magnetic particle examination, and its dimensions are rechecked and recorded. The hook is accepted if no cracks, permanent deformation, or other defects are produced by the testing.

9.1.5.5.4 Ropes

Samples are taken from each wire rope to be used in the crane and are subjected to destructive breaking strength tests to verify that the rope exceeds the manufacturer's published value for breaking strength. At least two such tests are performed on each rope.

9.1.5.5.5 Performance and Acceptance Tests

After erection of the crane in the reactor enclosure, extensive performance and acceptance testing is carried out, including:

a. Detailed checking of all mechanical and electrical components of the crane to verify proper assembly and operation

b. Running-in tests at no-load. This test includes all speeds and motions for which the crane is designed plus verification of the proper operation of all limit switches.

c. Load testing of the main hoist at 125% of its rated capacity and of the auxiliary hoist at 120% or greater of its rated capacity. These tests include the full range of movement for hoist raising and lowering and bridge and trolley travel.

d. Performance testing at 100% of the rated capacity. This test includes all speeds and motions for which the crane is designed, plus verification of the proper operation of all limit switches. However, performance testing at less than 100% of rated capacity will be conducted on the geared upper limit switch, the programmable limit switches that limit movement over the spent fuel pool, and prevent movement to the extreme ends of the bridge and trolley rails. A performance test at 100% of the rated capacity will be conducted on the weighted upper limit switch. However, the load will be raised from a position just off the floor at maximum speed, and the upper limit switch will be manually tripped (Table 9.1-12, footnote 18).

9.1.6 REFERENCES

9.1-1 Limerick Generating Station, Limerick Units 1 and 2, Overhead Handling Systems Review Final Report, Bechtel Revision 6 (PECO Revision 1), August 1989.

9.1-2 R.J. Fritz, "The Effects of Liquids on the Dynamic Motions of Emmersed Solids", Journal of Engineering for Industry, (February 1972).

9.1-3 "Simulated Rack Minimum Coefficient of Friction" by PaR.

9.1-4 Professor Ernest Rabinowicz, "Friction Coefficients of Water-Lubricated Stainless Steels for a Spent Fuel Rack Facility", Massachusetts Institute of Technology, performed for Boston Edison Company.

9.1-5 "Current Trends in Fuel Performance," presented at the ANS Topical Meeting on Water Reactor Fuel Performance, St. Charles, Illinois (May 9-11, 1977).

9.1-6 "Licensing Report for Spent Fuel Storage Capacity Expansion, Limerick Generating Station", HOLTEC International.

9.1-7 “General Electric Standard Application for Reactor Fuel (GESTAR-II)”, including the United States Supplement, NEDE-24011-P-A and NEDE-24011-P-A-US, (latest approved revision).

9.1-8 “Limerick Generating Station Spent Fuel Storage K-infinity Conversion Analysis”, GENE-155-93032, DRF A00-05449, June 1993.

9.1-9 “Evaluation of Limerick (Holtec) High Density Storage Rack K-infinity Criterion”, GENE-155-94-075, DRF J11-02394, October 14, 1994.

9.1-10 “SVEA-96 Lead Fuel Assemblies for Limerick 2”, Supplemental Lead Fuel Licensing Report, ABB Atom Report BR 91-042, January 1991.

9.1-11 “GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II),” NEDC-32868P, (latest approved revision).

9.1-12 "GE14 Fuel Design Cycle-Independent Analyses for Limerick Generating Station, Units 1 and 2," GE-NE-L12-00884-00-01P, March 2001.

9.1-13 "GE14 Spent Fuel Storage Rack Criticality Analysis for the Limerick Generating Station, Unit 2" Global Nuclear Fuel Document No. J11-03898-01-SFP, March 2001.

9.1-14 "GE14 Spent Fuel Storage Rack Criticality Analysis for the Limerick Generating Station, Unit 1" Global Nuclear Fuel Document No. J11-03932-00-SFP, May 2001.

9.1-15 "Limerick Report for Spent Fuel Storage Capacity Expansion," Holtec International Report No. HI-931012, Revision 2, approved October 1, 1993 (Technical Specifications Amendments 82 and 43 for Unit 1 and Unit 2, respectively).

9.1-16 "LGS Unit 1 and 2 Thermal Hydraulic Analysis for Reducing the In-Core Decay Time from 125 Hour to 40 Hours," approved January 9, 1995.

9.1-17 "Thermal Hydraulic Evaluation of Limerick Unit 1 Fuel Pool Cooling," Holtec International Report No. HI-2094497 approved February 3, 2010, Exelon Doc No. LEAM-MUR-0067.

9.1-18 "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," Global Nuclear Fuels Document NEDC-33270P, (latest approved revision).

9.1-19 "Criticality Safety Evaluation for GNF2 Fuel in the SFP at Limerick," Holtec International Report HI-2104779, Revision 1.

Table 9.1-1

FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN PARAMETERS

FUEL POOL COOLING PUMP

Type	Vertical, centrifugal
Quantity	2 plus 1 backup
Flow, each	600 gpm
Total discharge head	200 ft
Rated power, each	50 hp
Design pressure	127 psig
Design temperature	150°F

FUEL POOL F/D HOLDING PUMP

Type	Horizontal, centrifugal
Quantity	1 per filter/ demineralizer unit
Flow, each	27 gpm
Total discharge head	60 ft
Rated power, each	3 hp
Design pressure	175 psig
Design temperature	155°F

FUEL POOL SKIMMER SURGE TANK

Type	Vertical, cylindrical
Quantity	2
Capacity, each	4690 gal

FUEL POOL FILTER/DEMINERALIZER

Type	Vertical, cylindrical
Quantity	1 per reactor unit plus one spare
Flow, each	550 gpm
Design pressure	175 psig
Design temperature	235°F

FUEL POOL HEAT EXCHANGER *

Type	Shell and straight tube
Quantity	2 plus 1 backup *
Duty, each	4.0×10^6 Btu/hr

	Tube Side	Shell Side
Flow, each	1100 gpm	600 gpm
Design pressure	125 psig	75 psig
Design temperature	200°F	200°F

* For a normal refueling discharge heat load of 16.1 MBTU/hr, each Unit 1 heat exchanger is approxinmatley 50% capacity. For a normal refueling discharge heat load of 18.05 MBTU/hr, each Unit 2 heat exchanger is approximately 50% capacity. Administrative controls assure that FPCC is not relied on for fuel pool cooling, unless the heat load is equal to or less than 16.1 MBTU/hr on Unit 1 and 18.05 MBTU/hr on Unit 2.

Table 9.1-2

Table Information **Deleted**

Table 9.1-2A

FUEL POOL COOLING SYSTEM HEAT REMOVAL CAPACITY
AND MAKEUP REQUIREMENTS (ORIGINAL DESIGN)

PARAMETER	VALUE AT NORMAL HEAT LOAD		VALUE AT MAX MUM HEAT LOAD	
Quan ity of fuel	33% core:	4.5 yr exposure(3)(1) 10 day decay	33% core:	4.5 yr exposure(2)(1) 10 day decay
	33% core:	4.5 yr exposure(3) 1.5 yr decay + 1 mo	33% core	4.5 yr exposure(2) 10 day decay
	33% core:	4.5 yr exposure(3) 3.0 yr decay + 2 mo	33% core:	4.5 yr exposure(2) 10 day decay
	33% core:	4.5 yr exposure(3) 4.5 yr decay + 3 mo	33% core:	4.5 yr exposure(3) 1.5 yr decay + 1 mo
	33% core:	4.5 yr exposure(3) 6.0 yr decay + 4 mo	33% core:	4.5 yr exposure(3) 3.0 yr decay + 2 mo
	33% core:	4.5 yr exposure(3) 7.5 yr decay + 5 mo	33% core:	4.5 yr exposure(3) 4.5 yr decay + 3 mo
	33% core:	4.5 yr exposure(3) 9.0 yr decay + 6 mo	33% core:	4.5 yr exposure(3) 6.0 yr decay + 4 mo
	33% core:	4.5 yr exposure(3) 10.5 yr decay + 7 mo	33% core:	4.5 yr exposure(3) 7.5 yr decay + 5 mo
	33% core:	4.5 yr exposure(3) 12.0 yr decay + 8 mo	33% core:	4.5 yr exposure(3) 9.0 yr decay + 6 mo
	33% core:	4.5 yr exposure(3) 13.5 yr decay + 9 mo	33% core:	4.5 yr exposure(3) 10.5 yr decay + 7 mo
	13% core:	4.5 yr exposure(4)(6) 15.0 yr decay + 9 mo	22% core:	4.5 yr exposure(5)(6) 12.0 yr decay + 8 mo
Initial heat load	$1.63x10^7$ Btu/hr		$3.64x10^7$ Btu/hr	
Number of pumps and heat exchangers required	2		RHR system	
Water makeup requirements due to boiling losses	61.4 gpm maximum		-	

Table 9.1-2A (Cont'd)

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(1) Exposure of fuel based on 39,420 MWD/MT for 4.5 yr exposure.
(2) This makes a full core discharge. The 4.5 yr exposure for the entire full core discharge is conservative.
(3) 33% core = 276 assemblies for conservatism.
(4) 13% core = 102 assemblies. This fills all fuel rack storage loca ions.
(5) 22% core = 166 assemblies. This fills all fuel rack storage loca ions.
(6) Assumes maximum spent fuel storage rack inventory, 23 racks (i.e. the Control Rod Blade and Defective Fuel Storage Rack is not in the pool).

Table 9.1-2B

FUEL POOL COOLING SYSTEM HEAT REMOVAL CAPACITY
AND MAKEUP REQUIREMENTS - INCREASED STORAGE CAPACITY
(Reference 9.1-15)

UNIT 1 (6)

PARAMETER	VALUE AT NORMAL HEAT LOAD(1) (2) (5)		VALUE AT MAXIMUM HEAT LOAD(1) (2) (5)	
Quan ity of fuel	36% core:	6 yr exposure 6.7 day decay (3)	100% core:	6 yr exposure 9.1 day decay (3)
	36% core:	6 yr exposure 2 yr decay	36% core	6 yr exposure 2 yr decay
	36% core:	6 yr exposure 4 yr decay	36% core:	6 yr exposure 4 yr decay
	36% core:	6 yr exposure 6 yr decay	36% core:	6 yr exposure 6 yr decay
	36% core:	6 yr exposure 8 yr decay	36% core:	6 yr exposure 8 yr decay
	36% core:	6 yr exposure 10 yr decay	36% core:	6 yr exposure 10 yr decay
	36% core:	6 yr exposure 12 yr decay	36% core:	6 yr exposure 12 yr decay
	36% core:	6 yr exposure 14 yr decay	36% core:	6 yr exposure 14 yr decay
	34% core:	6 yr exposure 16 yr decay	34% core:	6 yr exposure 16 yr decay
	37% core:	6 yr exposure 18 yr decay	37% core:	6 yr exposure 18 yr decay
	15% core:	6 yr exposure 20 yr decay	15% core:	6 yr exposure 20 yr decay
	103% core:	6 yr exposure 22 yr decay	103% core:	6 yr exposure 22 yr decay

Table 9.1-2B (Cont'd)

FUEL POOL COOLING SYSTEM HEAT REMOVAL CAPACITY
AND MAKEUP REQUIREMENTS - INCREASED STORAGE CAPACITY
(Reference 9.1-15)

UNIT 2

PARAMETER	VALUE AT NORMAL HEAT LOAD[(1) (2) (5)]		VALUE AT MAXIMUM HEAT LOAD[(1) (2) (5)]	
Quan ity of fuel	36% core:	6 yr exposure 6.7 day decay [(3)]	100% core:	6 yr exposure 9.1 day decay [(3)]
	36% core:	6 yr exposure 2 yr decay	36% core	6 yr exposure 2 yr decay
	36% core:	6 yr exposure 4 yr decay	36% core:	6 yr exposure 4 yr decay
	36% core:	6 yr exposure 6 yr decay	36% core:	6 yr exposure 6 yr decay
	36% core:	6 yr exposure 8 yr decay	36% core:	6 yr exposure 8 yr decay
	36% core:	6 yr exposure 10 yr decay	36% core:	6 yr exposure 10 yr decay
	36% core:	6 yr exposure 12 yr decay	36% core:	6 yr exposure 12 yr decay
	36% core:	6 yr exposure 14 yr decay	36% core:	6 yr exposure 14 yr decay
	36% core:	6 yr exposure 16 yr decay	34% core:	6 yr exposure 16 yr decay
	37% core:	6 yr exposure 18 yr decay	36% core:	6 yr exposure 18 yr decay
	15% core:	6 yr exposure 20 yr decay	36% core:	6 yr exposure 20 yr decay
	36% core:	6 yr exposure 22 yr decay	36% core:	6 yr exposure 22 yr decay
	37% core:	6 yr exposure 24 yr decay	37% core:	6 yr exposure 24 yr decay
	29% core:	6 yr exposure 26 yr decay	29% core:	6 yr exposure 26 yr decay

Table 9.1-2B (Cont'd)

FUEL POOL COOLING SYSTEM HEAT REMOVAL CAPACITY
AND MAKEUP REQUIREMENTS - INCREASED STORAGE CAPACITY
(Reference 9.1-15)

PARAMETER	VALUE AT NORMAL HEAT LOAD (3) (6) (7)	VALUE AT MAXIMUM HEAT LOAD (3) (4)
Initial Heat Load	1.805×10^7 Btu/hr (3) (6) (7)	3.76×10^7 Btu/hr (3) (4)
Number of Pumps and Heat Exchangers Required	2	RHR system
Water Makeup Requirements due to boiling losses	39.7 gpm (7)	81 gpm (4)

(1) Percentage of core is based on 764 fuel assemblies.

(2) Fuel assemblies in the spent fuel pool prior to analysis.

(3) 125 hour in-core decay time prior to movement of fuel assemblies.

(4) For a reactor power of 3527 MW, an in-core decay time of 40 hours and a transfer rate of 10 fuel assemblies per hour (approximately 2.8 day decay), the initial heat load is 4.801×10^7 Btu/hr with a water makeup requirement of 102.02 gpm (Reference 9.1-17).

(5) A one time per unit refueling cycle length extension to approximately 27 months (from a nominal 24 months) for Unit 1 Cycle 7 and Unit 2 Cycle 5 was evaluated. The increase in decay heat generation due to each core's total operating period of 6.25 years (vs. 6 years) has been determined to have no significant effect on maximum calculated fuel pool heat load.

(6) Administrative controls assure that FPCC is not relied on for fuel pool cooling unless he heat load is equal to or less han 1.61×10^7 BTU/hr due to the smaller heat removal capacity of the backup Unit 1 FPCC heat exchanger.

(7) For a reactor power of 3527 MW, an in-core decay time of 40 hours and a transfer rate of 10 fuel assemblies per hour (approximately 2.8 day decay), the initial heat load is 2.477×10^7 Btu/hr with a water makeup requirement of 51.29 gpm (Reference 9.1-17).

Table 9.1-3

FUEL POOL COOLING SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Normal	Fuel pool cooling water pumps	Failure of one pump with two pumps operating or one pump when one pump is operating	Decreased or loss of system flow	Low pressure alarm on local control panel and common trouble alarm in main control room	The spare pump is started by the operator to restore design flow.
Normal	Service water pumps	Loss of service water pump	Decreased system flow	Low pressure alarm in main control room	The spare pump is started by the operator to restore design flow .
Normal	Fuel pool service water booster pumps	Loss of service water booster pump	Decreased system flow	Pump Trip alarm in main control room	The spare pump is started by the operator to restore design flow .
Normal	Makeup from demin water tank	Any failure or failures that result in loss of water supply	Loss of normal makeup of demineralized water	Visual inspection during filling operation	The pool can be filled by temporary means or from one of the seismic Category I makeup supplies.
Accident	RHR pump	Failure of pump with full core unloaded into spent fuel pool	Loss of RHR cooling supplementation	Low pressure alarm in main control room	The other RHR pump associated with the RHR heat exchanger that services the fuel pool is started to restore cooling flow to the spent fuel pool.
Accident	RHR heat exchanger	Loss of cooling water to heat exchanger with full core unloaded into spent fuel pool	Loss of RHR cooling supplementation	RHRSW pump discharge low pressure alarm in main control room	The other RHRSW pump in the RHRSW loop is started to to restore cooling water flow to the RHR heat exchangers.

Table 9.1-3 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Accident	RHR system valves	Failure of a single power-operated valve with full core unloaded into spent fuel pool	Loss of RHR cooling supplementation	Valve indication in main control room	If the RHR system cannot be realigned or the failed valve manually operated to restore cooling, boiling may occur. In this case sufficient water from seismic Category I makeup sources can be supplied to offset water losses due to boiling.
Accident	Power supply	Loss of offsite power	Loss of normal power to system	Alarm in main control room	Two of the fuel pool cooling pumps can be powered from the diesel generators. Addi ionally, the RECW system, in conjunction with the ESW system, can be used to provide cooling water to the fuel pool heat exchangers. These systems are powered from the diesel generators.
Accident	FPCC system	Loss of system function due to seismically induced damage	Loss of cooling to spent fuel pool	spent fuel pool low level alarm in the main control room	The spent fuel pool will start to boil. The seismic Category I makeup sources are used to supply sufficient water to offset losses due to boiling.
Accident	FPCC System	Loss of system function due to LOOP coincident with a design basis LOCA	Loss of cooling to spent fuel pool	Alarms in the main control room	If the FPCC pump controls or RECW intertie piping is not accessible post-LOCA, the seismic Category I ESW makeup source is used to supply sufficient water to offset losses due to boiling.

Table 9.1-3 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Accident	Seismic Category I makeup supply	Failure (including loss of power) of 1 ESW or RHRSW pump	Loss of seismic Category I makeup water	Low pressure and low level alarm alarm in main control room	The other ESW or RHRSW pump in the ESW or RHRSW loop is started to provide sufficient makeup water. These pumps are powered from separate electrical divisions.
Accident	RHRSW Seismic Category I makeup supply	Failure of a single power-operated valve	Loss of seismic Category I makeup water.	Low level alarm in main control room. Valve indication	The ESW system can be used to supply makeup water. (There are no power-operated valves in the ESW supply pa h whose single failure can cause a loss of makeup water.)

Table 9.1-4

RESULTS OF SPENT FUEL POOL (SFP) BOILING ANALYSIS

Unit 1: Time from loss of cooling to boiling - 17.5 hours[(1)]
Water heatup rate following loss of cooling - 4.11°F/hr[(1)]

Unit 2: Time from loss of cooling to boiling - 13.5 hours[(1)]
Water heatup rate following loss of cooling - 5.33°F/hr[(1)]

LPZ thyroid doses (rem) for the 30 day duration of the accident:

	UNIT 1	UNIT 2	BOTH UNITS
For a Spent Fuel Pool PF[(2)] of 0.1			
Spike – 50	3.82×10^{-2}	3.75×10^{-1}	4.13×10^{-1}
Spike – 20	1.86×10^{-2}	1.88×10^{-1}	2.07×10^{-1}
Spike - 5	8.77×10^{-3}	9.47×10^{-2}	1.03×10^{-1}
For a Spent Fuel Pool PF[(2)] of 0.01			
Spike – 50	4.02×10^{-3}	3.98×10^{-2}	4.38×10^{-2}
Spike – 20	1.96×10^{-3}	2.0×10^{-2}	2.2×10^{-2}
Spike - 5	9.27×10^{-4}	1.01×10^{-2}	1.1×10^{-2}

(1) Assuming loss of spent fuel pool cooling as described in Section 9.1.3.6

(2) PF = Iodine partition factor at the pool surface

Table 9.1-5

DECAY HEAT AND EVAPORATION RATES FOR LOSS OF SPENT FUEL POOL COOLING

	TIME AFTER LOSS OF COOLING (hrs)							
	13.5	17.5	24	96	360	480	600	720
UNIT 1								
Decay heat in pool (MBtu/hr)	10.4	10.4	10.4	10.2	9.6	9.37	9.18	9.0
Evaporation rate (ft^3/hr)	0.0	171.4	171.1	168.16	158.28	154.58	151.36	148.47
UNIT 2								
Decay heat in pool (MBtu/hr)	13.4	13.3	13.3	12.9	11.4	10.9	10.5	10.2
Evaporation rate (ft^3/hr)	220.75	219.85	218.96	212.82	187.49	180.35	173.29	168.07

Table 9.1-6

TOOLS AND SERVICING EQUIPMENT

FUEL SERVICING EQUIPMENT

Fuel preparation machines
Channel bolt wrenches
Channel handling tool
Fuel pool sipper
Channel gauging fixture
General purpose grapples
Fuel inspection fixture
Jib crane
Upending platform/jib crane
Roller conveyer
Gantry crane
New fuel inspection/channeling stand

SERVICING AIDS

Pool tool accessories
Actuating poles
General area underwater lights
Local area underwater lights
Drop lights
Underwater TV monitoring system
Underwater vacuum cleaner
Viewing aids
Light support brackets
Incore detector cutter
Incore manipulator

REACTOR VESSEL SERVICING EQUIPMENT

Reactor vessel servicing tools
Steam line plugs
Shroud head bolt wrenches
Head holding pedestals
Head stud rack
Dryer/separator sling
Head strongback
Steam line plug/installation tool
Vessel nut handling tool
Head nut and washer storage racks
Reactor enclosure crane main hook extension
Service Pole Caddy
Fuel Floor Auxiliary Platform
Reactor Cavity Work Platform Assembly

Table 9.1-6 (Cont'd)

IN-VESSEL SERVICING EQUIPMENT

Instrument strongback
Control rod grapple
Control rod guide tube grapple
Fuel support piece grapple
Grid guide
Jet pump servicing tools
Control rod latch tool
Instrument handling tool
Control rod guide tube seal
Incore guide tube seals
Blade guides
Fuel bundle sampler
Peripheral orifice grapple
Orifice holder
Combined grapple, CRB/FSP

REFUELING EQUIPMENT

Refueling equipment servicing tools
Refueling platform

STORAGE EQUIPMENT

Spent fuel storage racks
Channel storage racks
Control rod blade storage racks
Defective fuel storage container

UNDER-REACTOR VESSEL SERVICING EQUIPMENT

CRD servicing tools
CRD hydraulic system tools
NMS servicing tool
CRD handling equipment
Equipment handling platform
Thermal sleeve installation tool
Incore flange seal test plug
Key bender

Table 9.1-7

FUEL SERVICING EQUIPMENT

COMPONENT	ESSENTIAL CLASSIFICATION(1)	QUALITY GROUP(2)	SEISMIC CATEGORY(3)
Fuel prep machine	PE	E	I
New fuel inspection/channeling Stand	NE	E	-
Channel bolt wrench	NE	E	-
Upending stand/jib crane	NE	E	-
Channel handling tool	NE	E	-
Roller conveyer	NE	E	-
Fuel pool sipper	NE	E	-
Gantry crane	NE	E	-
Fuel inspection fixture	NE	E	-
Channel gauging fixture	NE	E	-
General purpose grapple	PE	E	-
Jib crane	PE	E	-

(1) NE - nonessential
PE - passive essential

(2) E - industrial code applies

(3) (-) - no seismic requirements

Table 9.1-8

REACTOR VESSEL SERVICING EQUIPMENT

ESSENTIAL COMPONENT	QUALITY CLASSIFICATION[1]	SEISMIC GROUP[2]	CATEGORY[3]
Reactor vessel servicing tools	NE	E	-
Steam line plug	PE	E	-
Shroud head bolt wrench	NE	E	-
Vessel nut handling tool	NE	E	-
Head holding pedestal	NE	E	-
Head nut and washer rack	NE	E	-
Head stud rack	NE	E	-
Dryer and separator sling	PE	E	-[4]
Reactor enclosure crane main hook extension	PE	E	-[4]
Head strongback/carousel	E	E	-[4]
Steam line plug installation tool	NE	E	-
Service Pole Caddy	NE	E	IIA
Fuel Floor Auxiliary Platform	NE	E	-
Reactor Cavity Work Platform	NE	E	IIA

[1] NE - nonessential
PE - passive essential

[2] E - industrial code applies

[3] (-) - no seismic requirements
(+) - seismic IIA requirements

[4] Dynamic analysis methods for seismic loading are not applicable, because this equipment is supported by the reactor service crane. Lifting devices are designed with a minimum safety factor of 5 and undergo proof testing.

Table 9.1-9

UNDER-REACTOR VESSEL SERVICING EQUIPMENT AND TOOLS

EQUIPMENT/TOOL	CLASSIFICATION	SEISMIC CATEGORY
CRD handling equipment	Nonessential	-
Equipment handling platform	Nonessential	-
Spring reel	Nonessential	-
Thermal sleeve installation tool	Nonessential	-
Incore flange seal test plug	Nonessential	-
Key bender	Nonessential	-
CRD servicing tools	Nonessential	-
CRD hydraulic system tools	Nonessential	-
NMS servicing tool	Nonessential	-

(-) - no seismic requirements

Table 9.1-10

REACTOR ENCLOSURE CRANE DESIGN PARAMETERS

BRIDGE	
Runway length	323'-0"
Bridge span	129'-2"
Bridge weight	410,000 lb
Number of wheels	8
Type of wheels	Parallel tread
Wheel size	27 in
Number of drive motors	2
Drive motor power	7.5 hp @ 720 rpm
Maximum travel speed	40 fpm
Minimum travel speed	4 fpm
Minimum incremental movement	¼ in
Number and type of brakes	(2) magnetic shoe (2) hydraulic shoe
Type of bumpers	Spring
Type of control	562 static stepless
TROLLEY	
Length of trolley travel	129'-2"
Trolley span	26'-6"
Trolley weight	124,000 lb
Number of wheels	4
Type of wheels	Parallel tread
Wheel size	24 in
Drive motor power	7.5 hp @ 720 rpm
Maximum speed	26.8 fpm
Minimum speed	3 fpm
Minimum incremental movement	1/8 in
Number and type of brakes	(1) magnetic shoe, (1) magnetic disc
Type of bumpers	Spring
Type of control	562 ac static stepless

Table 9.1-10 (Cont'd)

HOISTS	Main	Auxiliary
Rated lifting capacity	125 tons	15 tons
Drum size (pitch diameter)	64.25 in	30.25 in
Upper sheave size (pitch diameter)	30 in	None
Lower sheave sizes (pitch diameter)	33.75 in, 30 in	None
Equalizer sheave size (pitch diameter)	17.75 in	None
Rope-type	6x37 preformed, SEIP, IWRC	6x37 preformed, SS 304 IWRC
Rope diameter	1.25 in	1.125 in
Reeving-type	8 part	2 part
Number of reeving systems	2	1
Hoist motor power	50 hp	25 hp
Maximum hook speed	5 fpm	23 fpm
Minimum hook speed	0.5 fpm	2.3 fpm
Minimum incremental hook movement	1/32 in	1/8 in
Maximum travel of hook	164'-6"	165'-5"
Number and type of load brakes	(1) eddy Current	(1) eddy current
Number and type of holding brakes	(3) magnetic Shoe	(2) magnetic shoe
Type of control	563 static Stepless	563 static stepless

Table 9.1-11

REACTOR ENCLOSURE CRANE FAILURE MODES AND EFFECTS ANALYSIS

COMPONENT OR SUBSYSTEM	COMPONENT OR SUBSYSTEM FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	REMARKS
Power supply	LOOP	All crane movements stopped by setting crane holding brakes and tripping all drive motors	Crane operator	-
Main hoist hooks	Failure of one hook	None. The redundant hook supports the load.	Periodic inspection, if not identified during crane use)	-
Main hoist wire Ropes	Failure of one rope	Spurious, dynamic, load transfer to the redundant rope, followed by setting of crane holding brakes and cessation of all crane movements. The load is supported by the remaining rope at a minimum static factor of safety of 5.	Crane operator	Two vane switches, mounted on the equalizer frame, are provided to detect the wire rope failure and cut off power to the crane.
Main hoist drum	Failure of drum Shaft	Possible load stalling, or noise and irregular hoist operation. The crane operator stops hoist operation, resulting in setting of the holding brakes and the safe suspension of the load.	Crane operator	The load can be positioned over its storage or lay-down area and then lowered by manual operation of the hoist holding brakes.
Main hoist holding Brakes	Failure of one brake in the open position	None. Two additional holding brakes stop the main hoist movement and hold the load.	Periodic inspection	Three holding brakes are provided, all rated at 150% of the hoist full load motor torque at the point of application.

Table 9.1-11 (Cont'd)

COMPONENT OR SUBSYSTEM	COMPONENT OR SUBSYSTEM FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	REMARKS
Trolley holding Brakes	Failure of one brake in the open position	None. When the trolley drive motor is stopped, power to the holding brakes is also cut off, which sets the redundant brake.	Crane operator	Two holding brakes are provided, both rated at 50% of the trolley drive motor torque at the point of application.
Bridge holding Brake	Failure of one brake in the open position	None. When the bridge drive motors are stopped, power to the holding brakes is also cut off, which sets the remaining brake.	Crane operator	One holding brake and one foot-operated hydraulic brake are provided for each of the two bridge drive motors. The holding brake is rated at 100% of the bridge drive motor torque.
Main hoist drive gear cases	Failure of one gear case, resulting in gear disengagement:			Two gear cases (drive and idler case) are provided for the main hoist.
	a) Drive gear case	Spurious drum revolving in the load lowering direction. The overspeed switch activated by revolving drum sets the hoist holding brakes and stops the load.	Crane operator	
	b) Idler gear case	None. The drive gear case with the hoist motor and the holding brakes maintains control of the load.	Crane operator	

Table 9.1-11 (Cont'd)

COMPONENT OR SUBSYSTEM	COMPONENT OR SUBSYSTEM FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	REMARKS
Main hoist upward movement limit switch (geared-type)	Failure of switch:			-
	a) Open	Immediate power cutoff to he main hoist. As a result, the hoist is stopped through action of the hoist holding brakes.	Crane operator or periodic testing	
	b) Closed	None. If the hoist continues its upward travel it is stopped by action of the redundant upper limit switch.	Periodic tes ing	
Main hoist upward movement limit switch (contact-type)	Failure of switch:			Tripped by physical contact with moving load block as it moves upward.
	a) Open	Immediate power cutoff to he main hoist. As a result, the hoist is stopped through action of the hoist holding brakes.	Crane operator or periodic testing	
	b) Closed	None. Hoist upward movement is limited by the redundant upper limit switch, before it reaches this limit switch.	Periodic tes ing	

Table 9.1-11 (Cont'd)

COMPONENT OR SUBSYSTEM	COMPONENT OR SUBSYSTEM FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	REMARKS
Main hoist downward movement limit switches (geared-type)	Failure of one limit switch:			-
	a) Open	Immediate power cutoff to he main hoist. As a result, the hoist is stopped through action of the hoist holding brakes.	Crane operator or periodic testing	
	b) Closed	None.Hoist movement downward is terminated by the redundant lower limit switch.		
Bridge and trolley movement programmable limit switches	Failure of one switch associated with a given bridge or trolley position:			-
	a) Open	Immediate cutoff of power to respective drive motor(s) and holding brake(s) and stopping of all crane movements.	Crane operator	
	b) Closed	The load may enter the restricted area, unless prevented by crane operator action.	Periodic tes ing	

Table 9.1-12

COMPARISON WITH NRC REGULATORY GUIDE 1.104 (FEBRUARY 1976) - OVERHEAD CRANE HANDLING SYSTEMS FOR NUCLEAR POWER PLANTS

REGULATORY POSITION	CONFORMANCE	NON-CONFORMANCE	NOTES
C.1 Performance Specification Design Criteria			
a. Separate performance specification	X		(1)
b. Environmental operating conditions			
i. Electrical motors	X		
ii. Balance of crane			
1. Box girders vent and draining	X		(2)
2. NDTT		X	(3)
3. Cold proof test	X		(16)
4. Low alloy steel cold proof test			(4)
c. Seismic Category I	X		
d. NDE - lamellar tearing	X		
e. Fatigue analysis		X	(5)
f. Preheat – postheat welding	X		(6)
C.2 Safety Features			
a. Controls, devices, safe holding position	X		(7)
b. Auxiliary system, dual component, immobile position	X		

Table 9.1-12 (Cont'd)

REGULATORY POSITION	CONFORMANCE	NON-CONFORMANCE	NOTES
c. Means for repairing	X		(8)
d. Design for safety while repairing	X		
C.3 Equipment Selection			
a. Dual load attachment points	X		
b. Lifting devices - redundant design	X		(9)
c. Dual hoisting, 5 fpm limitation	X		
d. Head block and load block	X		
e. Dual reeving system - rope standard	X		
f. Fleet angles		X	(10)
g. 200% static design test		X	(11)
h. Sensing of overspeed, overloading, etc.	X		
i. Control system, motors, torque		X	(12)
j. Two-blocking precautions, etc.		X	(13)
k. Drum protection	X		
l. Excessive breakdown torque	X		
m. Hoisting brakes, holding brakes	X		(14)
n. Dynamic and static alignment	X		
o. Increment drives	X		

Table 9.1-12 (Cont'd)

REGULATORY POSITION	CONFORMANC	NON-CONFORMANCE	NOTES
p. Trolley and bridge motors	X		
q. Cab located controls	X		
r. Safety devices, limit devices	X		
s. Operating manuals – MWL	X		
t. Change from construction to operating	X		
u. Installation instructions	X		
C.4 Mechanical Check, Testing and Preventive Maintenance			
a. Mechanical check	X		
b. 125% static test (2-block)			
i. 125% static test		X	(19)
ii. 100% full performances test	X		(18)
iii. 2-block		X	(15)
c. Preventive maintenance	X		
d. Cold proof test	X		(16)
C.5 Quality Assurance	X		(17)

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(1) Position C.1.a. The load lifts during construction were not greater than those for plant operation, therefore no separate specifications were prepared.

(2) Position C.1.b(1). Box girders are not of a closed design.

(3) Position C.1.b(3). The crane manufacturer did not perform impact testing on any structural members.

(4) Position C.1.b(4). Not applicable - no ASTM A514 is used.

Table 9.1-12 (Cont'd)

(5) Position C.1.e. The structural members of the crane are designed for a fatigue loading of 20,000-100,000 cycles, which far exceeds the conservatively estimated 4000 cycles in the life of the crane. Additional fatigue analysis is therefore deemed unnecessary.

(6) Position C.1.f. The preheat and postheat treatment of the welds is in accordance with AWS D1.1.

(7) Position C.2.a. Inadvertent operation must also be a function of administrative control, not just of design. The present design is considered to comply with the regulatory position.

(8) Position C.2.c. Provisions are made for manual operation of the main hoist holding brakes for lowering the load. No special provisions are made for manually moving the immobilized bridge or trolley; however, there are options available for moving the bridge or trolley if the electric power cannot be restored.

(9) Position C.3.b. The loads that have been determined to be critical loads are the spent fuel shipping cask and the portable refueling shield. A lifting yoke which is single failure proof in accordance with NUREG-0612 is provided for use in lifting the shipping cask with the reactor enclosure crane. Although the lifting rig provided for use with the portable refueling shield is not redundant in design, it is designed to support a weight equivalent to three times the weight of the portable refueling shield. This high degree of conservatism protects against the possibility of failure of the refueling shield's lifting rig.

(10) Position C.3.f. The fleet angle from drum to lead sheave is 3¼ degrees for LGS, which complies with the regulatory position. The regulatory position also recommends limiting the fleet angles between individual sheaves to 1½ degrees, whereas this parameter is 3½ degrees for LGS. This difference is justified by the following considerations:

a. The 3½ degree limitation has been proven to be a reliable parameter for rope leads off of drums, which are more critical than rope leads from sheaves, the latter being more deeply grooved.

b. With redundant reeving, sheave spacings are double the normal spacings. Thus, to maintain a 1½ degree fleet angle, the distance from the hook to the top of the crane would have to be needlessly and excessively increased to such a degree that it would be inconsistent with a good crane design.

The design ratio of running sheave pitch diameters to the rope diameter is 24:1 instead of the 30:1 or 26:1 recommended by Regulatory Guide 1.104. The 24:1 ratio is justified because, due to the large diameter of the wire rope used, 30:1 and 26:1 diameter ratios, sheave blanks are not readily available, and because the 24:1 ratio is recommended by the ASME Standard Committee on the Design of Overhead and Gantry Handling Systems for Critical Loads at Nuclear Power Plants in their comments on Regulatory Guide 1.104, dated March 18, 1976, and is consistent with the recommendations of CMAA Specification #70.

(11) Position C.3.g. ANSI B30.2 allows for a 125% load test of these components, and the crane is tested to this value.

Table 9.1-12 (Cont'd)

(12) Position C.3.i. The electric controls for the subject crane are set to limit the motor torque to 150% of rated motor torque.

(13) Position C.3.j. The crane is provided with dual upper limit switches to preclude the possibility of a "two- block" occurrence and an overload switch combined with overcurrent and rate of current rise cutouts to automatically terminate hoisting if there is a load hang-up.

(14) Position C.3.m. The crane design meets the requirements of this regulatory position, except that holding brake heat dissipation is accomplished by alternating the lowering and holding to provide time for cooling the brake mechanism. Also, administrative control is used to limit the lowering speed to less than 3.5 fpm if there is manual brake operation during emergency lowering.

(15) Position C.4.b.iii. No testing of these conditions is performed, since the reeving system is not designed for two-blocking or load hang-up as indicated in footnote 13 above.

(16) Position C.4.d. A cold proof test is performed with 125% of rated load below the minimum operating temperature for the crane during normal plant operation, which is 60°F. However, in no case is the test load increased above 125% of the rated load. Crane testing in excess of 125% of the rated load may adversely affect the safety of the crane, since any such tests may propagate undetectable material defects and thus increase the probability of crane component failures. Furthermore, such testing violates the ANSI B30.2 and 29CFR1910.179(k).

A NDE following the cold proof test is performed on 10% of each critical weld. Cold proof testing every 40 months, followed by NDE, will not be performed since the crane operating temperature will not be less than 60°F.

(17) According to the implementation section D.2 of the guide, the quality assurance discussion of paragraph C.5 is not applied to cranes ordered before September 1976. Although the LGS crane was ordered in August 1973, a quality assurance program was required of the vendor. However, this program could not and did not address the recommendations of paragraphs C.1 - C.4 as suggested in paragraph C.5.b of the guide.

(18) The geared upper limit switch will be tested using a 10% load to demonstrate the adequacy of the limit switch. The geared upper limit switch is dependent only on the drum position, and not on the crane load.

The programmable limit switches that limit movement over the spent fuel pool will be tested using a 0% load to demonstrate the adequacy of the limit switches. The programmable limit switches are dependent only on the position of the bridge and trolley, and not on the crane load.

Table 9.1-12 (Cont'd)

The travel programmable limit switches on the bridge and trolley that prevent movement to the extreme ends of the bridge and trolley rails will be tested using a 0% load to demonstrate the adequacy of the limit switch. The travel limits on the bridge and trolley are dependent only on the position of the bridge and trolley, and not on the crane load.

The weighted upper limit switch will be tested using 100% of the rated capacity by raising the load from a position just off the floor at a maximum speed and manually tripping the weighted upper limit switch before the hook attains enough height to trip the limit switch. Manual testing of the weighted upper limit switch will verify that the main hoist will stop raising and that all brakes will set with 100% of the rated capacity on the main hoist. Keeping the load at a minimum height off the floor will enable the weighted upper limit switch to be tested with the load in a safer position.

(19) The main hoist was tested at 125% of its rated load by raising the load off the floor and holding via the holding brakes then set back down. Not all positions of hoisting and bridge and trolley travel were tested with the 125% load. The auxiliary hoist was tested with at least 120% of its rated load by raising and lowering the load from minimum to maximum speed and holding the load via the holding brakes.

Table 9.1-13

UNIT 1 SPENT FUEL STORAGE RACK MODULES

Module I.D.	**Number of Cells**		**Module Envelope Size** (Note # 1)		**Shipping Weight** (Pounds) Note 2	**Number Of Cells Per Rack**
	N-S Direction	**E-W Direction**	**N-S** (Inches)	**E-W** (Inches)		
A1	18	14	112.73	87.76	23300	252
A2	18	14	112.73	87.76	23300	252
A3	17	14	106.49	87.76	22400	238
B1	18	17	112.73	106.49	27100	306
B2	18	17	112.73	106.49	27200	306
B3	17	17	106.49	106.49	26500	289
C1	18	18	112.73	112.73	28300	324
C2	17	18	106.49	112.73	27600	306
D	17	17	106.49	106.49	25700	289
E1	17	14	106.49	87.76	22100	238
E2	12	17	75.27	106.49	19200	204
F	12	18	75.27	112.73	17400	191
G	17	13	106.49	85.51	20700	221
H	18	13	112.73	112.73	25100	249

Notes

1 See Figure 9.1-34 for rack locations.
2 Weight is dry weight of rack only, without fuel.

Table 9.1-14

SPENT FUEL POOL MATERIALS

Description	Material Specification	Alloy	Finish
Fuel Pool Liner			
Plates	ASTM A240	Type 304	Stainless steel
Bars and shapes	ASTM A479	Type 304	Stainless steel
Control Rod Blade and Defective Fuel Storage Rack			
Perimeter bars	ASTM A240	Type 304L	Stainless Steel
Canisters	ASTM A240	Type 304L	Stainless Steel
Bottom grid assembly	ASTM A240	Type 304L	Stainless Steel
Foot assemblies	ASTM A564	Type 630	Stainless Steel
Spent Fuel Storage Racks			
Sheet Metal Stock	ASME SA240	Type 304L	Stainless Steel
Support Leg (internally threaded)	ASME SA240	Type 304L	Stainless Steel
Support Leg (externally threaded)	ASME SA564	Type 630	Stainless Steel

Table 9.1-15 through Table 9.1-20
have been deleted

Table 9.1-21

SPENT FUEL RACKS
APPLICABLE CODES AND STANDARDS

NUCLEAR REGULATORY COMMISSION	
Regulatory Guide 1.29	Seismic Design Classification (Rev 3), September 1979
Regulatory Guide 1.92	Combining Modal Responses and Spatial Components in Seismic Response Analysis (Rev 1), February 1976
Regulatory Guide 1.70	Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (Rev 3), November 1978
SRP 3.8.4	Seismic Category I Structures, 1981
SRP 9.1.2	Spent Fuel Storage Review Responsibility, 1981
SRP 9.2.5	Ultimate Heat Sink, Pages 9.2.5-8 through 9.2.5-14, 1975
Regulatory Guide 1.38	Quality Assurance Requirements for Packaging, Shipping, Receiving, Storage, and Handling of Items for Water-Cooled Nuclear Power Plants (Rev 2), 1977
Regulatory Guide 1.13	Spent Fuel Storage Facility Design Basis (Rev 1), December 1975
Regulatory Guide 1.61	Damping Values for Seismic Design of Nuclear Power Plants (Rev 0), October 1973
INDUSTRY CODES AND STANDARDS	
ASME	Boiler and Pressure Vessel Code Sections III, V, IX, and Subsection NA Appendix I and XVII, 1977 Edition up to and including the winter 1978 Addendum
AISC	Steel Construction Manual AISC (7th Edition), June 1973, Including supplements
AA	Aluminum Construction Manual, Third Edition, April 1976, Specifications for Aluminum Structures
AA	Aluminum Standards and Data 5th Edition, January 1976
ASTM	ASTM Standards: A240, A276, A312, B209, B26, B211, B221 (Latest revision in effect at time of purchase order unless otherwise specified.)
ANSI N45.2	Quality Assurance Requirements of Nuclear Power Plants, 1971

Table 9.1-21 (Cont'd)

ANSI N45.2.2	Packaging and Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants, 1972, except Paragraphs 2.4 and 2.6
ANSI N16.9	Validation of Calculation Methods for Nuclear Criticality Safety, 1975
ASNT-TC-1A	American Society for Nondestructive Testing, 1975 Edition
AWS D1.1	American Welding Society, Structural Welding Code (Rev 2), 1979
10CFR50	Code of Federal Regulations, Title 10, Part 50 (Appendix A & B)
ACI 318 (1971)	Building Code Requirements for Reinforced Concrete
ANSI/ANS 57.2	Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants
ANSI/ANS 57.3	Design Requirements for New Fuel Storage Facilities at Light Water Reactor Plants

MILITARY SPECIFICATIONS

Mil-R-24243	Aluminum Rivet Specification
Mil-A-8625C	Anodizing

Table 9.1-22

COMPLIANCE WITH ANS 57.1 FOR REACTOR ENCLOSURE CRANE

ANS 57.1 Guidelines[1]	Extent of Compliance	Deviation and/or Justification
6.1 Safety Classification and Design Standards		
6.1.e (Minimum industry standard requirements)	Partial	The specification for the crane was issued for purchase in 1973, prior to the issuance of the design standards in 6.1.e. The crane was designed to earlier versions of applicable ASME and CMAA standards than those listed in ANS 57.1. Section 9.1.5 provides further information on design standards used for the crane.
6.2 System Design Requirements		
6.2.1 Safety Requirements		
6.2.1.1 (Interlock protection)	Partial	No underload indication or overload interlock is provided for the auxiliary hoist. The worst possible load drop from this hoist would be a ne fuel assembly drop into the spent fuel pool. The effects of this would be less severe than those resulting from a spent fuel handling accident (Section 15.7.4).
6.2.1.3 (Physical safety features)	Full	-
6.2.1.4 (Bridge travel annunciator)	Partial	A warning gong can be manually actuated from the operator's cab and from the radio controller.
6.2.1.5 (Fail-safe on full loss of power)	Full	-

Table 9.1-22 (Cont'd)

ANS 57.1 Guidelines[1]	Extent of Compliance	Deviation and/or Justification
6.2.1.6 (Manual disconnect)	Partial	Radio and cab controls include a main power switch that can cut all power to the crane.
6.2.2 Analysis Requirements		
6.2.2.1 (Design verification)	Full	-
6.2.2.2 (Seismic design)	Partial	The crane is designed as seismic Category I but is not required to function following an SSE. All features required to prevent dropping the load are designed not to fail (Section 3.2).
6.2.3 Design Features		
6.2.3.1 (Retaining devices)	Partial	Retaining devices are generally not provided because parts are never removed when the crane trolley is near the reactor vessel or spent fuel pool. Bead chains are not used.
6.2.3.2 (Fastener locking devices)	Partial	The suitable fastener devices listed are not used. The potential for parts falling into a fuel assembly is small because the crane trolley is restricted from traveling near the spent fuel pool and from carrying loads over the open reactor vessel (Section 9.1.5.2 and Reference 9.1-1).
6.2.3.3 (Surface finish)	Full	-
6.2.3.6 (Inertial loads)	Full	-
6.2.3.7 (Design for repair)	Full	-
6.2.3.9 (Manual movement)	Partial	Loads can be manually lowered after loss of power.

Table 9.1-22 (Cont'd)

ANS 57.1 Guidelines[1]	Extent of Compliance	Deviation and/or Justification
6.2.3.10 (Leakage collection)	Partial	All lubricated parts that can be positioned above the pool are provided with drip pans or other means to prevent lubricant from falling into the pool. Collection systems are not sized for 1.1 times the lubricant volume. However, the crane trolley is normally prohibited from traveling near the pool (Section 9.1.5.2).
6.2.3.12 (Load drop interlocks)	Partial	See ANS 57.1 Guideline 6.2.1.1
6.2.3.14 (Loudspeaker system)	Partial	A 6 channel public address system is provided in the drywell and refueling floor from the main control room. A telephone system is provided between the main control room and refueling floor. Both systems are powered by the plant emergency auxiliary system, which is backed up by emergency diesel generators. Circuits for the public address system and the telephone system are run in different conduits.
6.2.3.18 (Operator controls)	Full	-
6.2.3.20 (Corrosion)	Full	-
6.2.3.21 (Immersed components)	Full	-
6.2.3.22 (Materials properties)	Full	-
6.2.3.23 (Lamellar tearing)	Partial	Lamellar tearing is not specifically addressed in the crane design documents. Crane welding is in accordance with AWS D1.1-75 and AWS D14.1.
6.2.3.24 (Materials compat bility)	Full	-

Table 9.1-22 (Cont'd)

ANS 57.1 Guidelines[1]	Extent of Compliance	Deviation and/or Justification
6.2.3.25 (Lubricants and coatings)	Full	-
6.2.4 Specific Components Requirements		
6.2.4.1 Handling Equipment		
6.2.4.1.2 (Personnel clearances)	Full	-
6.2.4.1.5 (Area radiation monitors)	Full	-
6.2.4.1.9 (Automatically de-energize drive systems)	Full	-
6.2.4.1.10 (High humidity)	Full	-
6.3 Testing and Maintenance Provisions		
6.3.1 Testing		
6.3.1.1 Electrical Test Capabilities	Full	-
6.3.1.2 Mechanical Test Capabilities	Full	-
6.3.2 Maintenance (standard parts)	Full	-

Table 9.1-22 (Cont'd)

ANS 57.1 Guidelines[(1)]	Extent of Compliance	Deviation and/or Justification
6.3.2.1 Handling Equipment		
6.3.2.1.3 Auxiliary Fuel Handling Crane (easy access)	Full	-
6.3.2.1.9 General Requirements (safe disconnection of electrical hardware)	Partial	The features listed are generally not used. The crane trolley is normally prohibited from traveling near the spent fuel pool (Section 9.1.5.2).

(1) Guidelines not listed are either not applicable to the fuel handling function of the reactor enclosure crane or are recommendations, not requirements, of ANS 57.1.

TABLE 9.1-23

SIZES AND WEIGHTS OF MAXIMUM DESNITY SPENT FUEL STORGE RACKS

MODULE I.D.	NUMBER OF CELLS		MODULE ENVELOPE SIZE (See Note #1)		SHIPPING WEIGHT	NUMBER OF CELLS RACK
	N-S Direction	E-W Direction	N-S	E-W		
A1	18	14	112.77"	87.71"	22700#	252
A2	18	14	112.77"	87.71"	22700	252
A3	18	14	112.77"	87.71"	22700#	252
B1	18	17	112.77"	106.51"	27600#	306
B2	18	17	112.77"	106.51"	27600#	306
B3	18	17	112.77"	106.51"	27600#	306
C1	18	18	112.77"	112.77"	29200#	324
C2	18	18	112.77"	112.77"	29200#	324
D	17	17	106.51"	106.51"	26100#	289
E1	17	14	106.51"	87.71"	21500#	238
F	14	18	87.71	112.77"	22400#	248
G	17	18	106.51	112.77"	25800#	286
H	18	18	112.77"	112.77"	27000#	49
J ((Existing)	7	7	83"	83"	12200#	49
J (Alternate)	14	14	87.71"	87.71"	17700#	196

- See Figure 9.1-35 through 9.1-37 for locations

TABLE 9.1-24

REFERENCE CASE
MAXIMUM DENSITY SPENT FUEL STORAGE RACK
INPUT PARAMETERS

	Standard 8x8	GE-9 8x8	GE-11 9x9	Siemens 9x9	GE-14 10x10	GNF2 [1] 10x10
FUEL ROD DATA						
Clad outside diameter, in.	0.483	0.483	0.440	0.489	0.404	0.404
Clad inside diameter, in.	0.419	0.419	0.384	0.373	0.352	0.3567
Clad material	Zr-2	Zr-2	Zr-2	Zr-2	Zr-2	Zr-2
UO_2 density, g/cc UO_2 (Tolerance $\pm$0.20)	10.42	10.42	10.42	10.42	10.503	10.566
Pellet diameter, in.	0.410	0.411	0.376	0.3665	0.345	0.3496
Enrichment, wt% U-235 (Tolerance $\pm$0.05)	3.50	3.50	3.50	3.50	4.90	4.90
WATER ROD DATA						
Number of water rods	2	1	2	1*	2	2
Inside diameter, in.	0.531	1.26	0.920	1.458	0.920	0.920
Outside diameter, in.	0.591	1.34	0.980	1.516	0.980	0.980
FUEL ASSEMBLY DATA						
Fuel rod array	8x8	8x8	9x9	9x9	10x10	10x10
Number of fuel rods	62	60	74	72	92	92
Fuel rod pitch, in.	0.640	0.640	0.566	0.569	0.510	0.510
Fuel channel, material Inside dimension, in. Outside dimension, in.	5.278 5.478	5.278 5.438	5.278 5.478	5.278 5.438	5.278 5.438	5.283 5.433

* Square central channel
[1] See Reference 9.1-18

TABLE 9.1-25

MAXIMUM DENSITY SPENT FUEL STORAGE RACK
EFFECT OF TEMPERATURE AND VOID ON REACTIVITY

CASE	INCREMENTAL REACTIVITY CHANGE, δK
4°C (39°F)	Reference
20°C (68°F)	-0.003
80°C (176°F)	-0.016
122°C (252°F)	-0.028
122°C, 20% Void	-0.039

TABLE 9.1-26

MAXIMUM DENSITY SPENT FUEL STORAGE RACKS
REACTIVITY UNCERTAINTIES DUE TO MANUFACTURING TOLERANCES

QUANTITY	NOMINAL VALUE	TOLERANCE	δK_∞
Boron loading	0.0200 g/cm^2	$\pm$0.0015 g/cm^2	$\pm$0.0051
Boral width	5.00 inches	$\pm$1/16 inches	$\pm$0.0018
Lattice spacing	6.244 inches	$\pm$0.040 inches	$\pm$0.0027
SS thickness	0.075 and 0.035 inches	$\pm$0.008 inches mean	$\pm$0.0004
Fuel enrichment	3.50% U-235	$\pm$0.05% U-235	$\pm$0.0033
Fuel density	10.42 g/cm^3	$\pm$0.20 g/cm^3	$\pm$0.0026
Statistical combination of uncertainties			$\pm$0.0074

TABLE 9.1-27

MAXIMUM DENSITY SPENT FUEL STORAGE RACKS
SUMMARY OF K_∞ FOR VARIOUS FUEL TYPES

FUEL	MAXIMUM K_∞
Standard (8x8)	0.944
GE-9 - 8x8	0.942
GE-11 - 9x9	0.941
Siemens - 9x9	0.934
GE-14 – 10X10	0.939
GNF2 – 10x10[1]	0.9375

[1] See Reference 9.1-19

TABLE 9.1-28

MAXIMUM DENSITY SPENT FUEL STORAGE RACKS
SUMMARY OF CRITICALITY SAFETY ANALYSES

	CASMO	KENO
Temperature of analysis	4°C	4°C
Gadolinia content	None	None
Fuel enrichment, wt% U-235	3.50	3.50
Reference k_∞	0.9366	0.9234[1]
Calculational bias	0.0000	0.0101
Uncertainties Calculational KENO statistics Tolerances[2]	 ±0.0024 NA ±0.0074	 ±0.0018 ±0.0011 ±0.0074
Removal of flow channel	negative	negative
Eccentric position	negative	negative
Statistical combination[3] of uncertainties	±0.0078	±0.0077
TOTAL	0.9366 ± 0.0078	0.9335 ± 0.0077
Maximum reactivity	0.9444	0.9412

1 Includes δk correction of +0.0026 to 4°C as determined by CASMO calculations.

2 See Table 9.1-26.

3 Square root of sum of square of all independent uncertainties.

TABLE 9.1-29

MAXIMUM DENSITY SPENT FUEL STORAGE RACK MATERIAL DATA

RACK MATERIAL DATA (200°F) (ASME - Section II,Part D)			
Material	Young's Modulus E (psi)	Yield Strength S_y (psi)	Ultimate Strength S_u (psi)
ASTM 240 304L S.S.	27.6 x 10^6	25000[(1)]	71000[(1)]
SUPPORT MATERIAL DATA (200°F)			
1. SA-240, Type 304L (upper part of support feet)	27.6 x 10^6	25000[(1)]	71000[(1)]
2. SA-564-630 (lower part of supportfeet age hardened at 1100°F)	27.9 x 10^6	106,300	140,000

[(1)] The material purchase order requires that the minimum limits for mechanicals be those of SA240-304.

TABLE 9.1-30

LOAD COMBINATIONS AND ALLOWABLE STRESSES - MAXIMUM DENSITY SPENT FUEL STORAGE RACKS

There are two sets of criteria to be satisfied by the rack modules:

a. Kinematic Criteria

In order to be qualified as a physically stable structure it is necessary to demonstrate that an isolated rack in water would not overturn when an event of magnitude 1.1 times the governing faulted seismic loading conditions is applied

b. Stress Limit Criteria

Stress limits must not be exceeded under the postulated load combinations. The following loading combinations ar applicable and are the bounding load combinations.

Loading Combinations	Service Level
D + L $D + L + T_o$ $D + L + T_o + E$ $D + L + T_o + SRV$	Level A
$D + L + T_2 + E$ $D + L + T_o + P_f$	Level B
$D + L + T_2 + E^9$ $D + L + T_o + F_d$ $D + L + T_2 + E^9 + SRV + LOCA$	Level D The functional capability of the fuel racks should be demonstrated.

TABLE 9.1-30 (Cont'd)

D = Dead weight-induced internal moments (including fuel assembly weight)

L = Live Load (not applicable for the fuel rack, since there are no moving objects in the rack load path)

F_d = Force caused by the accidental drop of the heaviest load from the maximum possible height specified in the PECO Specification

P_f = Upward force on the racks caused by postulated stuck fuel assembly

E = Operating Basis Earthquake (OBE)

E^9 = Safe Shutdown Earthquake (SSE)

T_o = Differential temperature induced loads (normal operating or shutdown condition based on the most critical transient or steady state condition)

T_2 = Differential temperature induced loads (the highest temperature associated with the postulated abnormal design conditions)

SRV = Safety Relief Valve Loading

LOCA = Loss-of-Cooling Accident Loads

T_2 and T_o produce local thermal stresses. the worst thermal stress field in a fuel rack is obtained when an isolated storage location has a fuel assembly generating heat at maximum postulated rate and surrounding storage locations contain no fuel. Heated water makes unobstructed contact with the inside of the storage walls,thereby producing maximum possible temperature difference between adjacent cells. Secondary stresses produced are limited to the body of the rack; that is support pedestals do not experience secondary (thermal) stresses.

TABLE 9.1-30 (Cont'd)

Stress limits for Various Conditions

Stress limits are derived form the ASME Code, Section III, Subsection NF Parameters and terminology are in accordance wit the ASME Code.

Normal and Upset Conditions (Level A or Level B)

a. Allowable stress in tension on a net section is:

$F_t = 0.6\ S_y$ (S_y = yield stress at temperature)

(F_t is equivalent to primary membrane stress)

b. Allowable stress in shear on a net section is:

$F_v = .4\ S_y$

c. Allowable stress in compression on a net section

$$F_a = \frac{\left[1 - \frac{(k\lambda)^2}{} / 2C^{2c}\right] S_y}{\left\{\left(\frac{5}{3}\right) + \left[3\left(\frac{k\lambda}{r}\right) / 8C_c\right] - \left[\left(\frac{k\lambda}{r}\right)^3 / 8C_c^3\right]\right\}}$$

where:

$$C_c = \left[\frac{(2n^2E)}{S_y}\right]^{1/2}$$

λ = unsupported length of component

k = length coefficient which gives influence of boundary conditions; e.g.

k = 1(simple support both ends)
= 2 (cantilever beam)
= 1/2 (clamped at both ends)

E = Young's Modulus

TABLE 9.1-30 (Cont'd)

r = radius of gyration of component

kl/r for the main rack body is based on the full height and cross section of the honeycomb region.

d. Maximum allowable bending stress at the outermost fiber of a net section, due to flexure about one plane of symmetry is :

$F_b = 0.60\ S_y$ (equivalent to primary bending)

e. Combined bending and compression on a net section satisfies:

$$\frac{f_a}{F_a} + \frac{C_{mx} f_{bx}}{D_x F_{bx}} + \frac{C_{my} f_{by}}{D_y F_{by}} < 1$$

where:

f_a = Direct compressive stress in the section

f_{fx} = Maximum bending stress along y-axis

f_{by} = Maximum bending stress along x-axis

C_{mx}= C_{my} = 0.85

$$D_x = 1 \frac{f_a}{F_{ax}}$$

$$D_y = 1 \frac{f_a}{F_{ey}}$$

$$F_{ax,ey} = \frac{12\ n^2 E}{23 \left(\frac{k\lambda}{r}\right)_{x,y}^{2}}$$

and subscripts x,y reflect the particular bending plane.

TABLE 9.1-30 (Cont'd)

f. Combined flexure and compression (or tension) on a net section:

$$\frac{f_a}{0.6S_y} + \frac{f_{bx}}{F_{bx}} + \frac{f_{by}}{F_{by}} < 1.0$$

The above requirements are to be met for both direct tension or compression.

Level D Service Limits

Section F-1334 (ASME Section III, Appendix F), states that limits for the Level D conditions are the minimum of 1.2 (S_y/F_t) or ($0.7S_u/F_t$) times the corresponding limits for the Level A condition. S_u is ultimate tensile stress at the specified rack design temperature. For example, if the material is such that $1.2D_y$ is less than $0.7S_{u9}$ then the multiplier on the Level A limits, to obtain Level D limits, is 2.0. For the Limerick plant, however, a more conservative multiplier of 1.6 set in the UFSAR. All level D evaluations are based on this more conservative limit.

TABLE 9.1-31

SUMMARY OF WPMR ANALYSIS RESULTS FOR 700# REGULAR FUEL LOADINGS AND COMPARISON WITH BOUNDING RESULTS OF SINGLE RACK ANALYSES						
CONDITIONS OF THE RUN		Maximum Displacements of Holtec Racks, in.				Maximum Pedestal Vertical Load, lbf
		Rack Top		Baseplate		
	SEISMIC	x	y	x	y	
WPMR2-R; 14 Holtec racks and 1 existing 7x7 rack; 700# channeled fuel fully loaded	SSE + SRV + LOCA	1.768 (R3)[1]	3.491 (R3)	1.605 (R3)	3.443 (R3)	210,000 (R1-F4)[1]
	SSE	3.079 (R3)	4.874 (R3)	2.869 (R3)	4.634 (R3)	205,900(R1-F4)
	OBE	1.316 (R3)	2.623 (R3)	1.264 (R3)	2.622 (R3)	150,600 (R10-F3)
WPMR1RFR: 15 Holtec racks; 700# channeled fuel fully loaded	SSE + SRV + LOCA	1.091 (R7)	.9466 (R3)	1.042 (R7)	.6953 (R3)	208,900 (R10-F4)
	SSE	1.121 (R7)	.8924 (R1)	1.072 (R7)	.6558 (R3)	196,400 (R13-F4)
	OBE	.4880 (R7)	.4488 (R7)	.4938 (R7)	.3510 (R3)	133,100 (R7-F2)
Bounding results from single rack analysis with 700# channeled fuel loadings for (SSE+SRV + LOCA), SSE and OBE Seismic loadings		1.0482	1.0149	.9445	.6037	266,191

TABLE 9.1-31 (Cont'd)

SUMMARY OF WPMR ANALYSIS RESULTS FOR 700# REGULAR FUEL LOADINGS AND COMPARISON WITH BOUNDING RESULTS OF SINGLE RACK ANALYSES								
CONDITIONS OF THE RUN		Maximum Fuel-Cell Impact Load Per Cell lbf.	Maximum Rack-to-Wall Impact Load, lbf		Maximum Rack-to-Wall Impact Load, lbf		Maximum Stress Factor of Rack Pedestals	Maximum Peak Dynamic Water Pressure on Wall, psi
	SEISMIC		Rack Top	Baseplate	Rack Top	Baseplate		
Bounding results from single rack analysis with 700# channeled fuel loadings for (SSE+SRV + LOCA), SSE and OBE seismic loadings		1040	0	0	113.9	1650.9	.650	N/A

TABLE 9.1-31 (Cont'd)

SUMMARY OF WPMR ANALYSIS RESULTS FOR 700# REGULAR FUEL LOADINGS
AND COMPARISON WITH BOUNDING RESULTS OF SINGLE RACK ANALYSES

CONDITIONS OF THE RUN		Maximum Fuel-Cell Impact Load Per Cell lbf.	Maximum Rack-to-Wall Impact Load, lbf		Maximum Rack-to-Wall Impact Load, lbf		Maximum Stress Factor of Rack Pedestals	Maximum Peak Dynamic Water Pressure on Wall, psi
	SEISMIC		Rack Top	Baseplate	Rack Top	Baseplate		
WPMR2-R; 14 Holtec racks and 1 existing 7x7 rack; 700# channelled fuel fully loaded	SSE + SRV + LOCA	1412.0 (R3)	0	0	4185 No. 138[1] (8)	6570 No. 250 (44)	.384 (R1-F4)[2]	22.8
	SSE	1165.1 (R3)	0	5599 No. 212 (6)	4318 No. 138 (8)	3903 No. 214 (8)	.351 (R1-F4)	23.5
	OBE	851.8 (R3)	0	0	1421 No. 173 (43)	1696 No. 222 (16)	.258 (R7-F2)	17.8
WPMR1RFR: 15 Holtec racks; 700# channeled fuel fully loaded	SSE + SRV + LOCA	690.8 (R3)	0	0	5271 No. 138 (8)	4656 No. 214 (8)	.371 (R10-F4)	24.6
	SSE	656.3 (R7)	0	0	3851 No. 138 (8)	4818 No. 247 (41)	.352 (R13-F4)	23.2
	OBE	542.9 (R3)	0	0	1560 No. 147 (17)	2059 No. 249 (43)	.265 (R7-F2)	17.1

1) In parenthesis are rack number and foot number with the maximum value, see Figure 9.1-47.
2) Impact spring number indicated in tables; in the parenthesis is the impact spring number indicated on layout Figure 9.1-47.

Table 9.1-32 has been deleted

9.2 WATER SYSTEMS

9.2.1 SERVICE WATER SYSTEM

The service water system supplies cooling water required for normal plant operation. The SWS has no safety-related function.

9.2.1.1 Design Bases

a. The SWS is designed to remove heat from heat exchangers in the turbine, reactor, and radwaste enclosures, and to transfer this heat to the cooling towers where it is dissipated.

b. The SWS is designed to operate during normal plant operation and plant shutdown with offsite power available.

c. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the SWS are discussed in Section 3.2.

9.2.1.2 System Description

The SWS, shown schematically on drawing M-10, is a single-loop cooling system utilizing three 50% capacity centrifugal pumps operating in parallel (one pump is on standby status). The pumps are located in the circulating water pump structure and circulate cooling water from the cooling tower, through the heat exchangers and back to the cooling tower. Each of the two generating units is provided with a separate SWS and cooling tower, although interconnections are provided so that either SWS can cool equipment common to both units. Design parameters for the major components of the SWS are listed in Table 9.2-1.

The SWS takes suction from the cooling tower basin. Water treatment to prevent long-term corrosion and organic fouling is discussed in Section 10.4.5.1.2.

During periods of low service water flow demand, the system is operated utilizing a single service water pump. System reliability is improved by operating a single service water pump closer to the rated capacity. To maintain back-up capability, an automatic pump start feature is available to be placed into service to automatically start the back-up pump in the event of a failure of the operating pump. This auto start feature is typically used during power operations when pump redundancy is desirable.

The service water flow to the heat exchangers is regulated by hand valves, temperature control valves, or solenoid-operated valves, as shown in drawing M-10.

The service water side (tube side) of the fuel pool heat exchangers is kept at a higher pressure than the shell side to prevent potential radioactive contamination of the service water, in case of a tube leak in a fuel pool heat exchanger. Pressure switches, located in the suction line to the fuel pool service water booster pumps, trip the pumps on low service water pressure.

During normal operation, the SWS supplies cooling water to various heat exchangers and coolers associated with the ESW system as shown in drawing M-11. In the event of a LOOP or LOCA, cooling for these components is automatically supplied by ESW. Switch-over to ESW cooling and isolation of the SWS from these components is discussed in Section 9.2.2.

The RECW and TECW heat exchangers are designed for nonessential service. However, they can be cross-connected to the ESW system (Section 9.2.2) so that in case of LOOP, the plant

operator can provide these heat exchangers with ESW. Isolation between the SWS and the ESW system for these heat exchangers is provided by two normally closed valves connected in series. These valves are key-locked and remote manually operated. Isolation of return lines is provided by check valves and one normally closed valve connected in series.

Interties are provided between the Unit 1 and Unit 2 SWS suction and return headers to provide for continued operation of a unit's SWS during plant shutdown in which the associated cooling tower may be out-of-service for maintenance. In this mode, an SWS pump of the shutdown unit takes suction from the opposite unit's SWS suction header and return flow is routed to the opposite unit's return header to its cooling tower. Heat loads on the SWS are reduced when the unit is shut down, and nonoperating or unnecessary heat exchangers are valved out and throttling may be performed to maintain proper pump and flow conditions.

During a refuel outage, the service water system supports decay heat removal during certain periods. In the event of loss of all service water pumps on the refuel unit, the operating unit can supply a limited quantity of service water through the common service water header to support decay heat removal. The service water is returned to the operating unit via the return header intertie described above.

9.2.1.3 Safety Evaluation

The SWS has no safety-related function. Failure of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

9.2.1.4 Tests and Inspections

System operability is demonstrated by use during normal plant operation. The service water system on each unit is equipped with three pumps in parallel, each of which is capable of providing somewhat greater than 50% of the system requirements at design conditions. This capability provides sufficient margin for component operational degradation and permits the removal of one pump from service for maintenance without affecting the normal operation of the plant.

Operational degradation of service water system components would be detected by observation of inadequate cooling or increased pressure drop. Most of the heat exchangers required for normal plant operation are supplied with redundant equipment that may be valved into service. The potential for plant disruption due to service water system component trouble is therefore minimized.

9.2.1.5 Instrumentation Applications

Local instrumentation is provided at the pumps and at the heat exchangers for maintenance, testing, and performance evaluation. The service water pumps discharge header is equipped with a pressure switch which sounds an alarm in the control room on low discharge pressure.

Radiation monitors in the service water return header to the cooling towers alarm in the control room on high or low radiation. The low alarm indicates monitor malfunction. See Section 11.5 for additional information on process radiation monitoring.

9.2.2 EMERGENCY SERVICE WATER SYSTEM

The ESW system is designed to supply cooling water to selected equipment during a LOOP condition or LOCA. The ESW system is safety-related.

9.2.2.1 Design Bases

a. The ESW system is designed to supply cooling water to essential equipment during a LOOP or LOCA.

b. The ESW system is designed to withstand the most severe natural phenomenon or site-related event (e.g., earthquake, tornado, hurricane, flood, or transportation accident) without impairing its function.

c. The ESW system is designed to prevent inadvertent leakage of radioactivity to the environment.

d. The ESW system is designed with sufficient capacity and redundancy so that a single active failure cannot impair the capability of the system to perform its safety-related functions.

e. The ESW system is designed to include the capability for full operational testing.

f. The ESW system is designed with connections to provide cooling water to certain nonessential equipment during a LOOP or LOCA as directed by Emergency Operating Procedures.

g. The ESW system is designed to include the capability of operating one loop from the remote shutdown panel.

h. The ESW system is designed to seismic Category I requirements. The quality group classification and corresponding codes and standards that apply to the ESW system are discussed in Section 3.2.

9.2.2.2 System Description

The ESW system is shown schematically in drawing M-11. Major equipment design parameters are listed in Table 9.2-2. It should be noted that the design parameters listed in Table 9.2.2 do not constitute performance requirements. ESW pump performance requirements are based on its ability to support the heat transfer rates listed in table 9.2-3. The system is common to Units 1 and 2, and consists of two independent loops (A and B), with two 50% system capacity (100% loop capacity) pumps per loop. Required heat removal rates for various heat exchangers and coolers served by ESW are listed in Table 9.2-3.

The ESW system is designed to supply cooling water to the following safety-related equipment:

a. RHR motor oil coolers

b. RHR pump compartment unit coolers

c. Core spray pump compartment unit coolers

d. Control room chillers

e. Standby diesel generator heat exchangers

f. RCIC pump compartment unit coolers

g. HPCI pump compartment unit coolers

h. Spent fuel pools (makeup water)

In addition to the above equipment, emergency procedures direct providing ESW to the following nonsafety-related equipment during a LOOP:

a. RECW heat exchangers

b. TECW heat exchangers

The reactor recirculation pump seal and motor coolers can be manually supplied with ESW as described in Section 9.2.8.2.

During normal plant operation all of the above equipment, with the exception of the diesel generators, is provided with cooling by the service water system.

Essential heat loads normally cooled by the service water system are automatically transferred to the ESW system under LOOP and LOCA accident conditions. This transfer is accomplished by the following automatic valve realignments:

a. The normally open check valve in each service water supply line closes as a result of the trip of the service water pumps, on a loss of offsite power, and the start of the ESW pumps.

b. The normally closed check valve in each ESW supply line opens as a result of the start of the ESW pumps.

c. The normally open isolation valves installed in series in each service water discharge line close on an ESW pump start signal.

d. The normally closed isolation valves installed in parallel in each ESW discharge line open on an ESW pump start signal.

The ESW pumps start automatically on diesel generator operation (e.g., diesel 1A or 2A cause ESW pump A to start) after speed, voltage, and bus breaker conditions are met, and after a load sequencing delay. ESW pump operation causes automatic valve and sluice gate realignments to:

a. Take pump suction from the spray pond.

b. Provide ESW to safety-related equipment.

c. Return the ESW to the spray pond via the RHRSW system and the spray networks.

The spray pond is described in Section 9.2.6. The operator may elect to realign the system to utilize the cooling towers, if they are available.

The components listed on Table 9.2-3 are provided with cooling water from either ESW loop A or B. Design heat removal rates are also shown in Table 9.2-3. Each diesel generator can be supplied with cooling water from ESW loop A or loop B. Normal system alignment, however, is

such that loop A supplies cooling water to the A and C diesel generators, and loop B supplies the B and D diesel generators.

Each loop is designed such that ESW flow to one unit can be isolated without adversely affecting flow to the other unit.

The valves on an ESW branch line serving a diesel generator are fed from power supplies of the same channel as the diesel generator. All other safety-related components in the ESW system are powered by channels A or C if they are in ESW loop A, or by channels B or D if they are in ESW loop B.

The ESW pumps can be manually started from the control room. The A ESW pump and associated A loop valves can be operated from the remote shutdown panel. The B and C ESW pumps can also be operated from the B and C pumps motor circuit breaker cubicles, respectively.

The ESW pumps are located in the spray pond pump structure. The A and B loop pumps are separated by physical barriers. The pump structure is described in Section 3.8.4. The spray pond pump structure is designed so that sufficient NPSH and adequate hydraulic conditions for proper pump operation are maintained down to a pond level below that associated with the design basis water loss. To verify adequate hydraulic conditions in the pump structure wet pits for proper long-term pump operation, it has been determined from model studies that acceptable hydraulic conditions exist down to elev. 243'-6". Drawing M-389 shows the elevations of the spray pond water levels, suction piping, and the ESW pump.

ESW loop A and B piping is physically separated or protected so that no single postulated event can impair the system's capability to perform its required safety functions. The ESW is combined with the RHRSW before it is returned to the spray pond or cooling tower. The return from each ESW loop is connected to both the A and B RHRSW loops.

Each ESW loop is also provided with two crossties to the RHRSW System and associated isolation valves. One crosstie is installed in a valve pit near the Spray Pond Pumphouse and the second crosstie is installed in the Reactor Building Pipe Tunnel. The crosstie lines and associated isolation valves allow the underground portion of the ESW or RHRSW supply piping of a given loop to be isolated for inspection or repairs without interrupting the supply of cooling water to the ESW or RHRSW System. Operating restrictions, however, apply to certain crosstied configurations and the use of these lines is administratively restricted.

The ESW supply and return yard piping is made of carbon steel, with approximately 200 mils corrosion allowance. All piping outside of the pump structure, main plant, and spray pond is coated for corrosion protection. All heat exchangers, except those in the RHR pump motor coolers have 90/10 Cu-Ni tubes. The 2A-P202 pump motor has type 316 stainless steel tubes in the oil coolers. The remaining RHR pump motor oil coolers have 90/10 Cu-Ni tubes. The heat transfer rates for essential components are verified by testing to ensure that the design basis heat transfer rate is being maintained. The fouling factor for each component is typically 0.002 hr-ft^2-°F/Btu. Water treatment provisions to prevent fouling are discussed in Section 9.2.6.

Radiation detectors are located on the combined ESW/RHRSW system return lines to detect inleakage of radioactive water. Only reactor recirculation pump seal coolers have a potential for radioactive inleakage to the ESW system. However, this line contains locked valves which further reduces the potential for inleakage into the ESW system. Control room alarms are provided on

high radiation. Radioactive leakage from the ESW system is controlled by closing the ESW return valves for the loop where the leak has been identified and realigning the system for operation from the alternate loop. These actions are initiated manually from the control room.

A significant difference between inlet and outlet flows in each ESW loop is indicated for net system water loss or inleakage and annunciated in the control room for net water loss only. Flooding detectors annunciate high water level in the RHR, RCIC, HPCI, and core spray pump compartments and the diesel generator compartments.

Credible pump leakage rates would be of no consequence because the design flow rate of each pump is approximately 6400 gpm. As stated in Section 9.2.2.2, a significant difference between the common pump discharge flow and return flow from each ESW loop is indicated and annunciated in the control room. This differential flow is indicative of ESW loop leakage, other than pump leakage, and provides the operator with indication of system degradation. The instrumentation is shown in drawing M-11.

If the lead cooler in any ECCS/RCIC pump compartment degrades to the point that room temperatures exceed desired levels, the redundant/standby cooler will automatically start. In the event that cooling capability degrades to the point that the compartments cannot be effectively cooled, high compartment temperature will be annunciated in the control room. Operator corrective actions could entail cooler repair, switching to the use of pumps located in another compartment, diverting more ESW flow to the compartment from other nonessential cooling loads, and/or opening compartment doors to facilitate cooling by natural circulation. After a DBA LOCA, use of ECCS equipment in another compartment is the most likely operator response due to high radiation conditions in the Reactor Enclosure. No credit has been taken for manual operator actions in the Reactor Enclosure in this scenario. One room unit cooler per ECCS/RCIC loop may be removed from service at the same time under administrative controls. Failure of both unit coolers in a HPCI, RCIC or Core Spray compartment is no worse than failure of the supported HPCI, RCIC or Core Spray equipment in the compartment because each compartment contains equipment associated with only one ECCS/RCIC loop. However, each RHR compartment contains LPCI equipment and two LPCI loops. Thus, a failure in one LPCI loop or a failure in one LPCI loop support system (such as the air cooling system or a power supply) could impact the other LPCI loop's equipment in the room. If both LPCI pumps' lead and standby unit coolers are in service prior to the DBA LOCA, no single active failure will result in less than the necessary number of coolers remaining functional to limit the RHR room temperature to less than 140 Degrees F. Analysis has demonstrated that any two unit coolers can adequately cool the RHR room to support both LPCI loops. If one or both LPCI pump standby unit coolers is/are out of service prior to the DBA LOCA (with the associated lead unit cooler in service), a single active failure could result in only one functional unit cooler in one RHR room, in which case that RHR room's temperature may exceed 140 Degrees F. Administrative controls are in place to assess and limit the risk of such maintenance configuration for the ECCS/RCIC room unit coolers. These coolers are a non-Tech Spec support system.

9.2.2.3 Safety Evaluation

All safety-related components (including supporting structures) of the ESW system are designed to seismic Category I requirements, as defined in Section 3.7. The piping is designed, fabricated, inspected, and tested in accordance with the requirements of ASME Section III, Class 3. The ESW system, with the exception of the buried piping and the piping in the spray pond, is housed within either the reactor enclosure or the spray pond pump structure, both of which are designed to the

seismic Category I requirements discussed in Section 3.8.4. Evaluation of the ESW system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1
g.	Icing and freezing	Section 9.2.6

Each of the two independent ESW system loops is isolated from the other by barriers, separate trenches, or distance to ensure that simultaneous loss of both loops cannot occur. Power is supplied from four independent divisions. Failure of either a MOV, diesel generator, electrical division, or pump does not prevent the system from removing the full heat load. This arrangement ensures that the full heat removal capacity required is available after a postulated single active failure. See Table 9.2-4 for a failure mode and effects analysis of the ESW system.

Although not specifically included in the ESW system design basis, the cooling provided by a single ESW loop is sufficient to safely shut down both units at all times with the exception of the first 10 minutes of a postulated DBA LOCA. During this time, three RHR pumps may be required on the LOCA unit for flooding (LPCI mode). The RHR pumps are arranged so that only two can be cooled by each ESW loop. See section 6.3.2.5 for a discussion of single failure modes and effects on ECCS reliability.

Connections between the ESW system and the normal service water system, which supplies the equipment other than the diesel generators during normal plant operation, are provided with automatic AOVs and check valves. These isolate the service water system from the ESW system, so that a failure in the normal service water system does not impair ESW system operation. The check valves used at the interface of the essential (ESW) from nonessential (service water) piping is verified to be operable and to have less than 10 gpm leakage as part of the LGS ISI Program. Leakage of this magnitude will not compromise the safety function of the ESW system. Thus, even with this leakage at each interface, the ESW system could withstand a single active failure and still perform its safety function. In addition, seismic Category I manual gate valves are provided upstream of each interface check valve. These valves can be closed for more effective blocking during long-term operation of the ESW system (drawing M-11).

The crosstie piping between the ESW and RHRSW supply loops is provided with manual isolation valves which are locked in the safe position to prevent inadvertent mispositioning of these valves from disabling these systems.

Each ESW loop return is intertied to both ESW/RHRSW combined return headers to the spray pond, so that loss of a combined return header does not cause the loss of an ESW loop.

During certain maintenance configurations, one ESW loop may be lost due to the loss of a single ESW/RHRSW combined return header. However, sufficient redundancy and heat removal capacity remains in the other ESW loop such that ESW can perform its safety function.

Each ESW pump motor is powered from a separate Class 1E bus. Upon LOOP, the standby diesel generators automatically start to supply power to their respective buses, and thus power to the safety-related components of the ESW system. See Section 8.3 for a discussion of the onsite power system.

9.2.2.4 Tests and Inspections

The ESW system is preoperationally tested in accordance with the requirements of Chapter 14, and periodically tested in accordance with the requirements of Chapter 16. Inservice inspection is in accordance with the ASME Section XI for Section III, Class 3 components.

9.2.2.5 Instrumentation Applications

The ESW system is designed for remote operation from the control room. In addition, one pump and the valves associated with its loop can be operated from the remote shutdown panel. A second pump in loop A can be operated using local controls at the C pump motor circuit breaker cubicle. The loop B pump can be operated using local controls at the B pump motor circuit breaker cubicle.

Local and remote indication is provided to monitor process parameters of the system. The following alarms are annunciated in the control room: pump discharge low pressure; flow differential high between influent and effluent showing net water loss. Temperature elements on pump motor provide input to plant computer.

Radiation alarms from the combined ESW/RHRSW return headers are annunciated in the control room.

9.2.3 RHR SERVICE WATER SYSTEM

The RHRSW system is a safety-related system, designed to supply cooling water to the RHR heat exchangers of both units.

9.2.3.1 Design Bases

a. The RHRSW system is designed to provide a reliable source of cooling water for all operating modes of the RHR system, including heat removal under postaccident conditions. It also provides water to flood the reactor core, or to spray the primary containment after an accident, if necessary.

b. The RHRSW system is designed to withstand the most severe natural phenomenon or site-related event (e.g., earthquake, icing conditions, tornado, hurricane, flood, or transportation accident) without impairing its function.

c. The RHRSW system is designed with sufficient capacity and redundancy so that a single failure of any active component, assuming the loss of offsite power, cannot impair the capability of the system to perform its safety-related functions.

d. The RHRSW system is designed to include the capability for testing through the full operational sequence that brings the system into operation for reactor shutdown and for LOCA.

e. The RHRSW system is designed to limit the possibility of any radioactive material release to the environment.

f. The RHRSW system is designed to include the capability of operating one loop from the remote shutdown panel.

g. The RHRSW system is designed to seismic Category I requirements. The quality group classification and corresponding codes and standards that apply to the design of the RHRSW system are discussed in Section 3.2.

9.2.3.2 System Description

The RHRSW system is shown schematically in drawing M-12. Major equipment design parameters are given in Table 9.2-5. It should be noted that the design parameters listed in Table 9.2-5 do not constitute performance requirements. RHRSW pump performance requirements are based on the pumps ability to support heat transfer regardless of discharge head. The system is common to the two reactor units, and consists of two loops. Each loop services one RHR heat exchanger in each unit, and provides sufficient cooling for safe shutdown, cooling, and accident mitigation of both units. The two RHRSW system return loops are cross-connected for flexibility. Two valves in series are provided on the cross-connect, so failure in one loop cannot affect the operation of the other. Each loop has two pumps located in the spray pond pump structure. One pump supplies 100% flow to one RHR heat exchanger. During two-unit operation, there are two heat exchangers (one per unit), and therefore, two of the four pumps are required for safe shutdown and accident mitigation. Description of the pump structure is found in Section 3.8.4. The RHR heat exchangers are described in detail in Section 5.4.7. The spray pond piping network is described in Section 9.2.6.

Spray pond pump structure wet pits are designed so that sufficient NPSH and adequate hydraulic conditions for proper pump operation are maintained down to a pond level below that associated with the design basis water loss. To verify adequate hydraulic conditions in the pump structure wet pits for proper long-term pump operation, it has been determined from model studies that acceptable hydraulic conditions exist down to elev. 243'-6". Drawing M-389 shows the elevations of the spray pond water levels, suction piping and the RHRSW pump.

The RHRSW flows through the tube side of the RHR heat exchangers; the tubes of which are made of corrosion-resistant AL-6XN (Unit 1 and Unit 2B) and 304L stainless steel (Unit 2A). To reduce corrosion, the tube side of the heat exchangers can be laid up with demineralized water when the RHRSW system is not in operation.

It should be noted that a corrosion monitoring system was installed when 304SS tubes were in the Unit 1 RHR heat exchangers. The Unit 1 heat exchanger tubes have been changed to AL6XN material and there is no longer a need to actively monitor the corrosion of the original 304SS tube bundles. Accordingly the monitoring equipment has been placed in a de-energized and isolated inactive status. The design and minimum heat transfer rates are the same and are shown on drawing E11-1020-G-002 for normal and accident modes of RHR system operation. These heat transfer rates are based on the assumption that 5% of the RHR heat exchanger tubes are plugged

and the remainder are fouled, RHR service water temperature is at a maximum, and RHR service water flow is at a minimum. Actual heat transfer rates will be greater than the minimum values based on actual tube and service water conditions plus the manufacturer's design conservatisms.

Credible pump leakage rates will be of no consequence. Excessive leakage in the RHRSW system would cause a high temperature alarm in the RHR system, a flooding alarm in the RHR room, or a low flow indication for RHRSW in the RHR heat exchanger inlet. The redundant RHRSW loop can be used while the leakage problem is being corrected.

The RHRSW system supply and return yard piping is made of carbon steel with approximately 200 mils corrosion allowance. A portion of the RHRSW return piping within the pipe tunnel is stainless steel. All piping outside the pump structure, main plant, and spray pond is externally coated for corrosion protection. Exposed spray pond piping is painted. Water treatment provisions to prevent fouling are discussed in Section 9.2.6. The spray networks can be drained after use to minimize corrosion and provide protection from freezing.

The RHRSW system is available for normal shutdown or emergencies, and does not operate during normal power generation, except that the RHRSW system can be used in conjunction with the RHR system suppression pool cooling mode to maintain the suppression pool below specified temperature limits, and RHRSW can be operated in the spray mode for spray pond cooling and chemistry control purposes.

For two-unit operation, during a plant operating mode in which one unit is in an accident shutdown (LOCA) and the other unit is in a normal shutdown (including LOOP occurring during normal shutdown), with one RHRSW loop in service (two RHRSW pumps in operation, and one ESW pump in operation using one spray pond return header and two spray networks), the unit undergoing normal shutdown will be supplied with 5570 to 8000 gpm of RHRSW flow to the RHR heat exchanger. The RHRSW cooling water flow to the unit under normal shutdown is sufficient to remove the heat load on its RHR heat exchanger. The time to cool the RPV down to 200°F will increase but will remain within the shutdown requirements of the Technical Specifications. The unit in an accident shutdown will still be supplied with 8000 GPM of RHRSW flow to the RHR heat exchanger. The required RHRSW flows to each RHR heat exchanger can be attained by adjusting HV-51-2F068A/B or HV-51-1F068A/B. RHRSW flow to the RHR heat exchangers can be monitored through FI-51-1R602A/B and FI-51-2R602A/B.

The RHRSW pump motors obtain their power from separate Class 1E buses; the A and B pumps from Unit 1 buses A and B, respectively, and the C and D pumps from the Unit 2 buses A and B, respectively. If LOOP occurs, the diesel generators start automatically, providing emergency power to the buses. The pumps are started manually. It is not necessary to secure any of the ECCS pumps before starting the RHRSW pumps. The RHRSW valves obtain their power from the safeguard buses, with loop A valves receiving power from Division 1 and 3, and loop B valves from Division 2 and 4. The RHR heat exchanger inlet valves are powered by different electrical sources. Specifically, HV51-1F014A and RHRSW pump OAP506 are powered by Division I, Unit 1 while HV51-1F014B and RHRSW pump OBP506 are powered by Division II, Unit 1. In the event of a power supply failure, an RHR heat exchanger is removed from service by manually closing the heat exchanger service water outlet valve.

The RHRSW return and the return from both ESW loops share a common return header to the spray pond. Loss of one RHRSW/ESW return loop does not affect the capability of the second return loop to safely shut down either or both units during emergency conditions.

Under certain maintenance configurations, flow from the two return headers may be combined in one line for a limited period of time. Any active valves which could fail and disable this line will be blocked in the safe position. Passive failures which could cause the total failure of this line during this limited duration have been evaluated and are not considered credible.

Upon standby emergency diesel generator or ESW pump start, the RHR service water system automatically aligns itself to the spray pond mode, if it is not already in that mode. If the cooling tower mode is available, the system can be manually aligned to it. Bypass lines are provided to discharge water directly to the pond, rather than the spray networks, during periods when the pond is frozen.

Double remotely operated isolation valves are provided on the cross-tie lines between the RHRSW system and the RHR pump discharge, for flooding the containment or reactor core, if such action is necessary and no other source of water is available.

Radiation monitors are provided in the RHRSW system return headers to the spray pond. High activity in the return header causes an alarm and the pumps associated with that loop to stop. Overrides are provided to restart the pumps.

For detection of possible RHRSW system pipe breaks, flow indicators on each RHR heat exchanger inlet, and RHR room flooding detectors that annunciate on high water level, are provided.

9.2.3.3 Safety Evaluation

Safety-related components (including supporting structures) of the RHRSW system are designed to seismic Category I requirements, as defined in Section 3.7. The piping is designed, fabricated, inspected, and tested in accordance with the requirements of ASME Section III, Class 3 except as noted in Table 3.2-7. The RHRSW system, with the exception of the buried piping and the piping in
the spray pond, is housed within either the reactor enclosure or spray pond pump structure, both of which are designed to seismic Category I requirements as discussed in Section 3.8.

Evaluation of the RHRSW system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

g. Icing and freezing Section 9.2.6

There are two RHRSW loops, each loop serving one RHR heat exchanger in each unit, to supply cooling water for plant shutdown. Each loop is isolated from the other by barriers, separate trenches, or distance to ensure that simultaneous loss of both loops cannot occur. Failure of either a MOV, a diesel generator, or pump does not prevent the system from performing its safety function. This arrangement ensures that the full heat removal capacity required is available after the postulated active failure of a single component. See Table 9.2-6 for a failure mode and effects analysis of the RHRSW system.

Motors of the four RHRSW system pumps are connected to separate Class 1E buses.

9.2.3.4 Tests and Inspections

The RHRSW system is preoperationally tested in accordance with the requirements of Chapter 14, and periodically tested in accordance with the requirements of Chapter 16. Inservice inspection is in accordance with ASME Section XI for Section III, Class 3 components.

9.2.3.5 Instrumentation Applications

The RHRSW system is designed for remote operation from the control room. Each pump has a discharge pressure switch which causes an alarm in the control room upon low discharge pressure. Each loop has a pressure transmitter in the common supply line for pressure indication in the control room.

The RHRSW supply line flow to each heat exchanger is indicated in the control room. Pressure and temperature in the return lines from each heat exchanger are indicated in the control room. High radiation alarms and radiation recorders are provided in the control room for each common return line. Temperature elements on the pump motors provide input to the plant computer.

Loop A pumps and valves can also be operated from the remote shutdown panel and pressure indication for the common supply line is provided. Loop B pump can be operated using local controls at the B pump motor circuit breaker cubicle.

9.2.3.6 Regulatory Commitments

The following table provides a description of the regulatory commitments identified in Exelon letter dated October 29, 2010 (Ref. 9.2-29), Attachment 4, as updated by supplemental letters dated December 3, 2010 (Ref. 9.2-30), and March 23, 2011 (Ref. 9.2-31), and is included in the Updated Final Safety Analysis Report as required by Amendment Nos. 203 to Facility Operating License No. NPF-39 and 165 to Facility Operating License No. NPF-85 for Limerick Generating Station (LGS), Units 1 and 2, respectively, dated July 29, 2011 (Ref. 9.2-32).

The amendments consist of changes to the LGS Technical Specifications (TS) of each unit extending the allowed outage time (AOT) from 72 hours to seven (7) days for the Suppression Pool Cooling mode of the Residual Heat Removal (RHR) system, the Residual Heat Removal Service Water (RHRSW) system, the Emergency Service Water (ESW) system, and the [Alternating Current] A.C. Sources – Operating (Emergency Diesel Generators [EDGs]).

The specific purpose of the amendments is to provide a 7-day TS AOT window to allow for repairs of the common RHRSW system piping. The AOT extension is only allowed once every other calendar

year, for each unit, while one unit is operating and the opposite unit is shut down, with the reactor vessel head removed and rector cavity flooded.

The piping repairs are intended to repair certain known areas of degraded RHRSW return piping, and are expected to take several refueling outages on each unit to complete the full scope of repairs. However, the TS changes may be used for other future RHRSW piping maintenance activities, as necessary, as long as the appropriate TS restrictions and the regulatory commitments identified below are observed.

These regulatory commitments will be controlled as part of a special procedure developed specifically to govern plant operation while in the extended TS AOTs to perform RHRSW system piping repairs.

Regulatory Commitments
1. The following action will be taken prior to entry into the proposed configuration: • Proper standby alignment of the operable RHRSW subsystem will be ensured by local verification of boundary valve and power supply position in accordance with a check-off list contained in the special procedure developed specifically to govern plant operations in the extended AOTs.
2. Also, the following actions will be taken prior to entry into the proposed configuration: • When the 'A' RHRSW subsystem is inoperable to allow for repairs of the RHRSW A subsystem piping with Limerick Generating Station Unit 2 shutdown, reactor vessel head removed and reactor cavity flooded, the following equipment will be verified as available and protected as defined in procedure OP-AA-108-117: o ESW loop A o Unit 1 RHR subsystems A and C o D11, D13, and D23 4kV buses and emergency diesel generators o Unit 1 Division 1 and Division 3 Safeguard DC • When the 'A' RHRSW subsystem is inoperable to allow for repairs of the RHRSW A subsystem piping with Limerick Generating Station Unit 1 shutdown, reactor vessel head removed and reactor cavity flooded, the following equipment will be verified as available and protected as defined in procedure OP-AA-108-117: o ESW loop A o Unit 2 RHR subsystems A and C o D11, D21, and D23 4kV buses and emergency diesel generators o Unit 2 Division 1 and Division 3 Safeguard DC • When the 'B' RHRSW subsystem is inoperable to allow for repairs of the RHRSW B subsystem piping with Limerick Generating Station Unit 2 shutdown, reactor vessel head removed and reactor cavity flooded, the following equipment will be verified as available and protected as defined in procedure OP-AA-108-117: o ESW loop B o Unit 1 RHR subsystems B and D o D12, D14, and D24 4kV buses and emergency diesel generators

o Unit 1 Division 2 and Division 4 Safeguard DC • When the 'B' RHRSW subsystem is inoperable to allow for repairs of the RHRSW B subsystem piping with Limerick Generating Station Unit 1 shutdown, reactor vessel head removed and reactor cavity flooded, the following equipment will be verified as available and protected as defined in procedure OP-AA-108-117: • o ESW loop B o Unit 2 RHR subsystems B and D o D12, D22, and D24 4kV buses and emergency diesel generators o Unit 2 Division 2 and Division 4 Safeguard DC
3. Activities in the switchyard that adversely affect risk exposure are those that have the potential to cause a loss of offsite power, such as testing and maintenance activities. Therefore, testing and discretionary maintenance will be prohibited during the RHRSW subsystem piping repairs in the at-power unit switchyard and on equipment in the outage unit switchyard supporting operability of its offsite source. Accordingly, during the RHRSW subsystem piping repairs, the at-power unit switchyard will be protected in its entirety using either a lock and/or chain different than that used for normal access to the switchyard, or a physical barrier placed in front of the gate used for normal access to the switchyard. In addition, equipment in the outage unit switchyard supporting operability of its offsite source will be protected during the RHRSW subsystem piping repairs using protected equipment signs and physical barriers, such as barrier rope, physical devices, tape, etc., to prevent access to the equipment. This will be controlled through applicable corporate and station procedures for equipment protection, and through the special procedure developed specifically to govern plant operation while in the extended AOTs.
4. Operational Risk Activities (ORAs), as defined in procedure WC-AA-104, involve activities on risk significant systems that have the potential to derate the plant, i.e., cause a loss of planned generation. Typical ORAs involve: an activity that could cause equipment actuations that could cause loss of planned generation; instrument, fuse, or circuit board removal/installation; an activity that will cause a 1/2 scram or 1/2 trip; pressurization of common instrument sensing lines; placing of jumpers or lifting energized leads; an activity that could cause vibration or impact near operational risk sensitive equipment, etc. Such activities will be prohibited on the online unit during the RHRSW piping repairs. Exceptions to this must be approved by the senior plant management. This will be controlled as part of the special procedure developed specifically to govern plant operation while in the extended AOTs.
5. The extended weather forecast will be examined to ensure severe weather conditions that would threaten the loss of offsite power are not predicted prior to entry into the AOT. In the event of an unforeseen severe weather condition due to rapidly changing conditions, such as severe high winds, a briefing with crew operators will be performed to reinforce operator actions and responses in the event of a loss of offsite power (E-1 0/20). This will be controlled via the special procedure developed specifically to govern plant operation while in the extended AOTs.
6. Shift briefs will be performed to reinforce other potentially important operator actions associated with the performance of the extended AOT (i.e., operator actions to refill the

condensate storage tank (CST), operator actions to vent containment, operator actions to maximize control rod drive (CRD) injection to the vessel, and operator actions to support continued use of feedwater and condensate post-trip as necessary and if available). Additionally, during the 'A' RHRSW subsystem outage, a shift brief on alternate remote shutdown operations will be performed since some of the normally operated equipment from the remote shutdown panel will not be available. This will be controlled via the special procedure developed specifically to govern plant operation while in the extended AOTs.

7. Unattended transient combustibles and hot work will be prohibited in the areas listed below during the extended AOT. This will be controlled via the special procedure developed specifically to govern plant operation while in the extended AOTs.

   For an 'A' RHRSW subsystem outage window:
   - Fire Area 15, Unit 1 Division 2 (012) safeguard 4kV switchgear room
   - Fire Area 17, Unit 2 Division 2 (022) safeguard 4kV Switchgear room
   - Fire Area 24, Main Control Room (ECCS B panel 10-C601 (Bay A, B))
   - Fire Area 24, Main Control Room (ECCS B panel 20-C601 (Bay A, B))
   - Fire Area 25, Auxiliary Equipment Room

   For an 'B' RHRSW subsystem outage window:
   - Fire Area 13, Unit 1 Division 1 (011) safeguard 4kV Switchgear room
   - Fire Area 19, Unit 2 Division 1 (021) safeguard 4kV Switchgear room
   - Fire Area 24, Main Control Room (ECCS A panel 10-C601 (Bay C, D, E, F))
   - Fire Area 24, Main Control Room (ECCS A panel 20-C601 (Bay C, D, F))
   - Fire Area 25, Auxiliary Equipment Room
   - Fire Area 26, Remote Shutdown Panel

9.2.4 CLARIFIED WATER SYSTEM

The plant clarified water system provides filtered, clarified river water for use as lubricating water, and as the input stream for the makeup demineralizer system.

The plant clarified water system, shown in drawing M-17 is not safety-related, and does not convey radioactive material.

9.2.4.1 Design Bases

a. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the clarified water system is discussed in Section 3.2.

b. Raw water is clarified and filtered to an effluent turbidity not exceeding 1.0 NTU and is stored in the clarified water storage tank.

c. The clarified water system is not connected to any systems having the potential for containing radioactive material.

d. The clarified water system is designed to meet maximum anticipated plant water demands.

9.2.4.2 System Description

The clarified water system is shown in drawing M-17.

Influent for the clarified water system is supplied by the Perkiomen Creek or Schuylkill River. The river water turbidity is reduced in the raw water clarifier by chemical addition. The clarified water from the clarifier outlet flows by gravity to the clearwell. The flow through the clarifier is controlled by a level control valve on the clarifier inlet.

The clarifier is designed to operate on the upflow sludge blanket principle. Chemical addition is in proportion to the inlet flow to the clarifier. Backflushing and sludge blowdown from the clarifier can be manually controlled or automatically controlled in proportion to inlet flow. The sludge is directed to the normal waste for disposal.

The clarified water service pump takes suction from the clearwell, and discharges to the clarified water storage tank via three anthracite bed pressure filters. The clarified water standby pump serves as a backup to the clarified water service pump. The anthracite filters remove suspended solids from the clarifier effluent to maintain proper water clarity within the clarified water storage tank. Each filter has a design flow rate of 100 gpm. Backwashing of the anthracite filters is either manual or automatic, with normal operation being automatic. Under automatic operation, the filters are sequentially backwashed by the filter backwash pump, and are returned to service at the conclusion of the backwash cycle. The clarified water standby pump also serves as a backup to the filter backwash pump. The clarified water service pump, filter backwash pump, and clarified water standby pump are provided with minimum flow recirculation loops for pump protection during low flow demand.

Flow to the clarified water storage tank is controlled by a level control valve on the tank inlet. A controller, normally in manual mode, throttles the inlet valve to the clarified water storage tank level. The tank is located in the yard next to the water treatment enclosure, and is furnished with steam heating to prevent freezing.

The clarified water storage tank furnishes water for the following systems during normal operation:

a. Demineralized water makeup system

b. Lube water system

The makeup demineralizer feed-pumps provide water to the makeup demineralizer system as needed to maintain a pre-established level in the demineralized water storage tank. Operation of the pumps is manually initiated by local or remote hand switches.

A valve in the makeup demineralizer feed pump discharge header is automatically closed when neither feed pump is running, thereby preventing inadvertent drainage of the clarified water storage tank during pump shutdown. If the valve fails to open when either feed pump is started, or if the valve fails closed, the makeup demineralizer feed pumps are tripped by a position switch. The pumps are also tripped on low-low level signal from the clarified water storage tank.

With the exception of the clarified water storage tank, which is located outside, the equipment in the clarified water system is located in the water treatment enclosure.

9.2.4.3 Safety Evaluation

The clarified water system has no safety-related function. Failure of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

9.2.4.4 Testing and Inspection Requirements

System operability is demonstrated by use during normal plant operation.

9.2.4.5 Instrumentation Requirements

The clarified water system is furnished with control panels, located in the water treatment enclosure, which are designed for remote manual and automatic control of the processes. Clarified water flow, and turbidity are monitored to verify system performance, and to alarm when abnormal conditions exist.

The clarified water storage tank is equipped with level switches to actuate high and low level alarms; to trip the clarified water service pump, the filter backwash pump, and the makeup demineralizer pumps .

Automatic operation of any of the lube water pumps due to low pressure in pump discharge line is annunciated in the control room. Low-low pressure in the lube water pump discharge is alarmed locally.

Local pressure indicators are provided at the discharge of all pumps in the systems for pump head indication.

9.2.5 DEMINERALIZED WATER MAKEUP SYSTEM

The demineralized water makeup system provides a supply of treated water suitable as makeup for the plant and reactor systems, and for other demineralized water requirements. The demineralized water makeup system has no safety-related function.

9.2.5.1 Design Bases

a. The demineralized water makeup system is designed to provide 80 gpm supply of demineralized water, to meet maximum anticipated plant operating requirements.

b. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the demineralized water makeup system are discussed in Section 3.2.

c. The demineralized water makeup system is designed so that the treated water composition does not exceed the limits given below:

Conductivity, micromhos/cm	0.2
Total dissolved solids, ppm	0.1
Silica, ppm SiO_2	0.010

9.2.5.2 System Description

The demineralized water makeup system is shown in drawing M-18. Design parameters for the major components of the system are given in Table 9.2-8.

Clarified and filtered river water is supplied to a vendor supplied water purification system by the makeup demineralizer feed pumps (Section 9.2.4). Chlorine residual and organics are removed by the activated carbon filter which precedes the vendor supplied water treatment system. The carbon filter may be bypassed if not required as determined by the water treatment vendor. Inlet water pressure to the carbon filter is regulated to a pre-established value by a pressure-reducing valve.

The original demineralizer system is no longer in service. All demineralized water makeup needs are met by a vendor supplied water purification system.

Discharge from the vendor supplied water purification system is continuously monitored by conductivity measuring devices which initiate alarms on a local panel, and divert the flow to chemical waste when maximum allowable levels are reached. Monitoring of silica shall be accomplished through the chemistry sampling program.

Demineralized water is stored in the 50,000 gallon capacity demineralized water storage tank. The tank is outside, and is furnished with steam heating to prevent freezing. This water supply is used to fill the CSTs and refueling water storage tanks, prior to unit operation. Demineralized water is also used prior to unit operation for plant systems flushing and filling. During normal operation, demineralized water is used for, but not limited to the following services:

a. Condensate and refueling water storage tanks

b. Fuel pool skimmer surge tanks

c. RECW system

d. TECW system

e. Auxiliary boilers

f. SLCS

g. Chemistry laboratory

h. Radwaste system

i. Chilled water system

j. Plant demineralized water hose stations

k. Zinc Injection Passivation system (GEZIP)

The demineralized water supply is provided by the demineralized water transfer jockey pump, or the demineralized water transfer pumps which are operated as needed to meet plant demineralized water demand.

9.2.5.3 <u>Safety Evaluation</u>

The demineralized water makeup system has no safety-related function. Failure of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

9.2.5.4 Testing and Inspection Requirements

System operability is demonstrated by use during normal plant operation.

9.2.5.5 Instrumentation Requirements

Local and remote indicators, alarms, and pressure relief valves are provided to monitor the system process and to protect system components. Pressure differential, level, flow, temperature, and alarms are provided for each applicable point in the demineralizer system. High and low level alarms are installed in the demineralized water storage tank.

9.2.6 ULTIMATE HEAT SINK

The UHS, a spray pond, serves the safety-related functions of providing cooling water, and acting as a heat sink for the ESW system and the RHRSW system during accident conditions.

9.2.6.1 Design Bases

a. The UHS is designed to provide sufficient cooling water to the ESW and RHRSW systems, permitting simultaneous safe shutdown and cooldown of both units, and maintaining them in a safe shutdown condition.

b. In the event of an accident in one unit, the UHS is designed to provide sufficient cooling water to the ESW and RHRSW systems to dissipate the heat for that accident safely, to permit the concurrent safe shutdown and cooldown of the other unit, and to maintain both units in a safe shutdown condition.

c. The UHS is sized so that makeup water is not required for at least 30 days, and design basis temperature and chemistry limits for safety-related equipment are not exceeded.

d. The UHS is designed to perform its safety function during periods of adverse meteorological conditions, resulting in maximum water consumption and minimum cooling capability.

e. The UHS is designed to withstand the most severe natural phenomenon or site-related event (e.g., SSE, tornado, hurricane, flood, freezing, or transportation accident), and reasonably probable combinations of less severe phenomena and/or events, without impairing its safety function.

   Note: For the case of tornadoes, the cooling towers and Schuylkill River makeup pumps supplement the Spray Pond as required, to mitigate the storm damage and provide required cooling.

f. The UHS is designed to withstand any credible single failure of manmade structural features without impairing its safety function.

g. The UHS is designed to automatically supply sufficient cooling water to the ESW and RHRSW systems, as required.

h. The UHS is designed to include the capability for full operational testing.

i. The UHS is designed so that the cooling towers may be used as the heat sink for normal shutdown operations, and for postaccident operations if they are available.

Codes and standards applicable to the UHS are listed in Table 3.2-1.

9.2.6.2 System Description

9.2.6.2.1 General Description

The UHS for both units is a highly reliable, seismic Category I spray pond, that ensures that an adequate source of cooling water is available at all times for reactor shutdown and cooldown, and for accident mitigation. The RHRSW and ESW systems (see Sections 9.2.2 and 9.2.3) receive cooling water via the spray pond pump structure located on the pond perimeter, and return the water to the spray pond via the spray networks, or winter bypass lines .

9.2.6.2.2 Spray Pond Description

The spray pond is of seismic Category I design, excavated below-grade, and sized for a water volume adequate for 30 days of cooling under design basis conditions. The general arrangement of the spray pond, spray networks, and spray pond pump structure is shown in Figure 9.2-6. Details of the spray pond excavation and finished grading are shown in Figures 3.8-55, 3.8-56, and 3.8-57. A summary of pond design data is shown in Table 9.2-9.

The pond is lined to minimize seepage. The pond bottom and soil cut slopes are covered with a soil-bentonite lining, while the rock-cut slopes are lined with shotcrete. See Sections 3.8.4.1 and 2.5 for further details of pond geology, geometry, and linings.

The pond is provided with a seismic Category I overflow weir to accommodate normal water level fluctuations, and an emergency spillway to limit the maximum water level in the pond during maximum precipitation conditions.

Four spray networks, which are arranged symmetrically in the pond, provide cooling for the ESW and RHRSW return water. The layout of the spray networks is shown in drawing M-384. The networks and their supply piping are suspended above water on reinforced concrete columns.

9.2.6.2.3 Spray Pond Pump Structure

The spray pond pump structure houses the RHRSW and ESW pumps, and associated piping and valves. See drawings M-388, M-390 and M-389 for the general arrangement of equipment within the structure, and drawings M-11 and M-12 for piping and instrumentation diagrams of the ESW and RHRSW systems.

The pump structure is located on the edge of the spray pond. Openings are provided in front of the structure to allow pond water to flow into the wet pits where the pump suctions are located. Closure

of the sluice gates on these openings, and realignment of system valves allows the ESW and RHRSW systems to shift from the spray pond mode to the cooling tower mode.

The wet pit area is divided into two sections, corresponding to the A and B loops of the RHRSW and ESW systems. The two areas are separated by a wall, with a sluice gate that can be closed to isolate the two trains. Each pump is installed in its own bay. A removable screen is placed at the entrance of each bay.

Provision of adequate net positive suction head for the pumps is discussed in Sections 9.2.2 and 9.2.3.

HVAC equipment maintains necessary ambient conditions for proper operation of the equipment (Section 9.4-7).

9.2.6.2.4 <u>System Components</u>

Piping and valves associated with the spray pond system are carbon steel. Safety-related portions are designed to seismic Category I requirements as defined in Section 3.7 and are installed, inspected, and tested in accordance with the requirements of ASME Section III, Class 3.

Four spray networks are provided: two redundant networks for each ESW/RHRSW combined return loop. The networks and network supply piping are completely above water, and are provided with a corrosion allowance of 250 mils. Network header piping is sized for proper flow rates to all nozzles in the network. Piping is sloped to allow complete drainage of the networks and network supply piping, to minimize corrosion and prevent freezing. The exterior surface of the piping is painted to provide additional corrosion protection.

The spray nozzles are precision cast stainless steel, of a design that provides good thermal performance, while minimizing drift loss. All nozzles are located at el 258', 7 feet above the normal pond water level, allowing for proper droplet formation and flight time. Procedural guidance assures proper flow rates so that the pressure drop across the nozzles necessary for proper spray performance (3.4 psi, minimum) is achieved for all anticipated modes of RHRSW and ESW operation. The nozzles have no internal parts susceptible to clogging. A cleanout connection is provided at the end of each of the twenty-eight spray pond supply header pipes, in order to periodically flush corrosion products from these pipes and thus ensure proper functioning of the spray nozzles.

A winter bypass line is provided for each ESW/RHRSW combined return line to allow bypassing the spray networks and returning the heated water directly to the pond volume.

Makeup water to the pond is supplied via a 6 inch branch line from the Schuylkill River makeup line to the cooling towers. The line enters the pond below normal pond water level; a single normally closed gate valve in the line prevent siphoning from the pond in the event of loss of pressure in the makeup line. Makeup to the spray pond is controlled manually. A level detector in the pond which alarms in the Main Control Room assures that proper level is maintained.

An 8 inch blowdown line and associated weir are provided on the western pond perimeter. The line is used for overflowing excess water during rain conditions and for water quality control.

Two drain sumps are provided in the bottom of the pump structure. The sump pumps discharge to the pond above the water surface to avoid siphoning of the pond to the pump structure.

9.2.6.3 System Operation

The spray pond is designed to automatically supply cooling water to the ESW and RHRSW systems when required, and to continue this function with a minimum of operator attention.

9.2.6.3.1 Normal Operation

The spray pond is normally in a standby mode, and, except for periodic testing or RHRSW operation for spray pond cooling and chemistry control, is used only for cooldown and shutdown operations, or during emergency or accident situations. Starting the ESW pumps causes sluice gates and system valves to automatically align for spray pond operation, if not already in that position. The operator may subsequently stop and start pumps, and remove or add spray networks from service as necessary to maintain proper flows and diesel loadings.

During standby, the pond level is manually maintained above the Tech. Spec. Minimum level of 250’-10” (9’-10” pond depth) by the makeup and blowdown lines. Design basis minimum operating level corresponds to el. 250’-10” (9’-10” pond depth). During long-term operation, without makeup and blowdown, the concentration of scale-forming constituents, which can impair heat exchanger performance, increases due to evaporation. Provisions are available for the manual addition of chemicals to inhibit scale formation from calcium carbonate. Sufficient spray pond inventory is provided such that other scale-producing agents, such as calcium sulfate, do not reach concentrations that might cause scaling during the 30 day postaccident period, when no makeup or blowdown is assumed.

9.2.6.3.2 Winter Operation

The spray pond is designed to perform its safety functions with an initial ice layer on the pond surface.

During icing conditions, return flow to the pond is initially directed to the winter bypasses, which inject the warm return water directly to the pond volume. The bypasses are directed toward the ends of the pond to allow the return water to circulate and mix with the pond volume, and avoid hydraulic short-circuiting. The increasingly warmer pond water causes any ice layer present on the pond surface to melt. Once a hole is formed in the ice layer, a return path for spray water is available, and the spray networks may be used as water temperature dictates.

9.2.6.3.3 Cooling Tower Operation

During normal shutdown and cooldown operations, the RHRSW system uses the spray pond or the cooling tower as the source of cooling water, and as the heat sink. The system may be aligned to use the cooling towers as the heat sink and water source by shutting the spray pond sluice gates, and diverting the return flow to the towers. Cooled water from the cooling tower basins flows back to the wet pits.

Should an emergency or accident condition arise while in the cooling tower mode, ESW pump start signals cause the system to automatically realign to the spray pond mode. Subsequently, and after assessment of the cooling tower's availability, the system may be placed in the cooling tower mode, if so desired.

9.2.6.4 Spray Pond Thermal Performance

9.2.6.4.1 Design Meteorology

Conservative design meteorological conditions were determined for two cases: maximum water consumption and minimum heat transfer. Since no long-term meteorological data from the LGS site exist, long-term data (40 years) from the NWS at Philadelphia International Airport for the period January 1, 1941 through December 31, 1980, were selected as the most representative available long-term record.

To demonstrate the applicability of Philadelphia data, a coefficient of thermal performance comparison was made between LGS and Philadelphia for the same 5 year period (January 1, 1972 through December 31, 1976) using 3 hourly averages of wind speed, dry-bulb temperature, and relative humidity from each site. Wind speed was taken from the LGS aerovane 30 feet above grade on Tower No. 1. The dry-bulb temperature from LGS Weather Station No. 1 (about 5 feet above grade) was used. Relative humidity was determined through an average of eight stations at and surrounding the LGS site. Location of towers and stations is discussed in Section 2.3.2.

A comparison of the frequency distributions of dry-bulb temperatures by 10% relative humidity groups shows that the Philadelphia data are similar to the LGS data for the 2½ year period from January 1, 1972 through June 30, 1974. At the higher humidities, where the minimum heat transfer case occurs, the distributions are essentially identical. At lower humidities, the Philadelphia dry-bulb temperatures are slightly higher. Representative comparisons are shown in Figures 9.2-8 and 9.2-9.

A comparison of the frequency distribution of daily average relative humidities, without regard to temperature, is listed in Table 9.2-10. This table also shows very similar frequency distribution over the 2½ year period, with Philadelphia exhibiting a slightly higher frequency of low humidities, and a slightly lower frequency of high humidities.

A comparison of the distribution of daily average wind speeds from Philadelphia Airport data with that from the LGS site, also listed in Table 9.2-10, show rather poor agreement. The airport exhibits considerably higher daily average wind speeds, especially during daytime hours since 1964. This is believed to be due to the location of the wind sensor near the runways, which results in the measurement of manmade wind from the aircraft. Since Philadelphia wind speeds are not considered representative of the LGS site, a natural wind speed of zero was assumed in the analysis of meteorological data for the spray pond design, in the minimum heat transfer case. This is a conservative assumption.

Since these comparisons of meteorological data from LGS with similar data from the Philadelphia Airport indicate that the Philadelphia Airport relative humidity and temperature are quite representative of the LGS site, and because the Philadelphia record is of sufficiently long duration to establish worst case conditions, the 40 years of Philadelphia data for humidity and temperature were used as the basis for the design of the spray pond.

The design meteorology was selected using the method of Reference 9.2-1, as discussed below. For maximum water consumption, the worst 30 day period was determined using a coefficient of water loss which combines losses due to evaporation and drift. The evaporation loss was calculated from the results of the work of Ranz and Marshall (Reference 9.2-2) on evaporation from water drops in air. The drift loss was calculated as a function of wind speeds, using a computer model (Section 9.2.6.4.1.1) whose predictions are based on field test results (Reference 9.2-3) of identical nozzles. A coefficient of water loss value (Section 9.2.6.4.1.1), which is proportional to

water loss rate, was calculated for each day in the 40 year period of record. Running averages of the coefficient values were used to select the worst 30 day period for water loss. The worst 30 days for water loss began May 30, 1958. The average conditions for that period are presented in Table 9.2-11. Since wind speeds at Philadelphia are generally higher than at the site, the use of Philadelphia data yields conservative results for maximum water consumption.

The minimum heat transfer meteorological conditions were determined using a similar technique. The Philadelphia meteorological data were modified for the minimum heat transfer case, however, by assigning a zero natural wind speed value to all data. This is conservative, in that it minimizes heat transfer. The average drop velocity was added to the natural wind speed to calculate evaporation. A coefficient of thermal performance (Section 9.2.6.4.1.1) was calculated for each day, using average daily data. Running averages were taken to determine the worst 30 days for heat transfer. The worst day was June 30, 1945, and the worst 30 day period began August 12, 1959. The resulting design meteorological conditions are given in Table 9.2-11.

Using the coefficient of performance technique described above, the worst meteorological conditions were also determined for the 5 year period from January 1, 1972 through December 31, 1976, with both Philadelphia and LGS site 3 hourly average data. Actual reported natural wind speeds were used in this comparison for the maximum water loss case; Philadelphia wind speeds were converted to a 30 foot elevation for comparison. Natural wind speed added to the drop velocity was used in selecting worst case conditions for the minimum heat transfer case.

Results, listed in Table 9.2-12, show that the worst conditions are very similar at both locations, with the Philadelphia conditions being more conservative in all cases, except the 30 day minimum heat transfer case. The use of zero natural wind speed in the actual thermal analysis of the spray pond makes the use of the Philadelphia data conservative in the minimum heat transfer case.

This comparison confirms that use of the Philadelphia meteorology data, as modified, is appropriate as a conservative basis for the design of the spray pond.

9.2.6.4.1.1 Meteorology Analysis Methods

Drift Loss Model

An independent model has been developed to predict drift losses. A review of the literature reveals no efforts directly applicable to calculation of drift losses from a spray pond. Due to basic system differences, cooling tower drift measurements cannot be applied directly to spray ponds; therefore, a model was developed from principles of analytical mechanics. The following parameters are included in the model:

a. Drop size spectrum

b. Wind speed and direction

c. Elevation necessary for loss of a drop from the pond

d. Distance of each nozzle from the perimeter of the pond in the direction of drift

e. Pressure drop across the nozzle

f. Angle at which water leaves the nozzle

g. Vertical air entrainment of droplets

Drift is caused by the horizontal drag force exerted on small drops as they move relative to the air. A water drop leaves the nozzle with a certain initial velocity, and from that time its motion is determined by drag and gravitational forces. By solving the equations of motion, the position of each drop is determined as a function of time. When all initial velocities are considered, the positions of drops of the same size that left the nozzle at the same time, trace out a locus in the horizontal plane. When drops of similar size are grouped together, a locus results for each drop size group. A schematic drawing of typical loci is shown in Figure 9.2-10, for one wind speed at one elevation. The loci are concentric circles for a wind velocity of zero, and are somewhat distorted and translated in the wind direction for nonzero wind speeds.

Once the loci have been determined, for a given wind speed, the fraction of flow lost by drift for each drop size group is the ratio of the length of the locus outside the pond perimeter to the total locus length. Since a locus represents the position of drops of a given group, no drops from that group are off the locus at the elevation; consequently, the length of the locus is used to calculate loss fraction rather than the enclosed area. The percentage of flow lost by drift is the sum over the drop size groups of the product of drift loss fraction and flow fraction.

$$P = \sum_{i=1}^{n} f_i B_i \qquad \text{(EQ. 9.2-1)}$$

where:

P = percentage of flow lost by drift

f_i = fraction of flow in drop size group (i) that is lost

B_i = fraction of total flow in drop size group (i)

n = number for drop size groups

In order to facilitate evaluation of the drag coefficient for each drop size group, the drops are assumed to be spherical. High speed photographs show that drops deviate very little from being spherical, especially for smaller diameters, which are most important in drift loss considerations.

Since the drag force on a sphere is proportional to the relative velocity raised to a power between 1 and 2 (depending on the Reynold's number), the resulting equations of motion are nonlinear. An approximation is made to allow a solution in closed-form, in which the drag force is assumed to vary linearly over a certain range of velocities. Two velocity ranges are used, and for all velocities the approximation equals or exceeds the actual drag force, thus preserving conservatism by maximizing drift losses. This approximation technique is depicted in Figure 9.2-11.

The linear drag force approximation, in combination with Newton's Second Law, is used to determine the acceleration of a drop. The acceleration is integrated to determine the position of

the drop as a function of time. This is done for both the X and Z directions, shown in Figure 9.2-12, to determine the coordinates, X_i (t,θ)' Z_i (t,θ)', of drop position for the i^h drop size group, as a function of time and initial direction. The motion in the Y direction is used only for calculating the drop exposure time.

In order to find the locus of a given drop size group at the elevation necessary for loss from the pond, the time of flight or exposure time, must be calculated. The motion of a drop in the Y direction, shown in Figure 9.2-12, is used to calculate the exposure time. Since the water leaves the nozzle in a conical pattern, no drag is applied for the first few feet of travel in the vertical direction to allow maximizing the time in the air, which maximizes drift losses. Drag is applied immediately in the calculation of X and Z coordinates, in order to maximize drift losses. The vertical position, Y(t), is determined as a function of time; subsequently, the elevation necessary for loss from the pond is substituted for the position. The resulting implicit equation is solved for exposure time. There is a different exposure time for each drop size group, due to the dependence of drag force on drop diameter.

With the exposure time determined, the locus for each drop size group can be generated by considering all initial velocity directions. A computer program has been written to supply the coordinates of points on each locus. The locus in the X, Z plane for each drop size group is integrated numerically over its length to determine the fraction of the locus, hence the drop size group, that is beyond the perimeter of the pond. The losses for the different drop size groups are summed to determine the total drift loss percentage from the pond.

The computer model generates a drift loss versus perimeter distance curve (Figure 9.2-13), which is used to generate a drift loss vs wind speed curve that is unique for each pond. A typical example is shown in Figure 9.2-14. Drift loss vs wind speed is used as input to the coefficient of water loss, discussed later, and in the system model.

The percentage of flow lost due to drift is an input parameter for the system model. The system model uses it as a loss term in determining the water remaining in the spray pond at any time after the start of operation of the sprays. The drift loss for the LGS spray pond is determined as a function of wind speed. This information is entered as a table, wind speed versus drift loss, in the system program. The drift loss is determined from the table at each time step in the calculation of system parameters.

Coefficient of Thermal Performance

The coefficient of performance for heat loss was calculated from the following equation:

$$C = (1/M_dC_p)\ [\ -K\pi D_p\ (2 + 0.6\ N_{re}^{1/2}N_{pr}^{1/3})\ (T_d - T_a) - (\pi D_v D_p h_g)$$

$$(2 + 0.6\ N_{re}^{1/2}N_{sc}^{1/3})\ ((P_{ai}/R_vT_d^*) - (P_{ao}/R_vT_a^*))] \quad \text{(EQ. 9.2-2)}$$

where:

C	=	coefficient of performance, °F/sec
M_d	=	drop mass, lb

C_p	=	specific heat of water, Btu/lb-°F (assumed = 1)
K	=	thermal conductivity of moist air, Btu/sec-ft-°F
D_p	=	drop diameter, ft (0.008 ft)
N_{re}	=	Reynold's number, moist air (dimensionless)
N_{pr}	=	Prandtl number (dimensionless)
T_a	=	air dry-bulb temperature, °F
T_d	=	drop temperature, °F (pond temperature)
D_v	=	diffusion coefficient of water vapor in air, ft^2/sec
h_g	=	enthalpy or water vapor, Btu/lb
N_{sc}	=	Schmidt number (dimensionless)
P_{ai}	=	vapor pressure at T_a, lb/ft^2
P_{ao}	=	partial pressure of vapor in air, lb/ft^2
T_d^*	=	T_d + 460, °R
T_a^*	=	T_d + 460, °R
ρ_w	=	density of water, lb_m/ft^3 (62.4)
P_{ao}	=	$(RH)(C+C_2T_a+C_3T_a^2+C_4T_a^3+C_5T_a^4+C_6T_a^5)$ 70.5 lb/ft^2
P_{ai}	=	$(C_1+C_2T_d+C_3T_d^2+C_4T_d^3+C_5T_d^4+C_6T_d^5)$ 70.5 lb/ft^2
C_1	=	$3.76515x10^{-2}$ inch Hg
C_2	=	$2.5463x10^{-3}$ inch Hg/°F
C_3	=	$2.96588x10^{-5}$ inch Hg/$°F^2$
C_4	=	$8.40577x10^{-7}$ inch Hg/$°F^3$
C_5	=	$7.-1246x10^{-10}$ inch Hg/$°F^4$
C_6	=	$4.33688x10^{-11}$ inch Hg/$°F^5$
RH	=	relative humidity
N_{sc}	=	ν/D_v

h_g = 1090 Btu/lb_m

D_v = $4.06 \times 10^{-8} (T_a^*)^{2.5}/(T_a + 901) ft^2/sec$

N_{pr} = $C_p\mu/k$

N_{re} = VD_p/ν

V = Wind velocity ft/sec

D_p = Drop diameter, 0.008 ft

v = Kinematic viscosity of air

υ = $1.45 \times 10^{-4} + (T_a - 32)(5.15 \times 10^{-7}) ft^2/sec$

K = $3.89 \times 10^{-6} + (3.89 \times 10^{-7} (T_a - 32))/68$ Btu/sec-ft-°F

M_d = $\rho_w V = \rho_w \pi d^3/6\ lb_m$

ρ_w = 62.4 lb/ft^3

R_v = 85.5 (gas constant, vapor)

Coefficient of Water Loss

The water loss coefficient of performance is calculated from the following equation:

$$C_w = 1.25 \times 10^4\ \pi D_v D_p (2 + 0.6 N_{re}^{1/2} N_{sc}^{1/3}) (P_{ai}/R_v T_d^*)$$

$$(P_{ao}/R_v T_a^*) + f_d \quad \text{(EQ. 9.2-3)}$$

where:

f_d = drift loss fraction (from drift loss curve for corresponding wind speed typical curve shown in Figure 9.2-14)

C_w = water loss coefficient

The remainder of terms are as defined in Equation 9.2-2.

The equations used to represent the typical curve of Figure 9.2-14 are:

a. For wind speed less than or equal to 2.5 miles per hour

$$f_d = C \times 10^{-4} WS \qquad \text{(EQ. 9.2-4)}$$

where:

WS = wind speed, mph

C = a constant for the specific pond geometry

b. For wind speed greater than 2.5 miles per hour

$$f_d = Ae^{(B(WS))} \qquad \text{(EQ. 9.2-5)}$$

where:

A and B = constants for the specific pond geometry

9.2.6.4.2 Spray Pond Water Requirements

This section discusses the water requirements that were considered in determination of the spray pond design volume and used in the pond thermal performance analysis.

9.2.6.4.2.1 Evaporation Due to Plant Heat Load

Evaporation due to the plant heat load is determined from the total heat dissipated by the spray pond in 30 days, due to decay heat, sensible heat, and auxiliary system heat loads. The total decay heat dissipated in 30 days is 5.47×10^{10} Btu for both units, based on Reference 9.2-4 for finite reactor operation. This includes contributions from fission products and heavy elements.

The LOCA/SSD auxiliary system total heat generation for the first 30 days is 2.27×10^{10} Btu. The auxiliary system heat load includes loads due to operation of engineered safeguards equipment, including the standby diesel generators, which would be in service following the loss of offsite power. The LOCA/SSD auxiliary heat generation rate averages 31.2×10^6 Btu/hr for the first 30 hours, and 31.5×10^6 Btu/hr thereafter, total for both units. The two-unit SSD auxiliary heat generation rate averages 64.2×10^6 Btu/hr for the first 30 hours and 65.2×10^6 Btu/hr thereafter, total for both units. The total sensible heat load of the reactor pressure vessel, its internals, and the suppression pool is 1.93×10^8 Btu, referenced to a final temperature of 121.4°F. The resultant evaporation is 13.58×10^6 gallons in 30 days.

9.2.6.4.2.2 Natural Evaporation

Natural evaporation of the spray pond was based on the design meteorology of Section 9.2.6.4.1 and a constant pond surface area of 9.6 acres. The water loss due to natural evaporation is shown in Table 9.2-13. This is conservative because the average surface area over the 30 day accident scenario is less than 9.6 acres and the effect of the sprays suppressing evaporation is not taken into account.

The evaporation calculation was based on the methodology of Reference 9.2-5.

9.2.6.4.2.3 Drift Loss

Drift loss due to entrainment of spray droplets during periods of moderate and high winds has been estimated using data from spray pond tests (Reference 9.2-3) and a drift loss computer model (Section 9.2.6.4.1.1). The 30 day period of highest water loss was determined by considering both evaporative and drift losses, as described in Section 9.2.6.4.2. For the 40 year period of meteorological record (January 1, 1941 to December 31, 1980), the worst 30 day period for water loss was found to be May 30 through June 28, 1958. The average wind speed for this 30 day period is 10.43 mph. Drift loss is minimized by placement of over 90% of the nozzles a minimum of 100 feet away from the perimeter of the pond. The remaining nozzles, located near the corners of the pond, are at least 60 feet away from the pond perimeter.

The operation of four RHRSW pumps and three ESW pumps after a two-unit SSD, results in the maximum loss of 1.44×10^5 gallons in 30 days, based on a spray flow rate of 9000 gpm per RHRSW pump and 5666 gpm per ESW pump.

This drift loss value is based on a pond surface area of 9.9 acres and nozzle height of 7.17 feet above the pond surface.

9.2.6.4.2.4 Seepage

The design seepage rate of 1.825×10^6 gallons in a 30 day period was used in the thermal analysis. A seepage test was conducted to verify that the allowable design seepage rate for the lined pond would not be exceeded. This test, which was conducted during the period December 13, 1982 to May 21, 1983, determined that the actual seepage loss was between 2.1×10^5 gallons and 3.8×10^5 gallons in 30 days, depending on how evaporation losses are measured. This rate is between 11% and 21% of the allowable design rate. Considering possible error contributions from all measurements, the upper limit of the seepage loss during the test is estimated to be approximately 40% of the allowable design rate, and the lower limit is effectively zero. Details of the spray pond seepage measurements and testing are discussed in Section 2.5.

9.2.6.4.2.5 Sedimentation

An allowance of 2.75×10^6 gallons of water is provided to ensure that frequent pond cleaning is unnecessary. This corresponds to a sediment layer of approximately 12 inches on the pond bottom. Accumulation of sediment on the spray pond pumphouse intake area concrete slab will be periodically checked as part of the inspection program required by Regulatory Guide 1.127. Based on the results of these inspections, a suitable program of reinspection and cleaning will be established. Any excessive accumulation of sediment will be removed by suction dredging equipment to prevent excessive particulate concentrations from occurring near the intake structure. Water removed from the pond with the sediment will be returned to the pond such that intake water quality is not adversely affected or limited to the capacity of the clean water makeup line.

9.2.6.4.2.6 Fuel Pool Cooling and Makeup

In the event of a LOOP, the spray pond is used as a source of cooling water for the spent fuel pool via the RECW system (Section 9.2.8). The heat dissipation for this service is included as an auxiliary system heat load in Section 9.2.6.4.2.1.

Provisions are also made to supply pond water directly to the fuel pools via the ESW or RHRSW system, in the event of unavailability of the fuel pool cooling system. Since cooling via the RECW system and direct makeup would not occur simultaneously, the makeup function does not represent an additional water loss.

9.2.6.4.2.7 Water Quality

The spray pond is treated with a mineral scale inhibiting chemical. The addition of chemical treatment allows the background chemical concentrations of the spray pond to increase due to normal water losses from drift and evaporation during non-accident operation. During an accident, the spray pond will normally increase in concentration, assuming no makeup. The mineral scale inhibiting chemical concentration will also increase in the same manner, preventing deposits on heat transfer surfaces. The spray pond will be analyzed periodically and adjustments made to scale inhibitor concentrations, as needed.

Provisions are also made to reduce the fouling effects associated with silting and biologics. Chemical treatment also includes the use of biocides and dispersants to maintain water quality.

9.2.6.4.2.8 Minimum Water Level for Operation

To verify adequate hydraulic conditions in the pump structure wet pits for proper long-term pump operation, it has been determined from model studies that acceptable hydraulic conditions exist down to el. 243'-6". This operational limit establishes the dead storage volume of the spray pond as 6.95 million gallons. This dead storage is utilized to fulfill the sedimentation volume requirements (Section 9.2.6.4.2.5) and used in the analysis of spray pond temperatures.

As discussed in the following section, the pond water level will not drop below el. 243'-6" at the end of the design basis 30 day period.

9.2.6.4.2.9 Total Volume Allocation

The design water allowances are shown in Table 9.2-13. Substantial margin ($4.74x10^6$ gallons) is shown to exist for the maximum water loss case

9.2.6.4.3 Evaluation of UHS Performance

The spray pond performance has been analyzed to assure that the design spray pond volume is adequate for 30 days of cooling without makeup or blowdown, and that the cooling water temperature does not exceed the design limit for the design basis heat input and meteorological conditions. The heat loads for the following conditions were examined:

a. One-unit LOCA, one-unit SSD

b. Two-unit SSD

The heat loads for the one-unit LOCA, one-unit SSD were modeled as a two-unit SSD with cooldown at the maximum rate of 100°F per hour and four RHR heat exchangers operable for the first 30 hours of the event. This model maximizes the heat rejection to the pond during the time when the peak pond temperature is reached. This results in the bounding pond temperature and maximum water loss. Therefore the two-unit SSD model with maximum heat rejection was used for the pond thermal and water loss analysis.

Other assumptions used in performing the transient analysis for performance evaluation include:

a. No makeup water is supplied to the spray pond during the 30 day period.

b. The decay heat generation rate is in accordance with NUREG 0800 Branch Technical Position ASB 9-2. (Reference 9.4-4)

c. Coincident with the postulated LOCA/SSD, the water level in the spray pond is at design minimum (corresponding to 29.07×10^6 gallons less the sedimentation allowance) .

d. Uniform mixing is assumed in the spray pond. Short circuiting was not observed in tests (Reference 9.2-3).

The spray efficiency values are determined using the spray cooling model described below. Comparisons of model predictions with test data show the model to be conservative (Section 9.2.6.4.3.4). The spray efficiency used in these transient analyses is presented in Figure 9.2-17 as a function of hot water temperature. The spray efficiency is determined for the minimum spray network flow rate of 8500 gpm. This flow corresponds to the minimun flow of two RHRSW pumps and one ESW pump divided between two spray networks. The minimum flow was combined with the heat loads defined above to create a model which envelopes all spray pond operating conditions.

Other pertinent data used in the analysis is presented in Table 9.2-14. The heat rejection rate to the spray pond is given in Figure 9.2-18 and Table 9.2-15 for decay heat, station auxiliary heat and sensible heat. The integrated decay heat, station auxiliary heat sensible heat and total heat are given in Figure 9.2-19 and Table 9.2-16. The initial spray pond temperature assumed, 88°F, corresponds to extreme monthly average atmospheric conditions that maximize initial temperature (Reference 9.2-8).

9.2.6.4.3.1 Analytical Techniques and Input Parameters

To perform the required transient analyses that demonstrate adequate performance of the ultimate heat sink, as measured against criteria specified by the U. S. Nuclear Regulatory Commission (NRC) in Regulatory Guide 1.27,[9] a spray pond model utilizing a new ultimate-heat-sink performance computer program has been developed. This computer program consists of various theoretical models that simulate the thermal performance of the spray pond subject to an imposed heat load and meteorological conditions, both of which vary with time. These meteorological conditions include the environmental dry-bulb temperature, relative humidity, and prevailing wind speed, if appropriate. In addition, the effects of solar radiation directly to the pond, infrared radiation from the atmosphere to the pond, and radiation from the pond to the environment are included along with heat transfer via convection and conduction between the spray pond and environment.

These models comprise the several modules (subprograms) that are described below. The computer program is written in the FORTRAN77 programming language, also known as FORTRAN X3.8 (1978), using the Microsoft FORTRAN v5.1 compiler specifically for a microcomputer equipped with a 80386 central processing unit (CPU) and 80387 co-processor or 80486 CPU.

9.2.6.4.3.1.1 Spray-Pond Model

The spray-pond model (module) is used by the Limerick Spray Pond model to calculate the mass and temperature of the spray pond from conservation principles. Both the water inventory (pond mass) and temperature are expected to also change with time. The spray pond is assumed to be thermodynamically described by a single bulk temperature. Heat transfer and water loss from the pond surface can be considered a secondary effect with regard to the heat and mass transfer action of the spray network.[10] Thermal stratification is diminished because the pond volumes are relatively small compared to the amount of water being circulated.[11]

The rate of change of (internal) energy for the spray pond is determined from a simple energy balance

$$\frac{dE_p(t)}{dt} = H_{dp} + H_{sn} + H_{an} - H_{br} - H_{ev} - H_{cn} - H_{ps} \qquad \text{(EQ. 9.2-6)}$$

where:

H_{dp} -	is the energy added via sprayed water, in the form of drops, falling on the spray pond surface;
H_{sn} -	is the solar insolation (direct solar radiation to the pond);
H_{an} -	is the radiation from the atmosphere to the pond;
H_{br} -	is the infrared radiation from the pond to the atmosphere;
H_{ev} -	is the energy loss due to evaporation from the pond surface;
H_{cn} -	is the conductive energy loss from the pond to the atmosphere; and
H_{ps} -	is the energy lost from the pond due to seepage through the basin liner.

Heat lost via conduction through the pond basin liner is neglected. In writing the above expression, it is explicitly assumed that the water in the spray pond can be represented by a single temperature that is independent of location.

In an analogous fashion, the rate of change of pond mass is just

$$\frac{dM_p(t)}{dt} = w_{dp} - W_{pe} - W_{sw} - W_{ps} \qquad \text{(EQ. 9.2-7)}$$

where:

w_{dp} -	is the mass flow rate to the pond, in the form of drops falling to the pond surface, from the spray;
w_{pe} -	is the evaporation rate from the pond surface;
w_{sw} -	is return flow to the service water systems; and
w_{ps} -	is the seepage losses through the pond basin liner.

Generally, apart from the direct solar radiation to the spray pond, the mass and energy flow rates are functions of time by way of the pond temperature which varies with time.

The total mass and energy of the spray pond can be obtained via numerical integration of a first-order Taylor's series expansion:

$$M(t + \Delta t) \approx M(t) + \frac{dM(t)}{dt}\Delta t$$

$$E(t + \Delta t) \approx E(t) + \frac{dE(t)}{dt}\Delta t \qquad \text{(EQ. 9.2-8)}$$

The temperature of the spray pond is determined from knowledge of the pond total internal energy E_p and mass M_p. Although the specific energy of water is a function of both temperature and pressure, it is only weakly dependent upon the pressure, and to an excellent approximation (about one part in ten thousand or 0.01%) values along the saturation line may be used. For temperatures below 373.15 K (100°C), the internal specific energy e_f is given by the product of the specific heat at constant volume for water, that is independent of temperature, and the temperature in Celsius. Hence, the spray pond specific energy is given by

$$\frac{E_p}{M_p} \equiv e(p_\infty, T_p) \approx e_f(T_p) \approx c_{vw}(T_p - T_o) \qquad \text{(EQ. 9.2-9)}$$

where c_{vw} = 4189.8 ± 5.1 J/kg-°C and T_o = 273.15 °K. Approximate determination of this spray pond temperature in this manner will produce an error in the temperature of about 0.01°C. In addition, note that the internal specific energy has been, in compliance with custom, referenced to 0°C, that is, at T_p = 273.15°K, the specific energy is zero.

9.2.6.4.3.1.1.1 Heat Load

As a matter of definition, the heat load rejected to the ultimate-heat sink Q_{Hx} is that energy added to the water from the spray-pond that is used as cooling for the sundry heat exchangers. The energy at the spray nozzles is the sum of the enthalpy of the cooling flow plus this heat load. Part of this energy is transferred to the atmosphere via evaporation or is lost by action of a prevailing wind carrying the sprayed water in the form of drops beyond the pond boundary. The energy added to the spray pond is equal to the heat load Q_{Hx}, plus the product of the spray mass flow rate and the pond specific enthalpy $w_{sw}h_f(T_p)$, minus the energy lost via evaporation from the sprays and driftloss, and is described below in Section 9.2.6.4.3.1.1.5. Figure 9.2-18 shows the spray-pond heat load as a function of time for a postulated design basis accident.

9.2.6.4.3.1.1.2 Solar Insolation

The average daily solar radiation absorbed by a body of water varies according to site latitude, time of year, and time of day. Various tabulations, graphs, and formulas are available which give the instantaneous solar radiation as a function of these parameters with an accuracy of about 5 percent. Because the average spray pond temperature is required for a period of one month, values for the instantaneous solar radiation will require time increments on the order of one hour. Such a formulation is cumbersome and requires long microcomputer running times and a formulation for average daily solar radiation is more appropriate. Thus, the average daily solar insolation (radiation that has been received) can be expressed in the form[12]

$$H_{an} = (1 - 0.0071C^2)H_oS_p \qquad \text{(EQ. 9.2-10)}$$

where H_o is the absorbed solar radiation for a clear sky in units of watts per meter squared, C represents the cloud in tenths of sky, and S_p is the pond surface area in units of square meters. Because of the rotation of the earth, H_o changes significantly throughout the daylight hours and, of course, is zero during the night. To facilitate computation, H_o is taken to be an average over a given time increment. However, if the increment is longer than about three or four hours, the accuracy of the absorbed solar radiation is unacceptable. Because the characteristic time required for significant changes in the ultimate-heat-sink system is on the order of one day, the absorbed

solar radiation H_o is taken to be the average daily absorbed solar radiation in units of watts per square meter of pond surface for a cloudless sky, and can be parameterized as a function of latitude and time (day) of year:[13]

$$H_o = A_{sn}(\lambda) + B_{sn}(\lambda)\sin\left(\frac{2\pi N}{366} + C_{sn}(\lambda)\right) \qquad \text{(EQ. 9.2-11)}$$

where the parameters $A_{sn}(\lambda)$, $B_{sn}(\lambda)$, and $C_{sn}(\lambda)$ are functions of latitude λ between 26 °N and 46 °N. The standard error associated with equation [EQ 9.2-11] is less than 8.7 W/m^2.

9.2.6.4.3.1.1.3 Atmospheric Radiation

Infrared radiation from the atmosphere is a function of many variables, including the distribution of temperature, moisture, carbon dioxide, ozone and other atmospheric constituents. However, since not all these parameters are normally known, Anderson[14] proposed an empirical relationship of the form:[15]

$$H_{ra} = \sigma S_p \left[A_{ra} + B_{ra} P_v\left(T_a\right)\right]\left(1 - \omega\right) T_a^4 \qquad \text{(EQ. 9.2-12)}$$

where σ = 56.687 pW/m^2-$°K^4$ is the Stefan-Boltzmann constant, p_v the saturation pressure in units of Pa, ω is the pond surface reflectivity, and T_a the atmospheric temperature in units of °K. The parameters A_{ra} and B_{ra} are empirical parameters and functions of the cloud cover parameter C. As before, S_p is the surface area of the spray pond in units of meters squared.

9.2.6.4.3.1.1.4 Spray-Pond Radiation

The energy flux radiated from the spray pond in units of watts per square meter of pond surface area is given simply by

$$H_{br} = \in \sigma S_p T_p^4 \quad H_{br} = \varepsilon\sigma S_p T_p^4 \qquad \text{(EQ.9.2-13)}$$

where $\in$ is the emissivity of the pond taken to be 0.97,[16] σ is the Stefan-Boltzmann constant, S_p is the spray pond surface area in units of meters squared, and T_p is the temperature of the pond surface in units of °C. Because the flow rate out from the pond to the sundry heat exchangers is in excess of 87% of the pond volume per day, it can be assumed that the pond is well mixed and the pond surface temperature is well-represented by the bulk average temperature T_p.

9.2.6.4.3.1.1.5 Spray-Pond Evaporation

Evaporation from the spray pond due to the plant heat load and heat input by the environment (natural evaporation) is calculated as part of the pond thermal performance module in the ultimate-heat-sink computer program. Evaporation from the surface of a body of water is a complicated phenomenon involving many factors and much discussed in the literature. The evaporative energy flux in units of watts per square meter of pond surface is proportional to the difference in steam (water vapor) concentration between the pond surface and the atmosphere. Hence, an empirical relation giving the energy loss rate in units of watts can be written in the form:

$$H_{pe}=C f(U)[P_v(T_p)-\phi_a P_v(T_a)]S_p \qquad \text{(EQ. 9.2-14)}$$

where C is a constant to convert from units of Btu/(day ft^2) to W/m^2, $f(U)$ is the "wind function" and S_p is the surface area of the spray pond. The term $p_v(T_p)$ is the saturation pressure evaluated at the pond temperature and thus is a measure of the steam concentration at the spray pond surface, while the term $\phi_a\ p_v(T_a)$ is the partial pressure of steam (water vapor) in the atmosphere and so represents the concentration there. Hence, the difference between these terms is the concentration difference which drives the net evaporation.

The "wind function" $f(U)$ describes the effect of a prevailing wind as it blows across the spray pond surface. One of the most accurate, but slightly non-conservative, empirical relations for the wind function is that given by Ryan and Harleman:[17]

$$f(U)=22.4(\Delta T_v)^{1/3}+14U \qquad \text{(EQ. 9.2-15)}$$

where ΔT_v is the "virtual" temperature difference between the spray pond surface water and the air above the pond and U is the prevailing wind speed in miles per hour. The virtual temperature has units of °F and is given by

$$\Delta T_v = \frac{5}{9}\left(\frac{p_{atm}\ T_p}{p_{atm} - 0.378\ p_v\ (T_p)} - \frac{p_{atm}\ T_a}{p_{atm} - 0.378\ p_v\ (T_a)}\right) \qquad \text{(EQ. 9.2-16)}$$

where T_p and T_a are respectively the spray pond and atmosphere temperatures in °K, $p_v(T_p)$ and $p_v(T_a)$ are respectively the vapor pressures at the pond surface and atmosphere in units of Pa, and p_{atm} is the total atmospheric pressure also in units of Pa.

Other wind speed functions commonly used can be selected by the user. The wind speed function proposed by Brady et al[18] which is derived from large-lake data is given by

$$f(U)=70 + 0.7U^2 \qquad \text{(EQ. 9.2-17)}$$

which has units Btu/(ft^2 day)/mm Hg. The prevailing wind speed U has units of miles per hour and is measured at ten feet above the surface of the pond. This model of the wind speed is generally more conservative than that proposed by Ryan and Harleman.

Comparison of predictions using each model with experimental data shows that the Brady formulation gives pond temperatures that are 5 - 11 °C higher than the Ryan and Harleman formulation.[19]

The wind speed function used by Thackston and Parker[20] is

$$f(U)=C_2\beta U \qquad \text{(EQ. 9.2-18)}$$

where C_2 is a conversion constant to convert from Btu/(hr ft^2)/in Hg to Btu/(day ft^2)/mm Hg and β is an empirical constant which depends on the size, shape and exposure of the water body, and on the location of the wind measurement. In the referenced work of Thackston and Parker, a value of 13.9 is used which was approximately the value obtained from their Lake Hefner studies.

9.2.6.4.3.1.1.6 Spray-Pond Conduction and Convection

The conduction and convection heat losses from the ultimate-heat-sink spray pond is driven by the temperature difference between the spray-pond and the atmosphere, and is dependent upon the prevailing wind. An empirical relation for this rate of energy loss is[21]

$$H_{cn} = \left(\frac{9}{5}\right) CBf(U)(T_p - T_a)S_p \qquad \text{(EQ. 9.2-19)}$$

where f(U) is the wind-speed function selected for the evaporation losses in Section 9.2.6.4.3.1.1.5, and C is a coefficient that converts from Btu/(day ft^2) to W/m^2. The parameter B = 0.26 mm Hg/°F is Bowen's Coefficient, and the temperatures have units °K.

9.2.6.4.3.1.2 Spray-Region Model

A spray field or region above the surface of the spray pond is created by operation of the spray network. Each nozzle creates a spray which forms a cone of water with an average angle α to the horizontal. In calm wind conditions, the sprayed water forms an "umbrella" which reaches some maximum height H above the pond surface and range R from the nozzle. All nozzles in concert generate a spray field or spray region above the surface of the spray pond in which the density of sprayed drops is great. As they pass through this region, the drops lose mass and energy via evaporation before entering the spray pond. As a result of this evaporative mass and energy loss, the temperature and relative humidity of the surrounding air is altered. Hence, consideration must be given to the modification of the environment in this region in order to adequately simulate the performance of the spray network.

Because the temperature and relative humidity vary appreciably throughout the spray field, this region is divided into segments. Two different methods for division are necessary depending upon whether or not there is a prevailing wind. As the sprayed water is hot, relative to the environment, it will heat the surrounding air and thereby reduce its density compared to the air outside the spray region. This difference in density will generate or induce a wind. Depending upon the temperature of the sprayed water and meteorological conditions, this buoyancy-induced wind can have a wind speed greater than that of a prevailing wind of low speed. However, as the prevailing wind speed increases, the effects of buoyancy become unimportant. Thus, to capture the physics of the spray region thermal performance when buoyancy is important, it is necessary to simulate the spray-region performance differently depending upon whether or not there exists a prevailing wind. Hence, both a low-wind-speed model and a high-wind-speed model are required. Which of these models dominate is determined by which model has the greater spray-region efficiency η which is described in more detail below in Section 9.2.6.4.3.1.2.4. Since this is not obvious, a priori, the Limerick Spray Pond model calculates the spray-region performance for each model separately

and automatically selects those results (inputs to the spray pond) from that model with the greatest calculated efficiency.

9.2.6.4.3.1.2.1 Spray-Region Geometry

The spray nozzles are assumed to be arranged in a rectangular pattern with the long dimension parallel to the x-axis and the short dimension parallel to the y-axis. Hence, the spray region will also have a rectangular geometrical pattern. The height of the spray region H is just the height reached by the spray above the surface of the pond. The length of the spray region is just the length of the nozzle geometrical pattern (in the x-direction) plus twice the range of drops from a nozzle; similarly, the width of the spray region is the geometrical width (in the y-direction) plus twice this range. This geometry is subdivided differently depending upon whether a low-wind-speed model or a high-wind-speed model is being used. However, for both models, the height and overall extent of the spray region are the same.

A ballistic drop trajectory that neglects drag forces is used to determine the height H and range R for a given initial (nozzle) drop velocity u_o. The nozzle spray angle α, effective nozzle flow area A_{nz}, and number of nozzles N_{nz} are assumed known. From these, the initial drop velocity at the nozzle is given by

$$u_o = \frac{v_f \; w_{nz}}{A_{nz} \; N_{nz}} \qquad \text{(EQ. 9.2-20)}$$

where $\underline{v}_f$ is the liquid specific volume for water evaluated at the spray temperature at the nozzle. Once the initial drop velocity, which is a vector quantity, has been determined, vertical and horizontal components are easily obtained. Hence, the height is just

$$H \cong \frac{u_o^2}{2g} \sin^2 \alpha + y_o - y_p \qquad \text{(EQ. 9.2-21)}$$

where y_o is the height of the spray nozzle above the water surface and $y_p < 0$ is the elevation of the pond surface with respect to the initial surface elevation ($y_{p,init} = 0$). The horizontal range of a drop is the product of the horizontal velocity and the sum of the time required for the drop to reach the apex of its trajectory and the time required to free fall to the pond surface:

$$R \cong \frac{u_o^2}{2g} \left(1 + \sqrt{1 + \frac{2g(y_o - y_p)}{u_o^2 \sin^2 \alpha}} \right) \sin(2\alpha) \qquad \text{(EQ. 9.2-22)}$$

9.2.6.4.3.1.2.2 High-Wind-Speed Model

For the high wind speed submodel, the spray region is divided into N rectangular segments normally oriented such that the wind velocity is parallel to the long axis of the region as depicted in Figure 9.2-20. Such an orientation is considered conservative because were the wind assumed parallel to the short region axis there would be a larger volume with lower relative humidity and hence more evaporative loss from the sprayed water, hence a larger efficiency. However, the

amount of water carried outside the spray pond boundary by the wind is minimum for the wind parallel to the long axis of the spray network and maximum for the wind parallel to the short axis. Therefore, spray pond analyses performed using the Limerick Spray Pond model are either for maximum pond temperature or maximum water loss depending upon whether the long or short axis is input as the "length" of the spray network.

Since the total segment mass is explicitly assumed to be conserved,

$$\frac{dM_i}{dt} = w_{sp,i} + w_{s,i-1} + w_{a,i-1} - w_{s,i} - w_{a,i} - w_{dp,i} = 0 \qquad \text{(EQ. 9.2-23)}$$

where:

$w_{sp,i}$ - is the mass flow rate from all spray nozzles to the *ith* spray region segment and is just the product of total mass flow rate to all nozzles in the spray network and the ratio of the segment area (in the x-y plane) to the spray region area;

$w_{s,i-1}$ - is the water vapor (steam) mass flow rate from the *(i-1)th* segment to the *ith* segment;

$w_{a,i-1}$ - is the dry air mass flow rate from the *(i-1)th* segment to the *ith* segment;

$w_{s,i}$ - is the water vapor (steam) mass flow rate leaving the *ith* segment;

$w_{a,i}$ - is the dry air mass flow rate leaving the *ith* segment; and

$w_{dp,i}$ - is the dry water drop mass flow rate for all diameter groups leaving the *ith* segment for the spray pond.

As the segment mass is explicitly assumed to be conserved, so then are the individual air and steam-water (vapor-liquid) masses also conserved. Note that because of a change in phase, only the combination of steam plus water is conserved, steam and water are not conserved separately. In addition, it is also assumed that there is no flow out the top of the spray region, Hence, it follows that

(EQ. 9.2-24)

$$w_{sp,i} = w_{dp,i} + w_{ev,i}$$
$$w_{a,i} = w_{a,i-1}$$
$$w_{s,i} = w_{s,i-1} + w_{ev,i}$$

where $w_{ev,i}$ is the total evaporative rate from the drop of all diameter groups. As the mass flow rate entering the spray pond from the ith segment $w_{dp,i}$ is known, being determined in the drop dynamic module described below, the total rate of evaporation from all drops in the ith segment, $w_{ev,i}$, and the vapor (steam) mass flow rate to the (i+1)th segment, $w_{s,i}$, is also known.

9.2.6.4.3.1.2.3 Low-Wind-Speed Model

For the low-wind-speed submodel, the spray field is divided into a set of concentric rectangular segments as shown in Figure 9.2-21. The number of these segments is the same as the number in the high-wind speed model. Due to buoyancy, the warm humid air in each segment will rise and thereby draw cooler air from the outer segment. As a result, cool humid air (air-steam mixture) flows into each segment through its outer surface. Part of the flow exits the segment through the segment top surface and the remainder flows to the next inner segment. All the air entering the center segment leaves through the top of that segment. Although there is no prevailing wind, there is an induced wind as a result of buoyancy. As before, each segment is assumed to be in thermodynamic equilibrium (single segment temperature). The hot water from the spray enters through the segment top as in the case of the high-wind speed model. Heat energy lost by spray is gained by the moist air. An energy balance similar to that in the high-wind speed model is constructed which, in this case however, includes the air leaving through the top of the segment. This flow out the top is calculated considering the buoyancy-driven motion

Consider the free-convection for a segment of the spray region in which the moist air temperature varies about some mean value. If all the moist air in this region were at this mean temperature and if the fluid were not moving, the pressure gradient in the segment would be given by the equation of motion with u = 0:

$$\nabla p = \langle\rho\rangle \vec{g} \qquad \text{(EQ. 9.2-25))}$$

in which the average density <ρ> is at the average temperature <T>. If the velocity gradients result entirely from temperature inequalities, the moist air motion is usually slow and equation [EQ. 9.2-25] may be assumed to be a reasonably good approximation of the pressure gradient. Making this assumption, the time-independent equation of motion in the vertical (z) direction can be expressed in the form:

$$\frac{1}{2}\frac{\partial v_i^2}{\partial z} = \left(1 - \frac{\langle\rho\rangle_i}{\rho}\right)g + \frac{dG_i}{dV} \qquad \text{(EQ. 9.2-26))}$$

where dG_i/dV is the rate per unit volume momentum is transferred to the moist air (air-steam mixture) in the segment via the falling drops. Integration over the segment volume and utilizing the Gauss-Ostrogradskii theorem,[22] the above expression becomes yields the vertical velocity at the top of the ith segment and is used to determine the induced wind velocity at the outer boundary of the spray region:

$$v_i = \sqrt{2\left(1 - \frac{\langle\rho\rangle}{\rho}\right)gH + 2\frac{G_i}{S_i}} \qquad \text{(EQ. 9.2-27))}$$

The parameter S_i represents the flow area at the top of the ith segment. The rate of momentum transfer to the moist air (air-steam mixture) via the falling drops in the segment G_i is given by Newton's Third Law and can be written as

$$G = -\frac{1}{2}\sum_{k=1}^{N_k} R_k \frac{\pi}{4}\int_t^{t_F} C_D D_k^2 \left|\frac{dy_k}{dt} - V_i\right|\left(\frac{dy_k}{dt} - V_i\right)dt \qquad \text{(EQ. 9.2-28))}$$

where V_i is the velocity in the vertical direction (along the y-axis) in the ith segment, R_k is the rate at which drops with an initial diameter D_k are created, and t_F is the "flight time" of that drop. The flight time is defined as the elapsed time required for a drop to travel from the nozzle to the surface of the spray pond drop and depends upon the initial drop diameter.

As before, the total mass in the ith segment is postulated to be conserved. Hence,

$$\frac{dM_i}{dt} = w_{sp,i} + w_{s,i-1} + w_{a,i-1} - w_{s,i} - \rho_{s,i} A_i v_i - w_{a,i} - \rho_{a,i} A_i v_i - w_{dp,i} \equiv 0 \qquad \text{(EQ. 9.2-29))}$$

where A_i is the area of the sides of the ith segment and $\rho_{a,i}$ is the air density of that segment. Because of phase change (evaporation), only the combination of steam plus water is conserved in addition to air, steam and water are not conserved separately. Therefore,

$$W_{sp,i}=W_{dp,i}+W_{ev,i}$$

$$W_{a,i}=W_{a,i-1} - \rho_{a,i}A_iV_i \qquad \text{(EQ. 9.2-30))}$$

$$W_{s,i}=W_{s,i-1}+W_{ev,i}-\rho_{s,i}A_iV_i$$

Starting at the last (inner most) segment where all air flows through the top of the segment, the above equation can be applied in a bootstrap fashion until the first segment is reached and the exerting dry air mass flow rate, and hence the induced inlet velocity, can be calculated. Once this induced velocity is known, the temperature in each segment is calculated exactly as for the high-wind speed model, except for the flow of humid air (air-steam mixture) through the segment top. Because the induced velocity is a function of the temperature difference, and thus the density difference, between the environment and a particular segment, this calculation proceeds iteratively until a convergence condition on the average drop temperature is satisfied.

9.2.6.4.3.1.2.4 Spray-Region Thermal Performance

The spray water in the form of drops passes through this region, losing mass and energy along the way by evaporation, and enters the spray pond. It is crucial that the spray pond temperature remain below a certain value in order for the service water systems to remove the necessary amount of heat. This depends upon the evaporative mass and energy transfer from the spray drops to the air-steam mixture constituting the spray region atmosphere. This region or volume is characterized by the temperature and the relative humidity and is explicitly assumed to be at atmospheric pressure, defined as 1.01325 bar = 101.325 MPa. The spray water is considered to enter the spray field from the top at the initial temperature and exit through the bottom to the spray pond. The temperature of the drop (final drop temperature) as it enters the pond depends upon the amount of evaporative cooling that has occurred which, in turn, depends upon the temperature and relative humidity of the spray region.

The spray region for both the high- and low-wind speed submodels are divided into N small segments of equal volume as shown in Figure 9.2-22. Under the segment indexing convention used in the computer program, the 0th section is considered to be the environment, or the atmosphere, adjacent to the spray region. The parameters describing the environment are the (dry bulb) temperature, wet bulb temperature, relative humidity, and prevailing wind speed. Except for the wind speed, these parameters are transient and specified by the user as input data. (Either the wet bulb temperature or the relative humidity, but not both, are specified and the unspecified parameter is calculated by the computer program.) The last segment is labeled as the (N+1)th segment. Each segment is considered to be in quasi-static thermodynamic equilibrium. Hence, the rate of energy change in the ith segment is zero and the energy gained by the air-steam (water) mixture is equal to that lost by the spray in that segment. Spray water enters the ith region from the nozzles with a flow rate w_{nz} and a liquid specific enthalpy h_f parameterized by the water temperature at the spray nozzle -- the spray temperature T_{sp}. The specific enthalpy at the nozzle is determined from the spray energy which is equal to the energy leaving the spray pond plus the heat load Q_{Hx}

$$h_f\,(T_{sp}) = h_f\,(T_p) + \frac{Q_{Hx}}{w_{sp}} \qquad \text{(EQ. 9.2-31))}$$

which is a defining equation for the spray temperature T_{sp}. Thus, the energy flow rate to the ith spray-region segment via sprayed water is

$$\dot{E}_{sp,i} \equiv w_{sp,i}\, h_f\,(T_{sp}) \qquad \text{(EQ. 9.2-32))}$$

Drops shortly after leaving the nozzle with a discrete spectrum of sizes described by the parameter f_k which is defined as the volume fraction of all drops which form with an initial diameter D_k. The drop group index k ranges from unity to a maximum value N_k which is the number of drop groups constituting the spectrum. Drops with initial diameter D_k are formed at a rate equal to

$$R_k = \frac{6\, f_k\, v_f}{\pi D_k^3}\, w_{sp,i} \qquad \text{(EQ. 9.2-33)}$$

where v_f is the specific volume of the liquid water evaluated at the spray initial temperature and N is the number of spray-region segments.

Each drop, regardless of size, has an initial velocity u_o oriented with angle α to the horizontal, and moves ballistically subject to gravitation and drag, losing mass and energy along its trajectory until entering the spray pond. A drop which originally had a diameter D_k enters the pond with a final mass $m_{d,k}$ which is smaller than the initial drop mass and a final drop temperature $T_{d,k}$. The drop group index parameter k is affixed to indicate the particular group to which the drop belongs. Equation [EQ 9.2-33] is also the rate at which drops that initially had a diameter D_k enter the spray pond, albeit with a smaller diameter. Drops which completely evaporate along their flight trajectory are considered to enter the spray pond with zero mass. The rate at which the spray in the form of drops enters the pond from the ith segment of the spray region is equal to the product of the rate of drop formation for drops with diameter D_k and the final mass $m_{d,k}$ of a drop which had that initial diameter, summed over the drop-size spectrum:

$$w_{dp,i} = \sum_{k=1}^{N_k} R_k \, m_{d,k} \qquad \text{(EQ. 9.2-34))}$$

For the kth drop-diameter group, the energy loss rate from the ith spray-region segment is just the product of the drop specific enthalpy $c_{pw}T_{d,k}$, the final mass of the drop $m_{d,k}$ and the rate at which drops in this diameter group are created R_k. The total rate at which energy in the form of drops leaves the ith spray region is just the sum of the rates for each drop-diameter group:

$$\dot{E}_{dp,i} \equiv \sum_{k=1}^{N_k} R_k \, m_{d,k} \, c_{pw} \, T_{d,k} \qquad \text{(EQ. 9.2-35))}$$

Therefore, the rate at which the energy of the ith spray region changes is just the evaporative energy losses from the spray water, plus the energy of the steam (water vapor) and air entering the ith segment via the prevailing or induced wind, minus the rate of energy leaving the segment. By hypothesis, the segment is quasi-statically in equilibrium and thus:

$$\frac{dE_i}{dt} = \dot{E}_{sp,i} - \dot{E}_{dp,i} + w_{a,i-1} \, c_{pa} \, T_{i-1} + w_{s,i-1} \, h_s(T_{i-1}) - w_{s,i} \, h_s(T_i) - w_{a,i} \, c_{pa} \, T_i = 0 \qquad \text{(EQ. 9.2-36))}$$

where h_s is the specific enthalpy of steam and T_i is the temperature of the ith spray-region segment. Between 273.15 °K (0 °C) and 373.15 °K (100 °C), the vapor (steam) specific enthalpy h_s can be expressed as a linear function of the Celsius temperature plus an additive constant at the referent temperature of 0 °C. Such an expression is accurate to within -0.13% and can be readily derived from steam tables. Hence, over this temperature range:

$$h_g(T) \simeq C_{ps} \, (T - T_0) + h_{so}$$

where c_{ps} = 1748.0 J/kg-°C, h_{so} = 2501.3 kJ/kg, and T_o = 273.15 °K. It is similarly assumed that mass contained in the spray region does not change with time. Hence, in the ith segment, the rate of mass change is zero. In addition, the air and steam-water (vapor-liquid) masses are separately conserved. It is here that differences arise between the high-wind speed model and the low-wind speed model. These differences entail how the steam and air mass flow rates between the ith and (i+1)th sections are calculated, and will be discussed below in the appropriate sections.

Using these expressions the energy balance equation for the ith segment (equation EQ. 9.2-36), the equilibrium temperature is given by

$$T_i = \frac{\Delta \dot{E}_i + (w_{a,i-1} c_{pa} + w_{s,i-1} c_{ps}) T_{i-1} - w_{ev,i} (h_{so} - c_{ps} T_o)}{w_{a,i} c_{pa} + w_{s,i} c_{ps}}$$
$$= T_{i-1} + \frac{\Delta \dot{E}_i - w_{ev,i} (c_{ps} T_{i-1} + h_{s1})}{w_{a,i} c_{pa} + w_{s,i} c_{ps}} \qquad \text{(EQ. 9.2-38))}$$

where

$$\Delta \dot{E}_{r,i} \equiv \dot{E}_{sp,i} - \dot{E}_{dp,i} \qquad \text{(EQ. 9.2-39))}$$
$$h_{s1} \equiv h_{so} - c_{ps} T_o$$

and $w_{a,i-1}$ is the air (dry) mass flow rate entering the ith segment while $w_{a,i}$ is the flow rate leaving the segment.

The average spray-region thermal efficiency is a parameter useful for describing the performance of the spray region and is defined as

$$\eta = \frac{T_{sp} - \Theta_d}{T_{sp} - T_{wb}} \qquad \text{(EQ. 9.2-40))}$$

where T_{sp} is the temperature of the sprayed water at the nozzle, T_{wb} is the meteorological wet-bulb temperature, and Θ_d is the average drop temperature which is given by

$$\Theta_d \equiv \frac{\sum_{i=1}^{N} w_{d,i} c_{pw} T_{d,i}}{c_{pw} \sum_{i=1}^{N} w_{d,i}} \qquad \text{(EQ. 9.2-41))}$$

9.2.6.4.3.1.3 Drop Model

Between the time a drop leaves the nozzle and until it enters the spray pond, a drop moves along a ballistic trajectory exchanging both mass and energy with the spray region. The mass and energy exchange rates are determined by the drop thermodynamics while the trajectory is determined by the drop dynamics. For a given spray-region segment, each drop diameter group of the drop-size spectrum is considered separately and the results of the total spectrum combined to determine the mass flow rate to the spray pond surface $w_{dp,i}$, the energy flow rate to the pond surface $dE_{dp,i}/dt$, and the average temperature of the spectrum $T_{dp,i}$.

9.2.6.4.3.1.3.1 Ballistic Motion

A spherical drop of diameter D_k leaves the spray nozzle with an initial velocity u_o which makes angle θ to the horizontal. The equations of motion for this drop are

$$\frac{d}{dt} m_k \vec{u} = -\frac{1}{2} \rho_i C_d \frac{\pi}{4} D_k^2 |\vec{u} - \vec{V}| (\vec{u} - \vec{V}) - m_k \vec{g} - \frac{d\, m_k}{dt} \vec{u} \qquad \text{(EQ. 9.2-42))}$$

where **u** is the instantaneous drop velocity vector and **V** is wind velocity vector which is presumed to lie in the horizontal plane, and C_d is the drag coefficient which is a function of the Reynolds number. The last term on the right side of equation [EQ. 9.2-42] is the rate of change of the momentum of the evaporating drop mass and is required for momentum conservation.[23] An approximation of C_d as a function of Reynolds number Re is given in the literature as[24]

$$C_d \simeq \begin{cases} \frac{24}{Re} & (Re < 2) \\ \frac{18.5}{Re^{0.6}} & (2 < Re < 500) \\ 0.44 & (Re > 500) \end{cases} \qquad \text{(EQ. 9.2-43)}$$

where the Reynolds number is given by

$$Re = \frac{\rho_i}{\mu_i} |\vec{u} - \vec{V}| D_k \qquad \text{(EQ. 9.2-44))}$$

in which ρ_i and μ_i are the average density and viscosity of the ith segment and D_k instantaneous drop diameter. Equation [EQ. 9.2-42] can be resolved along basis directions to yield

$$m_k \frac{d^2 y_k}{dt^2} = -\frac{\pi}{8} \rho_i C_D D_k^2 |\vec{u} - \vec{V}| \frac{dy_k}{dt} - m_k g$$

$$m_k \frac{d^2 x_k}{dt^2} = -\frac{\pi}{8} \rho_i C_D D_k^2 |\vec{u} - \vec{V}| \left(\frac{dx_k}{dt} - V \right)$$

Numerical solution of equation [EQ. 9.2-45] via Euler's method gives the trajectory of the drop expressed in terms of drop elevation y_k and range x_k which are functions of time. When the elevation of the drop y_k is equal to the elevation of the spray pond surface y_p, the integration ceases. This procedure is repeated for each of the N_k drop groups. The final drop mass of the kth group is $m_{d,k}$, i.e., the mass of the drop when its elevation is equal to that of the spray pond surface.

The rate at which drops in this group reach the pond surface is assumed to equal the rate at which they are created at the spray nozzle R_k. This is not strictly true as some drops will be carried by a prevailing wind beyond the spray pond boundary and thus become lost from the system. However, such an assumption is conservative as it deposits more energy to the spray pond than would occur in reality. Therefore, it is assumed that the rate for drops of the kth diameter group to enter the spray pond is equal to the rate at which they were created. Thus, the mass flow rate to the pond is given by equation [EQ. 9.2-34].

9.2.6.4.3.1.3.2 Mass and Energy Transfer

As the spray nozzles generate a spectrum of drop sizes and thus diameters, the mass and energy lost from the drops must be integrated over all drop diameters. A default drop size spectrum for the Sprayco 1751A nozzle is contained in the computer program; however, a different spectrum may be entered. A drop from the spray nozzle has an initial temperature equal to that of the water flowing to the nozzle. The internal energy of a drop of diameter D_k is given by

$$E_{d,k} = m_{d,k}\, c_{vw}\, (T_{d,k} - T_o) = \rho \frac{\pi}{6} D_k^3\, c_{vw}\, (T_{d,k} - T_o) \quad \text{(EQ. 9.2-46))}$$

to a good approximation. The instantaneous rate at which the drop internal energy is changing is just the sum of the convective heat transfer from the drop to the ith spray-region segment plus the evaporative energy loss, the latter of which is the product of the evaporative mass loss and the vapor specific enthalpy evaluated at the drop temperature. Hence, the instantaneous rate of energy change is

$$\frac{dE_{d,k}}{dt} \equiv \dot{E}_{d,k} = -\, h_{x,k}\, \pi\, D_k^2\, (T_{d,k} - T_{a,i}) - \dot{m}_{e,k}\, h_g\, (T_{d,k}) \quad \text{(EQ. 9.2-47))}$$

where the last term on the right side of equation [EQ. 9.2-47] is the rate of evaporation loss. The convective heat transfer coefficient $h_{x,k}$ for a spherical drop of diameter D_k is given in the literature[25] by

$$h_{x,k} = \frac{k_a}{D_k}\left(2 + 0.6\, Re^{1/2}\, Pr^{1/3}\right) \quad \text{(EQ. 9.2-48))}$$

where k_a is the thermal conductivity of air which depends upon temperature. The instantaneous rate of evaporation from a spherical drop can be expressed in terms of the difference in vapor pressure at the drop surface and in the region far from the drop:[26]

$$\dot{m}_{e,k} \equiv -\frac{dm_{d,k}}{dt} = k_{m,k}\, \pi\, D_k^2\, \frac{x_{so} - x_{s\infty}}{1 - x_{so}} = k_{m,k}\, \pi\, D_k^2 \left(\frac{p_{sat}(T_{d,k}) - p_{sat}(T_{a,i})}{p_\infty - p_{sat}(T_{a,i})}\right) \quad \text{(EQ. 9.2-49))}$$

where $k_{m,k}$ is the mass-transfer coefficient and has units of kg/s-m^2, x_{so} is the vapor (steam) mass fraction at the drop surface, and $x_{s\infty}$ the mass fraction of the spray region segment. The mass fractions of the vapor (steam) are determined assuming both air and the water vapor (steam) can be described by the equation of state for an ideal gas and is thus equal to the ratio of the partial pressure to the total pressure.

During evaporation, both heat and mass transfer are occurring. A brute force solution requires simultaneous solution of the momentum, heat, and mass transfer field equations. However, in some cases, the heat and mass transfer boundary-layer profiles can be made to collapse on each other by proper definition of variables. This allows the solution of many mass-transfer problems at low mass-transfer rates by analogy with corresponding problems in heat transfer. Using one of the Chilton-Colburn analogies,[27] the mass-transfer coefficient for a drop of diameter D_k is given in the literature[17]

$$k_{m,k} = \frac{\rho_{a,i}\,\lambda_{a,i}}{D_k}\left[2 + 0.60\left(\frac{D_k\,u_k\,\rho_{a,i}}{\mu_{a,i}}\right)^{1/2}\left(\frac{\mu_{a,i}}{\rho_{a,i}\,\lambda_{a,i}}\right)^{1/3}\right] = \frac{\rho_{a,i}\,\lambda_{a,i}}{D_k}\left(2 + 0.60\,Re_{a,i}^{1/2}\,Sc_{a,i}^{1/3}\right) \qquad \text{(EQ. 9.2-50))}$$

modified to change units and the dimensionless number groups forming the Reynolds and Schmidt numbers will be immediately recognized. Note that the convective and evaporative energy losses are functions of the drop diameter, velocity and temperature and will necessarily change along the drop's trajectory. The drop internal energy rate of change can be expressed in terms of the rate of change of drop mass and temperature as follows

(EQ.9.2-51)

$$\frac{dE_{d,k}}{dt} = \frac{d\,m_{d,k}}{dt}\,c_{vw}\,(T_{d,k} - T_o) + m_{d,k}\,c_{vw}\,\frac{dT_{d,k}}{dt} = -\,h_{x,k}\,\pi\,D_k^3\,(T_{d,k} - T_o) - \dot{m}_{d,k}\,h_g\,(T_{d,k})$$

from which the rate of change in drop temperature can be obtained to be

(EQ. 9.2-52)

$$\frac{dT_{d,k}}{dt} = -\,\frac{h_{x,k}\,\pi\,D_k^2\,(T_{d,k} - T_{a,i}) - \dot{m}_{e,k}\left[h_{fg}\,(T_{d,k}) + p_{sat}\,(T_{d,k})\,v_f\,(T_{d,k})\right]}{\rho\,\frac{\pi}{6}\,D_k^3\,c_{vw}}$$

$$= -\,\frac{6\,v_f}{D_k\,c_{vw}}\left[h_{x,k}\,(T_{d,k} - T_{a,i}) + k_{m,k}\left(\frac{p_{sat}\,(T_{d,k}) - p_{sat}\,(T_{a,i})}{p_\infty - p_{sat}\,(T_{d,k})}\right)(h_{fg} + p_{sat}\,v_v)\right]$$

As can be seen from equation [EQ. 9.2-52], the drop temperature rate of change consists of two terms representing convective and evaporative energy loss. Since evaporative mass and energy loss depend upon the drop diameter, each drop with diameter D_k will have a temperature T_k. This expression is numerically integrated from the time the drop is generated to the time when the drop enters the spray pond. During this integration, the properties of the air-steam (water) mixture in the spray region are considered constant. It is necessary to correct the convective heat transfer coefficient used in equation [EQ. 9.2-52] and the mass transfer coefficient used in equation [EQ. 9.2-49] because these factors depend, to some degree, upon the rates of heat and mass transfer. For low transfer rates, a multiplicative correction factor is adequate.

The rate of energy transfer to the spray pond by the drops from the ith segment is the product of the rate of drop formation, the final drop mass, and the liquid specific enthalpy, evaluated at the final drop temperature $T_{d,k}$, also summed over the drop-size spectrum:

$$\dot{E}_{dp,i} = \sum_{k=1}^{N_k} R_k \, m_{d,k} \, h_f \, (T_{d,k}) \qquad \text{(EQ. 9.2-53))}$$

Hence, the total evaporation rate and final drop temperature for the ith segment is just the difference between the rates at which mass enters the segment minus the rate at which mass leaves:

$$w_{ev,i} = w_{sp,i} - \sum_{k=1}^{N_k} R_k \, m_{d,k} \qquad \text{(EQ. 9.2-54))}$$

The final drop mass and temperature are obtained by numerically integrating the equations [EQ. 9.2-49] and [EQ. 9.2-52]. Final drop mass and temperature are defined as mass and temperature of the drop just prior to entering the spray pond. This integration need not be performed in synchrony with the mass and energy flow rates to the spray region and pond because the characteristic time for changes in drop mass and temperature is much shorter than the characteristic time for changes in spray region and pond parameters.

9.2.6.4.3.1.4 Drift Loss Model

The determination of water loss from the sprays due to the action of a prevailing wind, commonly referred to as "driftloss," has been incorporated as an integral part of the new Limerick Spray Pond model. Ideally, the driftloss mass flow rate would be calculated in conjunction with the drop dynamics of the ultimate-heat-sink computer program. However, as a practical matter, driftloss calculations are done in a separate module in order that an ultimate-heat-sink analysis requires a reasonable computer runtime. By computing the driftloss separately from the drop dynamics, certain approximations are necessary and are crafted such that the driftloss mass flow rate is conservative.

Mass loss from the spray region takes place when elevation of the drop y_k is equal to the elevation of the spray pond surface and the drop horizontal position, or range, R_k is beyond the pond boundary. To calculate the drift loss, the ballistic trajectory of drops from each drop diameter group is determined using equation and expressed in terms of drop elevation y_k and range x_k as functions of time. However, the drop mass is assumed constant and equal to the final drop mass calculated in the drop dynamics module. A constant-mass approximation is conservative since the drop inertia along its trajectory is less than would normally be the case; hence, the drag forces due to the prevailing wind will increase the drop range. Because driftloss constitutes a small fraction of the total spray-pond mass loss, such an approximation is not severe.

A water drop, assumed to be spherical with a constant diameter D_k, leaves the spray nozzle with an initial velocity u_o at an angle α to the horizontal. The equation of motion for this drop is

$$m_k \frac{d\vec{u}}{dt} = -\frac{1}{2}\rho_i C_d \frac{\pi}{4} D_k^2 |\vec{u} - \vec{V}| (\vec{u} - \vec{V}) - m_k \vec{g} \qquad \text{(EQ. 9.2-55))}$$

where **u** is the instantaneous drop velocity vector and **V** is wind velocity vector which is presumed to lie in the horizontal plane, and C_d is the drag coefficient which is a function of the Reynolds number. The last term on the right side of equation [EQ. 9.2-55] is the rate of change of the momentum of the evaporating drop mass and is required for momentum conservation.[28] An approximation of C_d as a function of Reynolds number Re is given above by [EQ. 9.2-43].

Equation 9.2-55 can be resolved along basis directions to yield

(EQ. 9.2-56))

$$m_k \frac{d^2 y_k}{dt^2} = -\frac{\pi}{8}\rho_i C_D D_k^2 |\vec{u} - \vec{V}| \frac{dy_k}{dt} - m_k g$$

$$m_k \frac{d^2 x_k}{dt^2} = -\frac{\pi}{8}\rho_i C_D D_k^2 |\vec{u} - \vec{V}| \left(\frac{dx_k}{dt} - V\right)$$

Numerical solution of equation [EQ. 9.2-56] gives the trajectory of the drop expressed in terms of drop elevation y_k and range x_k which are functions of time. When the elevation of the drop y_k is equal to the elevation of the spray pond surface y_p, the integration ceases. This procedure is repeated for each of the N_k drop groups. The final drop mass of the kth group is $m_{d,k}$, i.e., the mass of the drop when its elevation is equal to that of the spray pond surface as determined in the drop dynamics module.

If, during the driftloss ballistic trajectory calculation, the range of the drop, when it reaches the elevation of the spray-pond surface, is greater than the distance to the spray-pond boundary, the drop is presumed lost. In addition, all drops of this diameter that originate from a location closer to the edge of the spray network than the difference between the drop range and distance from the network to the pond boundary are also lost. If the mass of the lost drop $m^*_{d,k}$ is set is equal to the final drop mass $m_{d,k}$, the driftloss rate is given by

$$w_{dl,i} = \sum_k \xi_k R_k m^*_{d,k} \qquad \text{(EQ. 9.2-57))}$$

where R_k is rate at which drops of the kth drop-diameter group are produced and ξ_k is fraction of all drops sprayed in this group that are lost and given by

$$\xi_k = \frac{x_k |_{y_k=0} - B}{L_{sn}} \qquad \text{(EQ. 9.2-58))}$$

Clearly, the parameter ξ_k is bounded by unity and zero; that is, if it found to be less than zero, there is no drift loss is set equal to zero. The corresponding rate at which energy leaves the spray region is

$$\dot{E}_{d1} = \sum_{k}' \xi_k \, R_k \, \dot{m}^{*}_{d,k} \, c_{pw} \, T_{d,k} \qquad \text{(EQ. 9.2-59))}$$

These driftloss mass and energy flow rates are subtracted from the rate of change of spray-pond mass and energy during the spray-pond thermal performance determination.

9.2.6.4.3.2 Spray Cooling Thermal Performance Model

The computer model developed for the analysis includes the effects of the following parameters:

a. Drop mean diameter

b. Wind speed and direction

c. Air dry-bulb temperature

d. Air wet-bulb temperature or relative humidity

e. Height of nozzles above water level

f. Pressure drop through the nozzle or height attained by the spray

g. Dimensions of the spray volume

h. Water flow rate in spray volume

The spray pond is modeled as shown in Figure 9.2-20 for high wind speeds (above approximately 3 mph), and as shown in Figure 9.2-21 for low wind speeds, when cooling is assumed to be by natural convection only. The individual spray patterns are lumped together to form the spray volume, which is divided into a number of increments in the direction of the air movement. The temperature and vapor content of the air in each increment is assumed to be uniform within the increment, and is numerically the same as that exiting the preceding increment. The sprayed water temperature, air temperature, and air moisture content for each increment are calculated, and the results are combined to yield an average sprayed water temperature for the spray volume. A critical aspect of the calculation is the determination of the evaporation rate within the increment. The empirical work of Ranz and Marshall (Reference 9.2-2) on droplet heat and mass transfer is used as the basis for the evaporation rate and air temperature calculations. In their experiments, Ranz and Marshall suspended a drop from a capillary tube, supplied a known air flow over the drop surface, and measured the drop temperature, air temperature, drop diameter (held constant with water flow through the capillary tube from a microburet), and makeup flow rate from the microburet. In this way the heat transfer and evaporation rate were measured. Heat and mass transfer coefficients were derived by correlation with the data.

The increment mass and energy balance used in the calculation of spray cooling efficiency is shown schematically in Figure 9.2-22. Water enters the increment through the spray nozzles (flow rate (m_{ws}) at temperature (T_s)) and exits the increment after undergoing mass and energy transfer

(flow rate (m_{wp}) at temperature (T_{di})). The amount of mass and energy transferred is calculated from heat and mass transfer coefficients derived empirically:

$$N_{nv} = \frac{h_c D}{K} = 2.0 + 0.60\, N_{pr}^{1/3} N_{re}^{1/2} \qquad \text{(EQ. 9.2-60)}$$

$$N_{SH} = \frac{h_d D}{D} = 2.0 + 0.60\, N_{sc}^{1/3} N_{re}^{1/2} \qquad \text{(EQ. 9.2-61)}$$

where:

N_{nv} = Nusselt number

N_{SH} = Sherwood number

h_c = heat transfer coefficient for conduction and convection

h_d = mass transfer coefficient

D = drop diameter

K = thermal conductivity of air/vapor mixture

D_v = diffusivity of vapor in air

N_{pr} = Prandtl number

N_{re} = Reynolds number

N_{sc} = Schmidt number

The energy transfer rate is the sum of the contributions from conduction, convection, and evaporation. The lifetime of a drop in the increment, calculated from the pond geometry and other parameters affecting the drop trajectory, is used with the energy transfer rate to determine the temperature of the cooled water leaving the increment. The moisture content of the air leaving the increment is determined from the mass transfer (evaporation) rate and the air flow rate (residence time of the air in the increment). The temperature of air exiting the increment is calculated from an energy balance on the increment. The exit air temperature and moisture content for increment (i) is used in increment (i + 1) to determine the heat and mass transfer rate in that increment. This process is repeated until all the increments have been treated.

At low wind speeds (less than approximately 3 mph), air enters the spray volume from all sides rather than one; therefore, a new increment definition is used for low wind speeds. The definition is shown schematically in Figure 9.2-21. The air velocity entering each increment is determined from the density difference between the air/vapor mixture in the increment and the ambient.

The spray cooling efficiency for zero wind speed is used as the lower limit for the spray cooling efficiency calculated for nonzero wind speeds (no natural convection). That is, if the spray cooling efficiency calculated by neglecting natural convection is less than that calculated with natural convection only, then the efficiency is taken to be that determined for natural convection (zero wind

speed) only. This procedure shows good agreement with the test results, and avoids excessive conservatism.

The result of the calculation described above is a set of cooled water temperatures, one for each increment. Since the air temperature and moisture content for each increment is different, the cooled water temperatures are different. The incremental flow rate weighted average cooled water temperature, $\bar{T}$, is calculated.

$$\bar{T} = \sum_{i=1}^{n} F_i T_i / n \qquad \text{(EQ. 9.2-62)}$$

where:

F_i = spray water flow rate in increment (i)

T_i = cooled water temperature, increment (i)

n = number of increments in the spray volume

The thermal efficiency, E_{th}, is calculated from the ambient air wet-bulb temperature, T_{wb}, and the water temperature before spraying, T_s.

$$E_{th} = \frac{T_s - \bar{T}}{T_s - T_{wb}} \qquad \text{(EQ. 9.2-63)}$$

The thermal performance prediction model gives more conservative results than other prediction methods available. The primary conservatism in the model is the lack of convective air motion into the spray volume (for all but very low wind speeds), which results in lower calculated efficiencies. The convective air motion is most

important at low wind speeds; consequently, the degree of conservatism increases as wind speed decreases. Since thermal performance at low wind speeds is most important, this is a desirable effect as long as the degree of conservatism is not unrealistic. Data taken at an existing spray pond have been used to demonstrate the degree of conservatism of the model, as discussed in Section 9.2.6.4.3.4.

9.2.6.4.3.3 Results of the UHS Performance Evaluation

The results of the performance evaluation of the spray pond system demonstrate that the spray pond meets the requirements for the maximum cooling water temperature and the 30-day water supply. The cooling water temperature for the design basis accident heat load is presented in Figure 9.2-23 and Table 9.2-17. The maximum calculated cooling water temperature, for the design (accident) heat load, is 93.48°F. This temperature is below the spray pond thermal performance design limit of 95°F. The minimum remaining water volume in the spray pond after 30 days is approximately 4.74 million gallons for the maximum water-loss analysis.

Furthermore, adequate means are provided in the design of the spray pond system to ensure continued cooling capability beyond 30 days. Water required to maintain the functional capability of the spray pond can be supplied by truck or other means.

9.2.6.4.3.4 Comparison of Spray Pond Thermal Performance Results

In order to verify the conservatism of the spray pond thermal performance model, the model has been applied to a the Rancho Seco spray pond system which has well-documented performance (Reference 9.2-3). At the request of the Atomic Energy Commission, SMUD arranged to have the Rancho Seco spray ponds tested to verify the ability of the ponds to meet the design criteria. SMUD asked the University of California, Berkeley, to perform an evaluation of the performance of the ponds. Of particular interest from a performance standpoint were the thermal efficiency of the nozzles and drift loss versus wind speed.

A comparison of the relevant parameters between the Rancho Seco and LGS ponds is given in Table 9.2-18.

The result of the comparison of the Rancho Seco performance test and model predictions is given in Table 9.2-19. It can be seen that the model predictions for the performance are more conservative than the measured efficiencies.

9.2.6.5 Safety Evaluation

9.2.6.5.1 Thermal Performance

As demonstrated in Section 9.2.6.4, the full spray pond is capable of providing cooling water within the design temperature limit for at least 30 days for the design basis event using conservative meteorology and assumptions.

9.2.6.5.2 Effects of Severe Natural Events or Site-Related Events

The UHS is capable of fulfilling its safety function concurrent with any of the following events: SSE; tornado; flood; drought; transportation accident; or fire.

The UHS is designed as seismic Category I to ensure that it remains functional following an SSE. Pond and pump structure designs are discussed in Section 3.8.4. The effects of the SSE with respect to wave generation and wave loadings on the network support columns are discussed in Section 2.4.8.

Functional integrity is maintained during a tornado because of the redundancy and separation of the networks, and the tornado protection of the spray pond pumphouse, and contingency procedures as discussed in Section 3.5.1.4.

The PMF level for the Schuylkill River is at el 181', whereas the bottom of the spray pond is at el 241', 60 feet above the PMF level. Therefore, the spray pond is affected only by flooding due to precipitation on the pond, and run-off from the adjacent drainage area. This is discussed in Section 2.4.8. The provision of an emergency spillway ensures that the pond cannot reach a level that could impair performance. Further, calculations show that the volume and velocity of water after PMF will not cause erosion.

Drought does not impair the cooling capability of the spray pond system. The spray pond is designed so that makeup water is not required for at least 30 days.

Potential damage to the spray pond from the design transportation accident (railroad explosion) is prevented by the physical separation between the spray pond and the tracks of the railway. The design transportation accident is discussed in Section 2.2.3.

Fire protection for the spray pond pumphouse is discussed in Section 9.5.1.

The spray pond system is physically removed from the balance of the station, except for interconnecting piping. The effect of failure of other station components cannot impair the capability of the spray pond to fulfill its safety objective.

9.2.6.5.3 Freezing Considerations

The only safety-related systems with piping that could be exposed to freezing conditions are the ESW and RHRSW systems. The majority of the piping for these systems is located inside heated buildings or buried below the frost line and therefore are not exposed to freezing conditions. The spray pond network piping is drained after each use and therefore is protected from freezing. Any piping that is not within buildings, buried, or drained is electrically heat traced to protect against freezing. The electrical supply for the heat tracing is not supplied from a Class 1E source because, in the event of auxiliary power loss, water would be flowing in the piping. This design is consistent with IEEE 622 (1979), "Recommended Practice for the Design and Installation of Electric Pipe Heating Systems for Nuclear Power Generating Stations."

The spray pond is permitted to freeze during cold weather; ice formation may occur at the pond surface. The spray pond system is designed to perform its safety function during periods of maximum freezing. The design basis freezing event is one producing a maximum of 15 inches of ice on the pond surface. Maximum ice thickness was determined by calculation of ice thickness for 33 winters from 1941 to 1974, using the daily average Philadelphia meteorology (Section 9.2.6.4.1). Heat and mass transfer analyses established mathematical models of freezing of the pond surface. These models are compared with measured reservoir ice thickness data to verify a conservative design. For each freezing period, a daily incremental thickness was calculated. The maximum thickness calculated for the 33 year period was 13.4 inches in February 1961. A design value of 15 inches has been selected to provide additional conservatism. Measurements taken on quiescent pools near the site during the winter of 1977, considered to be the most severe on record for this area, were all less than the design thickness.

Two spray network bypass lines are provided in the design to allow spray pond operation while ice exists at the pond surface, as discussed in Section 9.2.6.3.2.

An analysis demonstrates that hole formation occurs well before the system design maximum temperature of 95°F is reached at the pump suction. This analysis assumes hydraulic short circuiting between the discharge and suction piping and a simultaneous one-unit LOCA and shutdown of the other unit.

Frazil ice formation does not interfere with operation of the spray pond system. The phenomenon of frazil ice formation is associated with supercooled and generally swiftly flowing water. Since the spray pond is a nonflowing body of water, supercooling of the water cannot occur during either standby or operation of the spray pond system. A small amount of frazil ice formation at the

surface of the spray pond is possible during periods of high winds. However, any mixing of the surface water deeper into the pond results in melting of the frazil ice. Once an ice layer forms on the pond, the effects of wind on water velocities and turbulence are eliminated, surface heat transfer will be greatly reduced, and frazil ice does not form.

The formation of anchor ice in the spray pond may occur under high wind conditions, but would be restricted to the uppermost part of the support columns. Ice accumulation on the support columns does not interfere with the operation of the spray pond system. As with frazil ice, formation of an ice layer inhibits anchor ice formation.

An accumulation of ice due to freezing rain sufficient to cause complete blockage of the spray nozzle was considered, but is not considered credible because of the large 1-9/64 inch opening and the shape of each nozzle, which has a raised vertical lip and sloped contour.

The design of concrete columns and footings supporting the pipe network in the spray pond considers the loads due to ice formation and ice expansion. These safety-related components have been adequately designed by combining these loads with other concurrent loads according to Table 3.8-10, including an SSE coincident with maximum ice thickness.

The interior of the spray pond pump structure is heated to a minimum of 65°F to prevent icing of the pumps and other components, or icing at the surface of the water in the wet pits. Ice from the spray pond is prevented from entering the wet pits by locating the tops of the sluice gates below normal pond water level.

9.2.6.5.4 Other Considerations

The ability of the UHS to perform its safety function assuming a single failure of an active component is demonstrated in discussions of the ESW and RHRSW systems, in Sections 9.2.2 and 9.2.3, respectively.

Transient analyses have been performed to determine the potential effects of water hammer on the spray networks. These analyses indicated that water hammer loads will not be significant and are adequately provided for in the design of the spray networks.

There are no credible failures of manmade structural features associated with the UHS. As discussed previously in this section, the spray pond is constructed completely in excavation. Structures associated with the pond (the pumphouse, spray network support piers, and the overflow weir) are designed to seismic Category I requirements. The system is designed so that the effects of flooding, missiles, and fire cannot affect the spray pond's safety function, as discussed in Sections 3.4, 3.5, and 9.5.1, respectively.

9.2.6.6 Conformance to Regulatory Guide 1.27

Regulatory Guide 1.27, "Ultimate Heat Sink for Nuclear Power Plants," contains guidance on the design and performance analysis for ultimate heat sinks.

The LGS spray pond UHS was designed taking Revision 1 of this regulatory guide into consideration. The LGS UHS and performance analysis is in accordance with this revision of the guide, as demonstrated in this section, with the following exceptions and clarifications by regulatory guide position paragraph:

a. Paragraph C.1.a: The LGS performance analysis complies with the intent of this paragraph, in that a more conservative "coefficient of water loss" combining dry-bulb temperature, wet-bulb temperature, and wind speeds is used to determine the weather data periods resulting in the maximum amount of evaporation and drift loss.

b. Paragraph C.1.b: LGS complies partially with this paragraph,in that average temperatures for the 1 day and 30 day periods are used instead of diurnal variations in temperature. The coefficient of thermal performance was calculated for each day, using daily average data (Section 9.2.6.4.1).

Revision 2 of this regulatory guide is presently in effect. With respect to this revision, the following exceptions apply:

a. Paragraph C.1: Same as response to Paragraphs C.1.a and C.1.b of Revision 1 above.

b. Paragraph C.1.a: The critical time periods approach is not used as described in the LGS analysis. The worst 1 day followed by the worst 30 day meteorological conditions were used in accordance with Revision 1 of the regulatory guide. This approach, along with the other conservatisms in the analysis, is adequate to verify pond performance under design conditions.

c. Paragraph C.1.b: Same as Paragraph C.1 and C.1.a above.

d. Paragraph C.1.c: This paragraph is not applicable to the LGS design. The coefficient of thermal performance method used in the LGS design selects conservative design basis meteorology, as discussed in Section 9.2.6.4.1.

With respect to Paragraph C.2 of both revisions of the guide, LGS meets the criteria as discussed in Sections 3.4, 3.5, 9.2.6.5.4, and 9.5.1.

With respect to Paragraph C.3 of both revisions of the guide, LGS employs the option of one source of water for the UHS, for which, as discussed in Section 9.2.6.5.4 and the referenced sections therein, there is an extremely low probability of loss of capability.

9.2.6.7 Instrumentation and Alarms

As shown in drawing M-12, spray pond low level and high temperature are alarmed in the control room. Spray pond surface temperature (within the upper 2 feet of the surface) is provided in the control room. During operation of the RHRSW system, spray pond temperature can also be obtained via the inlet to the RHR heat exchanger in the control room.

Pond makeup and blowdown volumes are indicated by flow totalizers located in the makeup and blowdown lines.

9.2.6.8 Tests and Inspections

The UHS is preoperationally tested in accordance with the requirements of Chapter 14.

A seepage test was performed to verify that the values used in this analysis are conservative (Section 2.5.4.6.1).

Preoperational tests are performed to verify that design flows and pressures to the networks and within the networks are obtained.

Analyses have indicated that water hammer loads will not be significant, and therefore, no special testing for water hammer loads will be performed.

The verification of proper system flow and distribution, and the results of the SSES thermal performance tests (Docket No. 50-387) verify the LGS design, and therefore a thermal performance test for LGS is not considered necessary.

The spray pond system is tested periodically during normal plant operation in accordance with the requirements of Chapter 16.

9.2.7 CONDENSATE AND REFUELING WATER STORAGE FACILITIES

The condensate and refueling water storage facilities provide storage of condensate water for use in normal plant operations and refueling operations. The facilities have no safety-related function, except for the section of piping located in the reactor enclosure that supplies condensate to the HPCI pump.

9.2.7.1 Design Bases

The condensate and refueling water storage facilities are designed to perform the following functions:

a. Supply water to fill the reactor well, the dryer/separator storage pool, and the spent fuel cask storage pit of one unit during refueling operations, and provide storage for this water when refueling is completed.

b. Supply condensate for various processes in the radwaste system and makeup for the plant systems, including the condenser hotwells.

c. Supply condensate to the suctions of the HPCI, RCIC, and core spray pumps of both units.

d. Provide a minimum storage capacity of 135,000 gallons for the RCIC and HPCI pumps associated with each unit.

e. Provide the capability to filter the water in the refueling water storage tank by pumping it through the condensate demineralizers and returning it to the storage tank.

f. Provide storage for condensate rejected from the cycle.

g. Provide storage for condensate from the radwaste system.

h. Provide the capability to drain the reactor well through the condensate filter demineralizer and back to the storage tank.

i. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the condensate and refueling water storage facilities are discussed in Section 3.2.

j. Postulated radioactive releases due to liquid radwaste tank failures are discussed in Section 2.4.12.

9.2.7.2 System Description

The condensate and refueling water storage system is shown in drawing M-08. Design parameters for the major components of the system are given in Table 9.2-20.

9.2.7.2.1 Condensate Storage Tanks (Units 1 and 2)

The CSTs are the normal source of water for the HPCI and RCIC pumps for both operational use and testing. In addition, the tanks supply water to the core spray system for testing. For a discussion of the HPCI and core spray systems, refer to Section 6.3. For a discussion of the RCIC system, refer to Section 5.4.6.

The condensate transfer pumps and condensate transfer jockey pump take their suction from either of these tanks to provide water for various services in the radwaste enclosure, the reactor enclosure, and for the fuel pool filter/demineralizer backwash.

The lead condensate transfer pump, as selected by the hand selector switch, runs continuously and the standby condensate transfer pump will start automatically on low discharge header pressure. The condensate transfer jockey pump will operate only as a manual backup. The condensate transfer pumps and condensate transfer jockey pump are automatically tripped by a level switch upon receipt of a CST low level signal, and a discharge header low flow signal automatically trips the standby condensate transfer pump.

Makeup to the CSTs is supplied by the demineralized water transfer pumps. The tanks also act as surge tanks for the condensate system by receiving any rejected condensate from and making up any deficiency in the heat cycle.

9.2.7.2.2 Refueling Water Storage Tank

The refueling water storage tank stores the water that is used to fill the reactor well, the dryer/separator storage pool, and the fuel cask storage pit of both Units 1 and 2.

During refueling operations the water is pumped from the storage tank to the respective reactor well and dryer/separator pool via the manually operated refueling water pumps.

When refueling is complete, the water in the reactor well and dryer/separator pool is pumped by the refueling water pumps to the storage tank through one of the condensate filter/demineralizers. Makeup for the refueling water storage tank is supplied by the demineralized water transfer pumps, taking suction from the demineralized water storage tank.

The refueling water storage tank also provides water to fill the spent fuel cask storage pit. This water can be returned to the tank by the refueling water pumps through one of the condensate filter/demineralizers.

The Unit 1 and the Unit 2 CSTs and the refueling water storage tank are located outdoors, and are provided with freeze protection. The area occupied by the Unit 1 CST and refueling water storage tank is surrounded by a common dike capable of holding the combined contents of the tanks in the event of tank rupture or overflow. The Unit 2 CST is surrounded by a dike capable of holding the tank contents in the event of tank rupture or overflow. Tank overflows are routed directly to the liquid radwaste system. Drains from the dike areas can be selectively routed to either the normal waste or radwaste systems.

9.2.7.3 Safety Evaluation

The condensate and refueling water storage facilities have no safety-related function except for the section of piping located in the reactor enclosure that supplies condensate to the HPCI, RCIC, and core spray pumps (Section 6.3). Failure of the nonsafety-related portions of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

9.2.7.4 Tests and Inspections

The condensate and refueling water storage facilities are preoperationally tested in accordance with Chapter 14.

9.2.7.5 Instrumentation Applications

9.2.7.5.1 Condensate Storage Tanks

These tanks are each provided with a level transmitter that operates a pen recorder located in the control room. In addition to the level transmitters, each tank has high and low level switches that alarm in the control room, and a low switch that trips the condensate transfer pumps and the condensate transfer jockey pump when the tank level reaches low level. The tank has a high level switch which actuates on CST high level to automatically close the condenser reject valves.

9.2.7.5.2 Refueling Water Storage Tank

This tank is provided with a level transmitter that operates pens on Unit 1 and Unit 2 pen recorders located in the control room. In addition, the tank has high and low level switches which alarm in the control room, and a low level switch that trips the refueling water pumps on tank low level.

9.2.8 REACTOR ENCLOSURE COOLING WATER SYSTEM

The RECW system is a closed-loop system that provides cooling water for miscellaneous reactor auxiliary plant equipment. The RECW system is not safety-related, except for the containment penetrations and isolation valves associated with the water supply to the reactor recirculation pump seal and motor oil coolers.

9.2.8.1 Design Bases

a. The RECW system is designed to remove the maximum anticipated heat loads developed by the components served by the system over the full range of the normal plant operating conditions and ambient temperature conditions.

b. The RECW system is designed to operate during normal operation and on LOOP without occurrence of a LOCA.

c. The system is designed to permit the use of corrosion inhibitors to prevent long-term corrosion and organic fouling of the water passages in the system.

d. The RECW system is designed to serve as a barrier between potentially radioactive systems and the plant service water system.

e. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the RECW system are discussed in Section 3.2.

f. A thermal relief valve was installed in Unit 1 and 2 primary containments on non-safety related RECW lines to enhance the design of the RECW systems to limit thermally induced pressurization concerns that were described in Generic Letter 96-06.

9.2.8.2 System Description

The RECW system consists of two 100% capacity cooling water pumps, two 100% heat exchangers, one head tank, one chemical addition tank, associated valves, piping, and controls as shown in drawing M-13. Major equipment design parameters are summarized in Table 9.2-21.

The RECW system provides demineralized cooling water to nonessential equipment located in the reactor and radwaste enclosures which have the potential to carry radioactive fluids, or which require a clean water supply to minimize long-term corrosion.

During normal operation, one RECW pump and one or two heat exchangers is in service. The second pump automatically starts on low pressure in the supply header. During normal plant operation, the RECW system furnishes cooling water to the following components:

a. Cleanup nonregenerative heat exchangers

b. Cleanup recirculation pump seal coolers/motor coolers

c. Reactor recirculation pump seal and motor oil coolers

d. Reactor enclosure equipment drain sump cooler

e. Sample station coolers

f. PCIG compressors and aftercoolers

The demineralized cooling water is circulated throughout the closed-loop by the RECW pumps. The pump motors are connected to Class 1E busses, and on a LOOP without occurrence of a

LOCA, both pumps automatically restart. In this mode, the RECW system may be used to furnish cooling water to the reactor enclosure equipment drain sump cooler, and the reactor recirculation pump seal and motor oil coolers. However, the cooling capacity of RECW will be limited by the unavailability of the Service Water System. The rest of the system can be isolated by a valve which is remote manually operated from the control room. Cooling water to the RECW heat exchanger can be provided by the ESW System after a LOOP by manual realignment of the ESW and Service Water systems.

On a LOCA, both RECW pumps are tripped when their respective load centers are shed from the Class 1E bus, and both pumps are inhibited from automatically starting; however, they can be manually started as allowed by diesel generator loading. Coolant for the reactor recirculation pump seal and motor oil coolers can also be supplied by the ESW system if the RECW supply is not available. This switch-over can be accomplished by manual operation of the connecting valves. The connecting valves with motor operators have their power supplies disconnected, as shown in drawing M-13. The primary containment isolation valves associated with the RECW system are discussed in Section 6.2.4.

The RECW system has also the capability to supply cooling water to the fuel pool heat exchangers via a removable spool piece. The RECW system also has the capability during shutdown to supply drywell chilled water to the RWCU non-regenerative heat exchanger(s) and the 1A RWCU pump motor cooler in order to increase the cooling capacity of the RWCU alternate method of reactor decay heat removal. This line-up may only be established when containment isolation valves are not required to be operable or when the affected containment penetration is isolated as dictated by the Technical Specifications and Technical Requirements Manual.

Makeup water is supplied to the RECW head tank from the demineralized water system. The head tank provides necessary makeup water to the RECW system, as required. Chemicals are added to the system through the chemical addition tank for corrosion prevention.

The RECW pumps, heat exchangers, chemical addition tank, and head tank are all located in the reactor enclosure.

9.2.8.3 Safety Evaluation

The RECW system has no safety-related function, and is not required to be operable following a LOCA. Failure of the system does not compromise any safety-related system or component, nor does it prevent a safe shutdown of the plant.

RECW system piping and valves are discussed in Section 3.7, 6.2, and Table 3.2-1..

The reactor recirculation pump seals are cooled following a shutdown of the pump caused by LOOP for economic, and not safety reasons.

9.2.8.4 Tests and Inspections

The RECW system is preoperationally tested in accordance with the requirements of Chapter 14.

9.2.8.5 Instrumentation Applications

Local and remote indicators, alarms, and pressure relief valves are provided to monitor the system process and to protect system components. Low pressure and high temperature in the RECW

system supply header are alarmed in the control room. Demineralized water supply to the RECW head tank is controlled by a level switch in the tank. High and low levels in the tank are also alarmed in the control room.

Continuous radiation monitors are installed in the pump suction header of the RECW system. This instrumentation records and alarms radioactivity leakage into the system in the control room.

9.2.9 TURBINE ENCLOSURE COOLING WATER SYSTEM

The TECW system is a closed-loop cooling system that provides cooling water for miscellaneous turbine plant components. The TECW system is not safety-related.

9.2.9.1 Design Bases

a. The TECW system is designed to remove the maximum anticipated heat loads developed by the components served by the system, over the full range of the normal plant operating conditions and ambient temperature conditions.

b. The TECW system is designed to operate during normal plant operation and on LOOP without occurrence of a LOCA.

c. The system is designed to permit use of corrosion inhibitors to prevent long-term corrosion and organic fouling of the water passages in the system.

d. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the TECW system are discussed in Section 3.2.

9.2.9.2 System Description

The TECW system consists of two 100% capacity cooling water pumps, two 100% capacity heat exchangers, one head tank, one chemical addition tank, and associated valves, piping, and controls as shown on drawing M-14. Major equipment design parameters are summarized in Table 9.2-22.

During normal plant operation, one TECW pump and one or two heat exchanger are in service. The second pump starts automatically on low pressure in the supply header. During normal plant operation, the TECW system furnishes demineralized cooling water to the following turbine plant components:

a. Condensate pump motor bearing oil coolers

b. Instrument air compressors and aftercoolers

c. Service air compressor and aftercooler

d. Sample station coolers

Demineralized cooling water is circulated throughout the closed-loop by the TECW pumps. The pump motors are connected to Class 1E busses, and on a LOOP both pumps automatically start.

On a LOCA, both pumps trip when their respective load centers are shed from the Class 1E bus. Both pumps are inhibited from restarting; however, the operator can manually reconnect the pumps to the Class 1E bus if diesel loadings permit.

Makeup water is supplied to the TECW head tank from the demineralized water system. The head tank provides necessary makeup water to the TECW system, as required. When required, chemicals are added to the system through the chemical addition tank for corrosion prevention.

Valves on the cooling water supply to the instrument and service air compressor aftercoolers, and water jackets are interlocked with the compressor motors so that cooling water is provided while the compressors are running. Temperature control valves modulate the cooling water flow to maintain a set compressor temperature. The flow rate of cooling water to all other coolers is manually set by individual valves on the cooling water piping for each unit.

The TECW system pumps, heat exchangers, chemical addition tank, and head tank are all located in the turbine enclosure.

9.2.9.3 Safety Evaluation

The TECW system has no safety-related function, and is not required to be operable following a LOCA. Failure of the system does not compromise any safety-related system or components, nor does it prevent a safe shutdown of the plant.

9.2.9.4 Tests and Inspections

The TECW system is preoperationally tested in accordance with the requirements of Chapter 14.

9.2.9.5 Instrumentation Applications

Local and remote indicators, alarms, and pressure relief valves are provided to monitor the system process and protect system components. Low pressure and high temperature in the TECW supply header are alarmed in the control room. The demineralized water supply to the TECW head tank is controlled by a level switch in the tank. High and low levels in the tank are also alarmed in the control room.

9.2.10 CHILLED WATER SYSTEMS

9.2.10.1 Drywell Chilled Water System

The DCWS provides chilled water for cooling the air supply to the following areas:

a. Drywell

b. Reactor enclosure

c. Refueling area

d. Turbine enclosure

e. Radwaste enclosure

In addition, the system provides chilled water to the following equipment:

a. Recirculation pump motor air cooler

b. Drywell equipment drain sump cooling coil

c. Sample coolers

d. Mechanical vacuum pump seal cooler

e. RWCU non-regenerative heat exchangers

f. 1A RWCU pump motor cooler

9.2.10.1.1 Design Bases

a. The DCWS is not safety-related, except for the containment penetrations and the containment isolation valves. These are designed to meet seismic Category I requirements and are discussed in Section 6.2.4.

b. The chilled water piping inside the drywell is designed to ensure that it has no adverse effects on adjacent safety-related equipment in the event of a SSE.

c. During normal operation, the DCWS is designed to provide chilled water at 50°F to components serviced by the system.

d. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the DCWS are discussed in Section 3.2.

9.2.10.1.2 System Description

9.2.10.1.2.1 General Description

The DCWS is shown in drawing M-87. Design parameters for major components of the DCWS are listed in Table 9.2-23. Major components of the system include the following:

a. Two centrifugal water chillers

b. Two chilled water circulating pumps

c. One head tank (expansion tank)

d. One chemical feed tank

The water chiller unit includes a centrifugal compressor, condenser, evaporator, pump-out unit, oil pump, oil heater, all refrigerant piping, instrumentation, and controls. Each chiller unit and circulating pump is sized for 100% capacity.

Cooling water for the chiller condensers is provided by the service water system. Makeup water for the DCWS is provided by the demineralized water system through an automatic makeup water valve.

The chemical addition subsystem provides control against corrosion. Chemical addition to the system is manually initiated.

The head tank is vented to the atmosphere, and is located at the highest elevation in the system.

9.2.10.1.2.2 System Operation

During normal operation, one chilled water circulating pump and one chiller unit operate. However, to provide additional drywell cooling during normal operation, the system may be aligned with 2 chilled water circulating pumps, 2 containment piping systems, and one chiller unit operating. Reactor enclosure supply air cooling coils are not supplied with chilled water under normal conditions. The second chiller and pump can be started in the event of high temperature in the drywell, or reactor enclosure. The standby chiller is manually started if there is a failure of the operating chiller. The standby pump starts automatically or can be started manually if there is a failure of the operating pump.

The closed-loop refrigerant system in the water chiller unit extracts heat from water in the evaporator, and rejects heat to service water in the condenser. A temperature sensor, in the chilled water outlet, positions the inlet guide vanes of the compressor to maintain a constant outlet water temperature.

Inside containment, two independent piping systems connected to two sets of coolers are provided. Changeover from one to the other system is accomplished by switching the containment isolation valves from the control room. A containment isolation signal closes the containment isolation valves. The valves can be reopened from the control room, if desired, to resume chilled water flow.

The RECW system may provide backup to the portion of DCWS that serves the drywell only when containment isolation valves are not required to be operable. In addition, the associated containment isolation valves for this service are administratively controlled as locked closed valves as described in UFSAR Section 6.2.4.3.1.3.2.11.

The RECW system also has the capability during shutdown to supply drywell chilled water to the RWCU non-regenerative heat exchanger(s) and the 1A RWCU pump motor cooler in order to increase the cooling capacity of the RWCU alternate method of reactor decay heat removal. This line-up may only be established when containment isolation valves are not required to be operable or when the affected containment penetration is isolated as dictated by the Technical Specifications and Technical Requirements Manual.

Chilled water flow through the cooling coils and unit coolers is controlled by temperature-actuated valves, as shown in drawing M-87.

Chilled water can be supplied to the refueling floor air supply cooling coil, to provide comfortable conditions for plant personnel.

9.2.10.1.3 Safety Evaluation

The DCWS has no safety-related function, except for the containment penetrations and containment isolation valves which are described in Section 6.2.4.

9.2.10.1.4 Tests and Inspections

The DCWS is preoperationally tested in accordance with the requirements of Chapter 14.

9.2.10.1.5 Instrumentation Applications

Chillers and pumps are operated from the control room. Failure of the lead chiller or pump causes an alarm in the control room. Pressures at pump suction, pump discharge, and chiller discharge are displayed locally. Chilled water temperatures and flows are indicated in the control room.

Level in the head tank is indicated locally and alarmed through a computer in the control room at low or high level.

9.2.10.2 Control Structure Chilled Water System

The CSCWS provides chilled water to maintain stipulated ambient air temperature (Section 3.11) in the following areas:

a. Control room

b. Auxiliary equipment room including the computer room

c. Emergency switchgear compartment

d. Battery room

e. SGTS compartment and access area

9.2.10.2.1 Design Bases

a. The CSCWS is designed to remain functional following an SSE.

b. The CSCWS is designed to supply adequate chilled water at 44°F to maintain the stipulated ambient air temperatures.

c. The CSCWS is designed so that a single failure of any active component, assuming LOOP, cannot result in the loss of chilled water supply.

d. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the CSCWS are discussed in Section 3.2.

e. The CSCWS supports operation of the Control Room HVAC System by providing chilled water during normal and design bases accident conditions.

9.2.10.2.2 System Description

9.2.10.2.2.1 General Description

The CSCWS is shown in drawing M-90. The system is common to Units 1 and 2, and consists of two independent, 100% capacity, chilled water systems. Piping interties, with double isolation valves, are provided between the two systems to provide flexibility. Design parameters for major components of the CSCWS are listed in Table 9.2-24. Major components of each system include the following:

a. One centrifugal water chiller

b. One chilled water circulating pump

c. One head tank (expansion tank)

d. One chemical feed tank

The chiller unit includes a centrifugal compressor, condenser, evaporator, pump-out unit, oil pump, oil heater, all refrigerant piping, and controls.

Cooling water for the chiller condensers is provided by the service water system during normal operation. On LOOP, the cooling water supply automatically switches over to the ESW system. Makeup water for the CSCWS is provided by the demineralized water system through an automatic makeup water valve.

The chemical addition subsystem provides control against corrosion. Chemical addition to the system is manually initiated.

The head tank is vented to the atmosphere, and is located at the highest elevation in the system.

9.2.10.2.2.2 System Operation

One of the two CSCWS is designed to be in operation during all modes of plant operation. For normal operation, hand switches for both chillers are placed in the normal after start or normal after stop position. When the lead chilled water pump is started from the control room, the corresponding chiller is normally started after all the safety requirements on the chiller unit are satisfied, and the chilled water flow is established .

The closed-loop refrigerant system in the chiller unit extracts heat from water in the evaporator, and rejects heat to service water in the condenser. A temperature sensor in the chilled water outlet positions the inlet guide vanes of the compressor to maintain a constant outlet water temperature.

The CSCWS is designed to perform its safety function assuming a single active failure. If there is a failure of any of the operating cooling coils or unit coolers except the main control room HVAC supply units, the standby unit starts and causes the standby chiller to start without interrupting the operation of the lead chiller. If the operating cooling coil for the main control room HVAC supply fails, the standby unit is manually started when required. If the lead chiller fails, the standby chiller is automatically activated by the standby fan cabinet when the lead fan cabinet fails to maintain the required temperature. The operating and standby chilled water loops can be interconnected by operating the gate valves in their interconnecting lines. The lead chiller continues to operate whenever the standby chiller is started automatically.

Chilled water flow through cooling coils and unit coolers is controlled by temperature-actuated valves as shown in drawing M-90.

9.2.10.2.3 Safety Evaluation

All safety-related components of the CSCWS are designed to seismic Category I requirements, as defined in Section 3.7. The safety-related components of the CSCWS are located in the seismic Category I designed control structure as discussed in Section 3.8. Power is supplied to these seismic Category I components from the Class 1E power sources as discussed in Section 8.3.

Piping, valve, or equipment failures (including supporting structures) that could result in the generation of a missile, in flooding, or in a pipe whip that could cause damage to safety-related equipment are discussed in Sections 3.5 and 3.6.

Two independent 100% capacity systems provide complete mechanical redundancy. Coupled with the redundancy of electrical design, a failure of any single active component cannot result in a complete loss of both CSCWS, thus assuring a safe shutdown condition. For a FMEA of the CSCWS, refer to Table 9.2-25.

9.2.10.2.4 Tests and Inspections

The CSCWS is preoperationally tested in accordance with the requirements of Chapter 14, and periodically tested in accordance with the requirements of Chapter 16.

9.2.10.2.5 Instrumentation Applications

Chillers and pumps are operated from the control room. Failure of the lead chiller or pump causes an alarm in the control room. Pressures at pump suction, pump discharge, and chiller discharge are displayed locally. Chilled water temperatures and flows, and motor electrical currents, are indicated in the control room.

Level in the head tank is indicated locally and alarmed through a computer in the control room at low level.

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9.2-30 Letter from Pamela B. Cowan (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "License Amendment Request Response to Additional Questions, Proposed Technical Specification Allowed Outage Time Extensions to Support Residual Heat Removal Service Water Maintenance," dated December 3, 2010.

9.2-31 Letter from David P. Helker (Exelon Generation Company, LLC) to U.S. Nuclear Regulatory Commission, "Response to Request for Additional Information, License Amendment Request, Proposed Technical Specification Allowed Outage Time Extensions to Support Residual Heat Removal Service Water Maintenance," dated March 23, 2011.

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Table 9.2-1

SERVICE WATER SYSTEM DESIGN PARAMETERS

SERVICE WATER PUMPS	
Quantity	3 (50% capacity each)
Type	Horizontal, centrifugal
Capacity	18,000 gpm
Head	250 feet
Motor power rating	1500 hp
FUEL POOL SERVICE WATER BOOSTER PUMPS	
Quantity	3 (33-1/3% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity	1300 gpm
Head	60 feet
Motor power rating	25 hp

Table 9.2-2

EMERGENCY SERVICE WATER SYSTEM DESIGN PARAMETERS

PUMPS	
Quantity	4 (50% capacity each)
Fluid	Spray pond water
Type	Wet pit turbine
Design flow, each	6400[(1)] gpm
Total dynamic head	240[(1)] feet
Material	
Casing	Carbon steel
Shaft	Stainless steel
Impeller	Aluminum bronze
MOTORS	
Rated power	500 hp
Voltage/phase/cycle	4000/3/60
Speed	1200 rpm
Service factor	1.0

(1) Design parameters listed in Table 9.2.2 do not constitute performance requirements. ESW pump performance requirements are based on its ability to support the heat transfer rates listed in Table 9.2-3 regardless of discharge head. The pump design flow and total dynamic head values in this table were the basis for selecting the pumps; however, there is no licensing basis requirement for these particular design parameter values. Startup Testing and Surveillance Testing has demonstrated that the ESW System fulfills its required safety functions with the pumps delivering less flow and developing less total dynamic head. The pump design flow/head values in this table provide considerable margin from the system licensing design basis performance requirement to deliver the flow rates in Table 9.2-3.

Table 9.2-3

EMERGENCY SERVICE WATER SYSTEM DESIGN FLOWS
AND HEAT TRANSFER RATES

COMPONENT (Quantity per ESW Loop)	FLOW RATE Loop 'A'	in GPM [3] Loop 'B'	HEAT TRANSFER RATE in 10^6 Btu/hr
Standby Diesel Generator Heat Exchangers (4)	1800	1800	32.232 for four D/Gs
RHR Pump Motor Oil Cooler (4)	20.4	20.4	0.040 per pump
RHR Pump Room Unit Coolers (8 total, 4 each room, 1 room each Unit)	184 [5]	184 [5]	0.548 for A/C room 0.520 for B/D room
Core Spray Pump Room Unit Coolers (8 total, 2 each room, 2 rooms each Unit)	216 [6]	216 [6]	0.226 per room
HPCI Pump Room Unit Coolers (4 total, 2 each room, 1 room each Unit)	N/A	400 [4]	0.726 per room [4]
RCIC Pump Room Unit Coolers (4 total, 2 each room, 1 room each Unit)	160 [4]	N/A	0.303 per room [4]
Main Control Room Chiller (1)	450	450	2.873 per ESW Loop
RECW Heat Exchanger (1)	1166 [1]	1166 [1]	6.41 [1] for one HX
TECW Heat Exchanger (1)	243 [1]	243 [1]	0.3402 [1] for one HX
Reactor Recirculation Pump seal cooler and motor oil cooler (2 sets total, 1 set each Unit/Pump)	260 [1]	260 [1]	0.628 [1] for two pumps
Makeup to fuel pools	60	60	N/A
TOTAL	4399.4	4399.4	

NOTES:

[1] Non-essential service
[2] Footnote 2 deleted
[3] Flow rates required for each heat exchanger and room cooler to remove design heat loads will vary with heat exchanger/room cooler fouling. Acceptance criteria are administratively controlled by plant surveillance procedures.
[4] The minimum required flow for these coolers is zero. However, the coolers are still normally connected to the ESW system. Therefore all the essential components must receive their minimum flow rates with these coolers connected to ESW and receiving some flow. The flow and heat transfer rates shown are those used to calculate the maximum heat that could be removed from the HPCI and RCIC pump rooms to be used when analyzing the Ultimate heat sink. The Ultimate heat sink must be capable of dissipating the heat that will be removed from these rooms without adversely impacting its required function to support other essential components.
[5] RHR room – 23 gpm per cooler; the flow rates for both ESW loops are based on the higher A/C RHR room heat load and assumes two coolers per room in service (one blocked out of service and the other one fails - ESW valves does not open). From an ESW flow balancing standpoint, this scenario is the design basis case. From a Spray Pond performance standpoint, a different scenario is the design basis case. For the Spray Pond design basis case, the total heat load from the accident unit RHR rooms is 1.955 MBtu/hr.
[6] Core Spray room – 27 gpm per cooler

Table 9.2-4

EMERGENCY SERVICE WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Accident	ESW pump	Loss of ESW 'A' pump (typical for 'B', 'C', & 'D' pumps)	ESW loop 'A' flow reduced	Pump discharge low pressure alarm control room	ESW pump 'C' running; adequate cooling flow maintained to ESW loop 'A' diesels and components[1]
Accident	Instrument air supply	Loss of air pressure to air pressure to air operated valves	System air operated valves become inoperable	Alarm in control room	AOVs fail to safe position; cooler inlet valves fail open; isolation valves fail shut; ESW supply valves fail open. System cooling to essential components not impaired.
Accident	Power Supply	LOOP	Normal power supply lost to system pumps and valves	Alarm in control room	Standby diesel generators start automa ically, supplying power to all system components. ESW pumps to start automa ically.
Accident	Power Supply	Failure of Dll Class 1E bus (typical for D12, D23, & D24) for D13 & D14 Unit 1 operation/ Unit 2 construc ion)	Loss of ESW 'A' pump system valves powered from D11 (Sec ion 8.3)	Alarm in control room	Same as for loss of ESW 'A' pump above.
Accident	Power Supply	Failure of D13 Class 1E bus (typical for D14, D21 & D22)	Loss of power to system valves powered from D13 (Section 8.3)	Alarm in control room	MOVs fail as-is. AOVs fail to safe condition as described for loss of instrument air above. System components not impaired.

Table 9.2-4 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Accident	Controls	Short-circuit in controls causes valve to fail in unsafe condition (pump failure discussed above)	Valve fails in unsafe position	Valve position indication. Coolers & chillers – trouble alarm. Diesel generators – high temperature alarm. ESW return line-differential flow alarm.	Case 1: Cooler inlet valve closure - redundant cooler automa ically starts operation when standby fan unit(s) start. No effect on plant operation. When he standby Core Spray, HPCI or RCIC cooler is not in service, an eventual loss of the associated pump will occur. When a standby RHR cooler is not in service, eventual loss of both RHR pumps in the room may occur. No loss of safety func ion will occur since the ECCS pumps in separate rooms are redundant and HPCI/RCIC are needed for only 6 hours or less. Case 2: Diesel generator inlet/outlet valves closure – loss of diesel generator - see the effects above. Case 3: Loop return valve closure - valve to opposite combined RHRSW/ESW loop remains open, no loss of flow. Case 4: Intertie to nonessential system (service water and TECW) opens – redundant motor-operated or check valve remains shut, no loss of system integrity. Isolation valves on connections to RECW are remote manual (Section 6 2.4). Case 5: Chiller control valve or outlet valve closure-redundant chiller operates or redundant outlet valve remains open. No effect on plant operation.

(1) During the first ten minutes of a postulated LOCA, 3 RHR pumps, and therefore 3 diesels and their associated Class 1E busses may be required for the affected unit (Table 8.3-2). Both ESW pumps in a loop automatically start and would be operating during this time.

Table 9.2-5

RESIDUAL HEAT REMOVAL SERVICE WATER SYSTEM DESIGN PARAMETERS

<u>PUMPS</u>	
Quantity	4(1)
Fluid	Spray pond water
Type	Wet pit turbine
Design flow, each	9000(2) gpm
Total dynamic head	240(2) feet
Material	
Casing	Carbon steel
Shaft	Stainless steel
Impeller	Aluminum bronze
<u>MOTORS</u>	
Power rating	700 hp
Voltage/phase/cycle	4000/3/60
Speed	1200 rpm
Service factor	1.0

(1) One pump supplies 100% flow to one RHR heat exchanger. During two-unit operation, two heat exchangers (one per unit), and therefore two of the four pumps, are required for safe shutdown and accident mitigation. For two-unit and one ESW/RHRSW loop operation, the RHR heat exchanger of the unit under normal shutdown will receive 67% to 100% RHRSW flow and the unit with the LOCA will receive 100% RHRSW flow.

(2) Design parameters listed in Table 9.2-5 do not constitute performance requirements. RHRSW pump performance requirements are based on the pumps ability to support heat transfer regardless of discharge head. The pump design flow and total dynamic head values in this table were the basis for selecting the pumps; however, there is no licensing basis requirement for these particular design parameter values. Startup Testing and Surveillance Testing has demonstrated that the RHRSW System fulfills its required safety functions with the pumps delivering less flow and developing less total dynamic head. The pump design flow/head values in this table provide considerable margin from the system licensing design basis performance requirement to deliver at least 5570 gpm to an RHR heat exchanger on the unit undergoing emergency shutdown and at least 8000 gpm to an RHR heat exchanger on the unit experiencing an accident (see Section 9.2.3.2).

Table 9.2-6

RHR SERVICE WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Normal/Accident	RHRSW pump	Failure of one RHRSW pump heat exchanger	Loss of cooling water to one RHR in control room	Pump discharge low pressure alarm RHRSW pumps supply sufficient	Unavailability of one RHR heat exchanger. Three remaining cooling to he other RHR heat exchangers of both units for safe shutdown, cooldown, and accident mitiga ion.
Accident	Power supply	LOOP supply	Loss of normal power to all system components	Alarm in control room	Plant is tripped. Standby diesel generators automa ically start to supply power to all system components.
Accident	Power supply	Failure of D11 safeguard bus (typical for D12)	Loss of power to RHRSW 'A' pump and system valves powered from D11 (refer to Section 8.3)	Alarm in control room	Case I: System initially aligned to spray pond mode; loss of cooling to one RHR heat exchanger, remaining RHRSW pumps provide sufficient cooling water to other RHR heat exchangers. Valves remain in original posi ion, failing as-is, hereby having no effect on system operation. Case II: System initially aligned to cooling tower mode; Loss of cooling to one RHR heat exchanger loss of 'A' spray network and loop 'A' winter bypass. Cooling towers isolated by redundant valves when system is automatically aligned to spray pond mode.

Table 9.2-6 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
					Remaining spray networks or winter bypass, and RHRSW pumps provide adequate cooling for shutdown, cooldown, and accident mitigation.
Accident	Power supply	Failure of D23 safeguard bus (typical for D13 during Unit 1 only operation)	Loss of power to system valves powered from D23 (Section 8.3)	Alarm in control room	Case I: System initially aligned to spray pond mode; valves remain in original position, failing as-is thereby having no effect on system operation.
					Case II: System initially aligned to cooling tower mode; loss of 'C' spray network and loop 'B' winter bypass. Unit 1 cooling tower isolated by redundant valves when system aligned to spray pond mode. Remaining networks and winter bypass provide sufficient cooling.
Accident	Power supply	Failure of D24 safeguard bus (typical for D14 during Unit 1 only operation)	Loss of power to system valves powered from D24 (Section 8.3)	Alarm in control room	Case I: System initially aligned to spray pond mode; valves remain in original position, failing as-is, thereby having no effect on system operation.
					Case II: System initially aligned to cooling tower mode; loss of 'D' spray network and loop 'B' winter bypass. Unit 2 cooling tower isolated by redundant valves when system aligned to spray pond mode. Remaining networks and winter bypass provide sufficient cooling.

Table 9.2-6 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Accident	Power supply	Loss of D11, D13, D21, and D23 safeguard buses (typical for loss of D12, D14, D22, and D24 safeguard buses)	Loss of RHRSW pumps 'A' and 'C' and system valves powered from D11, D13, D21 and D23 (Section 8.3)	Alarm in control room	Loss of cooling to one RHR heat exchanger in each unit. Valves fail as-is and thereby do not affect system operation. Two RHRSW pumps are sufficient for safe shutdown, cooldown, and accident mitigation.
Accident	Controls	Short-circuit in controls causes valve to fail in unsafe condition (pump failure discussed above)	Valve fails in unsafe condition	Valve position indication, flow temperature, and pressure indication for RHR heat exchanger valves	Case 1: RHR Heat exchanger inlet/outlet valve closure - loss of heat exchanger. Redundant heat exchanger provides sufficient cooling. Case 2: Spray network return valve closure - loss of one spray network. Remaining 3 networks provide sufficient cooling. Case 3: Winter bypass valve closure - loss of one RHRSW loop (until spray operation begins). Remaining RHRSW loop supplies sufficient cooling to both units. ESW system unaffected since it returns to both RHRSW return loops. Case 4: Spray pond sluice gate closure – remaining sluice gate and wet pit intertie provide flow path into wet pit. No effect on operation.

Table 9.2-6 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
					Case 5: Cooling tower supply and return or TECW return valve opens - redundant MOV or check valve prevents loss of flow. No effect on operation.
Normal/Accident	Radia ion monitors	Radiation monitor fails low	Loss of radiation detection in RHRSW return loop. RHRSW pumps automatically tripped	High radiation alarm in control room	Monitoring of Loop return flows continues by taking grab samples on a periodic basis in accordance with he off-site dose Calcula ion manual. Pumps can be returned to service with manual override.
Normal/Accident	Radia ion monitors	Radiation monitor fails high	Loss of radiation detection in RHRSW return loop RHRSW pumps automatically tripped.	High radiation alarm in control room	Monitoring of Loop return flows continues by taking grab samples on a periodic basis in accordance with he off-site dose Calcula ion manual. Pumps can be returned to service with manual override.

Table 9.2-7

CLARIFIED AND DOMESTIC WATER SYSTEMS DESIGN PARAMETERS

RAW WATER CLARIFIER

Quantity	1
Type	Circular, upflow, solid contact, with internal variable-speed agitator
Capacity	310 gpm
Motor power rating	¾ hp

CLEARWELL

Quantity	1
Type	Vertical, cylindrical
Capacity	5000 gallons

CLARIFIED WATER SERVICE PUMP
CLARIFIED WATER STANDBY PUMP
FILTER BACKWASH PUMP

Quantity, each	1
Type	Horizontal, centrifugal, single-phase
Capacity, each	300 gpm
Head	90 feet
Motor power rating	15 hp

PRESSURE FILTERS

Quantity	3 (33-1/3% capacity each)
Type	Vertical, pressure, anthracite bed
Capacity	100 gpm
Design pressure	100 psig

Table 9.2-7 (Cont'd)

CLARIFIED WATER STORAGE TANK	
Quantity	1
Type	Vertical, cylindrical
Capacity	200,000 gallons
MAKEUP DEMINERALIZER FEED PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity	90 gpm
Head	230 feet
Motor power rating	15 hp
LUBE WATER PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity	120 gpm
Head	300 feet
Motor power rating	25 hp

Table 9.2-8

DEMINERALIZED WATER MAKEUP SYSTEM DESIGN PARAMETERS

CARBON FILTER

Quantity	1
Type	Vertical, pressurized, activated carbon bed
Flow rate	120 gpm
Design pressure	125 psig

DEMINERALIZED WATER STORAGE TANK

Quantity	1
Type	Vertical, cylindrical
Capacity	50,000 gallons

DEMINERALIZED WATER TRANSFER PUMPS

Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, double suction, single stage
Capacity	150 gpm
Head	350 feet
Motor power rating	40 hp

DEMINERALIZED WATER TRANSFER JOCKEY PUMP

Quantity	1
Type	Horizontal, centrifugal, single stage
Capacity	60 gpm
Head	350 feet
Motor power rating	20 hp

Table 9.2-9

SPRAY POND DESIGN DATA

SPRAY NOZZLES	
Number	240 per spray network (4 networks)
Type	Hollow-cone spray pattern (Spray Engineering Co. ramp bottom model 1751A)
Capacity, each	51.0 - 64.6 gpm
SPRAY POND	
Dimensions at pond bottom	
Length	1000 feet
Width	400 feet
Depth	9'10" (at TECH SPEC minimum water level of 250'10" MSL)
Surface area	9.9 acres
Storage volume	$29.06x10^6$ gallons
Lining	Soil-Bentonite mixture
Network flow rate	12,250 - 15,500 gpm

Table 9.2-10

PERCENT FREQUENCY DISTRIBUTION OF
DAILY AVERAGE RELATIVE HUMIDITY AND WIND SPEED

	LGS 2½ YEARS	PHILADELPHIA 2½ YEARS	PHILADELPHIA 34 YEARS
Relative Humidity (%)			
90-100	12.3	7.9	6.3
80-89	17.7	17.3	15.7
70-79	29.4	22.9	24.7
60-69	20.1	23.7	26.2
50-59	14.7	17.5	18.5
<50	5.8	10.7	8.6
Wind Speed (mph)			
0-2	10.8	0.0	0.2
3-4	31.1	0.2	3.4
5-6	25.3	10.1	16.0
7-8	14.5	25.7	25.3
9-10	8.7	24.6	21.3
11-15	7.5	31.2	26.6
16-20	1.8	7.4	6.0
>20	0.4	0.9	1.1

Table 9.2-11

SPRAY POND SYSTEM DESIGN METEOROLOGY

	WORST 30 DAYS FOR WATER LOSS	WORST DAY FOR HEAT TRANSFER	WORST 30 DAYS FOR HEAT TRANSFER
Average dry-bulb temperature, °F	67.5	85.6	78.1
Average wet-bulb temperature, °F	59.2	78.6	73.4
Average natural wind speed, mph	10.43	0.0	0.0
Period	05/30/58 to 06/28/58	6/30/45	8/12/59 to 09/10/59

Table 9.2-12

COEFFICIENT OF THERMAL PERFORMANCE
COMPARISON OF LGS AND PHILADELPHIA WORST CASE
METEOROLOGICAL CONDITIONS (JANUARY 1, 1972 - DECEMBER 31, 1976)

	WORST 30 DAYS FOR WATER LOSS		WORST DAY FOR HEAT TRANSFER		WORST 30 DAYS FOR HEAT TRANSFER	
	LGS	PHILADELPHIA	LGS	PHILADELPHIA	LGS	PHILADELPHIA
Average dry-bulb temperature (F)	72.0	75.1	80.7	84.2	75.3	78.1
Average wet-bu b temperature (F)	64.8	65.8	74.6	78.3	70.4	70.9
Average natural wind speed at 30 ft elevation (mph)	5.6	9.7	2.3	5.7	4.1	7.1
Period	07/22/72 to 08/20/72	06/24 to 07/23/74	07/19/72	07/19/72	07/07 to 08/05/75	07/07 to 08/05/75
Coefficient	0.0135	0.0147	-12.22	-11.92	-14.28	-15.62

Table 9.2-13

SUMMARY OF SPRAY POND WATER ALLOWANCES

Allowances	VOLUME (millions of gallons) Final Design
Water Losses (max heat transfer case)	
Evaporation, plant heat load	13.58
Evaporation, natural	1.82
Drift loss	.14
Seepage	1.83
Total Water Loss	17.37
Nonwater Loss	
Sedimentation	2.75
Excess for minimum operating level (el. 243'-6")	4.20
Total Nonwater Loss	6.95
Total Required	24.33
Reserve for Water Loss	4.74
Total Water Pond Capacity	29.07

Table 9.2-14

DATA USED IN PERFORMANCE ANALYSES

A. INITIAL CONDITIONS (10 minutes after LOCA)

	LOCA UNIT	SHUTDOWN UNIT
Reactor Vessel		
Temperature, °F	250	550
Water mass, lb_m	550,000	700,000
RPV heat capacity, metal, Btu/°F	$3.53x10^5$	$3.53x10^5$
Water on Drywell Floor		
Temperature, °F	180	-
Water mass, lb_m	500,000	-
Suppression Pool		
Temperature, °F	150	104.6
Water mass, lb_m	$7.01x10^6$	$7.36x10^6$
Spray Pond		
Temperature, °F	88	

B. PHYSICAL PARAMETERS

Mass median drop size	3000 microns	
Included spray angle	76 degrees	
Pressure drop through nozzle	7 psi @ 51 gpm	
Height of spray above nozzle	7 ft @ 51 gpm	
	Min. heat transfer	Max. water loss
Flow/nozzle	35.4 gpm	64.6 gpm
Nozzle height above pond	6.0 ft	7.17 ft

Table 9.2-14 (Cont'd)

C. FLOW RATES (gpm)[3]

TIME	PARAMETER	LOCA UNIT	SHUTDOWN UNIT	COMMON
10-30 min	Containment spray	0	[1]	[1]
	Core spray	7,430	[1]	[1]
	Relief valves & RCIC	[1]	[2]	[1]
	RHR HX (shell side)	10,000	0	[1]
	RHR HX (tube side)	9,000	0	[1]
	ESW	[1]	[1]	13,000
30-180 min	Core spray	7,430	[1]	[1]
	RHR HX (shell side) LPCI mode	10,000	[1]	[1]
	RHR HX (tube side)	9,000	18,000	[1]
	ESW	[1]	[1]	13,000
3-30 hr	Core spray	7,430	[1]	[1]
	RHR HX (shell side)	10,000	[2]	[1]
	RHR HX (tube side)	9,000	18,000	[1]
	ESW	[1]	[1]	13,000
30-720 hr	Core spray	7,430	[1]	[1]
	RHR HX (shell side)	10,000	10,000	[1]
	RHR HX (tube side)	9,000	9,000	[1]
	ESW	[1]	[1]	13,000

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(1) Not applicable

(2) Flow rate adjusted to limit cooldown rate to 100°F/hr

(3) These flow rates are used to compute heat loads to the spray pond. The spray pond performance analysis is based on bounding flow rates of 17,000 gpm (Min. Heat Transfer) and 53,000 gpm (max. Water Loss Case).

Table 9.2-15

HEAT REJECTION TO THE SPRAY POND (ONE-UNIT LOCA, ONE-UNIT SSD)

Time after Shutdown (min.)	Decay and ECCS Pump Heat Two Units (BTU/ hr)	Sensible Heat Two Units (BTU/ hr)	Auxiliary Loads Two Units (BTU/ hr)	ESW and RHRSW Pump Heat Two Units (BTU/hr)	Total Heat Load Two Units (BTU/ hr)
0	0.0000E+00	0.0000E+00	2.5200E+07	1.2400E+06	2.6440E+07
10	1.2942E+08	0.0000E+00	2.5200E+07	4.0400E+06	1.5866E+08
11	1.3223E+08	0.0000E+00	3.1590E+07	4.0400E+06	1.6786E+08
12	1.3499E+08	0.0000E+00	3.1590E+07	4.0400E+06	1.7062E+08
13	1.3768E+08	0.0000E+00	3.1590E+07	4.0400E+06	1.7331E+08
15	1.4291E+08	0.0000E+00	3.1590E+07	4.0400E+06	1.7854E+08
20	1.5474E+08	0.0000E+00	3.1590E+07	4.0400E+06	1.9037E+08
25	1.6504E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.0067E+08
30	1.7449E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.1012E+08
30.1	1.7467E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.1030E+08
31	1.7627E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.1190E+08
35	1.8315E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.1878E+08
40	1.9118E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.2681E+08
45	1.9861E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.3424E+08
50	2.0550E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.4113E+08
55	2.1191E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.4754E+08
60	2.1789E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.5352E+08
70	2.2885E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.6448E+08
80	2.3849E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.7412E+08
90	2.5122E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.8685E+08
100	2.5877E+08	0.0000E+00	3.1590E+07	4.0400E+06	2.9440E+08
110	2.6551E+08	0.0000E+00	3.1590E+07	4.0400E+06	3.0114E+08
120	2.7156E+08	0.0000E+00	3.1590E+07	4.0400E+06	3.0719E+08
130	2.7700E+08	0.0000E+00	3.1590E+07	4.0400E+06	3.1263E+08
170	2.8992E+08	7.0600E+07	3.1550E+07	4.0400E+06	3.9611E+08
200	2.7891E+08	7.0600E+07	3.1550E+07	4.0400E+06	3.8510E+08
240	2.6663E+08	7.0600E+07	3.1550E+07	4.0400E+06	3.7282E+08
260	2.6115E+08	1.3064E+07	3.1550E+07	4.0400E+06	3.0981E+08
300	2.5119E+08	2.8281E+06	3.1550E+07	4.0400E+06	2.8960E+08
320	2.4661E+08	2.5063E+06	3.1550E+07	4.0400E+06	2.8471E+08
340	2.4228E+08	2.3500E+06	3.1550E+07	4.0400E+06	2.8022E+08
360	2.3817E+08	4.4279E+05	3.1550E+07	4.0400E+06	2.7420E+08
600	2.0201E+08	1.2552E+06	3.1550E+07	4.0400E+06	2.3886E+08
870	1.7936E+08	6.9974E+05	3.1550E+07	4.0400E+06	2.1564E+08
1080	1.6844E+08	4.8166E+05	3.1550E+07	4.0400E+06	2.0451E+08
1350	1.5878E+08	3.5075E+05	3.1550E+07	4.0400E+06	1.9472E+08
1440	1.5621E+08	3.0158E+05	3.1550E+07	4.0400E+06	1.9210E+08
1800	1.4779E+08	2.2610E+05	3.1550E+07	4.0400E+06	1.8361E+08
2280	1.3909E+08	1.8002E+05	3.1550E+07	4.0400E+06	1.7486E+08
3000	1.2859E+08	7.2244E+04	3.1550E+07	4.0400E+06	1.6425E+08
3720	1.1997E+08	7.2244E+04	3.1550E+07	4.0400E+06	1.5564E+08
4500	1.1222E+08	7.2244E+04	3.1550E+07	4.0400E+06	1.4788E+08
5220	1.0624E+08	7.2244E+04	3.1550E+07	4.0400E+06	1.4190E+08

Table 9.2-15 (cont.)

HEAT REJECTION TO THE SPRAY POND (ONE-UNIT LOCA, ONE-UNIT SSD)

Time after Shutdown (min.)	Decay and ECCS Pump Heat Two Units (BTU/ hr)	Sensible Heat Two Units (BTU/ hr)	Auxiliary Loads Two Units (BTU/ hr)	ESW and RHRSW Pump Heat Two Units (BTU/hr)	Total Heat Load Two Units (BTU/ hr)
5940	1.0116E+08	7.2244E+04	3.1550E+07	4.0400E+06	1.3682E+08
6660	9.6823E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.3249E+08
7200	9.3980E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.2964E+08
7920	9.0645E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.2631E+08
8640	8.7745E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.2341E+08
9360	8.5206E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.2087E+08
10100	8.2908E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.1857E+08
16600	7.0322E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.0598E+08
19400	6.6966E+07	7.2244E+04	3.1550E+07	4.0400E+06	1.0263E+08
22300	6.4067E+07	7.2244E+04	3.1550E+07	4.0400E+06	9.9729E+07
23800	6.2728E+07	7.2244E+04	3.1550E+07	4.0400E+06	9.8390E+07
26600	6.0450E+07	7.2244E+04	3.1550E+07	4.0400E+06	9.6113E+07
29500	5.8334E+07	7.2244E+04	3.1550E+07	4.0400E+06	9.3996E+07
32400	5.6415E+07	7.2244E+04	3.1550E+07	4.0400E+06	9.2077E+07
41000	5.1624E+07	7.2244E+04	3.1550E+07	4.0400E+06	8.7287E+07
41800	5.1235E+07	7.2244E+04	3.1550E+07	4.0400E+06	8.6898E+07
42500	5.0902E+07	7.2244E+04	3.1550E+07	4.0400E+06	8.6564E+07
43200	5.0575E+07	7.2244E+04	3.1550E+07	4.0400E+06	8.6237E+07

Table 9.2-16

INTEGRATED HEAT REJECTION TO THE SPRAY POND

Time after Shutdown (min.)	Total Integrated Decay Heat Load (BTU)	Total Integrated Pond Heat Load (BTU)
0	0.0000E+00	
10	1.0785E+07	1.5425E+07
11	1.2965E+07	1.8146E+07
12	1.5192E+07	2.0966E+07
13	1.7464E+07	2.3832E+07
15	2.2141E+07	2.9696E+07
20	3.4543E+07	4.5068E+07
25	4.7866E+07	6.1361E+07
30	6.2013E+07	7.8477E+07
30.1	6.2304E+07	7.8827E+07
31	6.4936E+07	8.1994E+07
35	7.6917E+07	9.6349E+07
40	9.2514E+07	1.1492E+08
45	1.0875E+08	1.3413E+08
50	1.2559E+08	1.5393E+08
55	1.4298E+08	1.7429E+08
60	1.6089E+08	1.9517E+08
70	1.9812E+08	2.3834E+08
80	2.3707E+08	2.8322E+08
90	2.7787E+08	3.2997E+08
100	3.2037E+08	3.7841E+08
110	3.6406E+08	4.2803E+08
120	4.0882E+08	4.7873E+08
130	4.5453E+08	5.3038E+08
170	6.4351E+08	7.6663E+08
200	7.8571E+08	9.6193E+08
240	9.6756E+08	1.2146E+09
260	1.0555E+09	1.3283E+09
300	1.2263E+09	1.5281E+09
320	1.3093E+09	1.6239E+09
340	1.3908E+09	1.7180E+09
360	1.4708E+09	1.8104E+09
600	2.3512E+09	2.8365E+09
870	3.2093E+09	3.8592E+09
1080	3.8179E+09	4.5944E+09
1350	4.5541E+09	5.4927E+09
1440	4.7904E+09	5.7828E+09
1800	5.7024E+09	6.9100E+09
2280	6.8499E+09	8.3438E+09
3000	8.4560E+09	1.0378E+10
3720	9.9474E+09	1.2298E+10
4500	1.1457E+10	1.4271E+10
5220	1.2767E+10	1.6009E+10
5940	1.4012E+10	1.7682E+10

Table 9.2-16 (cont.)

INTEGRATED HEAT REJECTION TO THE SPRAY POND

Time after Shutdown (min.)	Total Integrated Decay Heat Load (BTU)	Total Integrated Pond Heat Load (BTU)
6660	1.5200E+10	1.9298E+10
7200	1.6058E+10	2.0477E+10
7920	1.7166E+10	2.2013E+10
8640	1.8236E+10	2.3511E+10
9360	1.9274E+10	2.4977E+10
10100	2.0311E+10	2.6453E+10
16600	2.8611E+10	3.8617E+10
19400	3.1814E+10	4.3484E+10
22300	3.4981E+10	4.8375E+10
23800	3.6566E+10	5.0851E+10
26600	3.9440E+10	5.5389E+10
29500	4.2310E+10	5.9984E+10
32400	4.5084E+10	6.4481E+10
41000	5.2826E+10	7.7335E+10
41800	5.3512E+10	7.8496E+10
42500	5.4108E+10	7.9508E+10
43200	5.4700E+10	8.0516E+10

Table 9.2-17

SPRAY POND TEMPERATURE TRANSIENT (ONE-UNIT LOCA, ONE-UNIT SSD)

TIME AFTER LOCA (min)	SPRAY POND TEMPERATURE (°F)	TIME AFTER LOCA (min)	SPRAY POND TEMPERATURE (°F)
0	88	7200	89.68
10	88	7920	89.52
10.1	88	8640	88.9
11	88	9360	88.82
12	88	10100	87.43
13	88.01	16600	87.38
15	88.02	19400	86.94
20	88.03	22300	86.7
25	88.04	23800	86.56
30	88.04	26600	86.16
30.1	88.04	29500	85.92
31	88.06	32400	85.71
35	88.07	41000	85.38
40	88.09	41800	84.61
45	88.11	42500	84.72
50	88.13	43200	84.08
55	88.15		
60	88.10		
70	88.23		
80	88.28		
90	88.34		
100	88.39		
110	88.45		
120	88.5		
130	88.74		
170	88.98		
200	89.29		
240	89.44		
260	89.66		
300	89.75		
320	89.85		
340	89.94		
360	90.92		
600	91.79		
870	92.32		
1080	92.85		
1350	92.92		
1440	93.09		
1800	93.14		
2280	93.48		
3000	92.92		
3720	93.03		
4500	91.96		
5220	91.53		
5940	90.59		
6660	90.35		

Table 9.2-18

SIZE COMPARISON OF RANCHO SECO AND LGS
SPRAY PONDS

	LGS	RANCHO SECO
Water flow rate (gpm) 49,000 (max)	16,500	
Nozzles	960 @ 51.0 gpm	304 @ 53.6 gpm
Water pressure at nozzle (psig)	7	7
Pond length at bottom (ft)	1000	330
Width at bottom (ft)	400	165
Depth (ft)	10	5
Volume (gal)	$29.6x10^6$	$5.7x10^6$
Area (acres)	9.9	1.3

Table 9.2-19

PERFORMANCE COMPARISON OF RANCHO SECO
TEST RESULTS AND MODEL RESULTS

Ambient Conditions				% Efficiency	
T_{wb} (°F)	T_{db} (°F)	Wind Speed (mph)	Spray Temperature	Rancho Seco	Model
60.98	81.50	13.0	79.88	41.7	35.72
61.52	80.96	12.5	80.06	47.5	34.89
55.04	51.08	5.3	77.36	32.5	31.84
48.56	51.98	1.0	77.36	28.8	31.00
64.94	56.48	6.0	77.54	30.9	31.6
71.06	57.56	6.5	78.62	35.5	22.10
72.32	95.00	7.0	80.06	38.9	31.91
69.62	93.02	6.6	81.14	34.3	28.85
66.56	85.64	8.4	80.78	45.8	30.02
60.98	72.32	3.8	80.24	34.5	32.96
60.26	69.26	3.8	79.7	28.5	34.61
54.20	57.92	1.0	101.4	35.2	39.16
53.06	57.02	1.6	100.0	36.2	38.23
51.98	55.94	1.3	97.88	34.4	37.24
48.92	53.06	1.0	101.66	34.5	36.70
48.02	51.08	0.4	97.34	34.6	35.62

Table 9.2-20

CONDENSATE AND REFUELING WATER STORAGE FACILITIES
DESIGN PARAMETERS

CONDENSATE STORAGE TANK	
Quantity	1
Type	Vertical, cylindrical, dome roof, with heating coil
Capacity	200,000 gallons
REFUELING WATER STORAGE TANK	
Quantity	1
Type	Vertical, cylindrical, dome roof, with heating coil
Capacity	550,000 gallons
CONDENSATE TRANSFER PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity, each	600 gpm
Head	250 feet
Motor power rating	60 hp
CONDENSATE TRANSFER JOCKEY PUMP	
Quantity	1
Type	Horizontal, centrifugal, two-stage
Capacity	70 gpm
Head	250 feet
Motor power rating	15 hp
REFUELING WATER PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity, each	1500 gpm
Head	180 feet
Motor power rating	100 hp

Table 9.2-21

REACTOR ENCLOSURE COOLING WATER SYSTEM DESIGN PARAMETERS

RECW PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity	1500 gpm
Head	170 feet
Motor power rating	100 hp
RECW HEAT EXCHANGERS	
Quantity	2 (100% capacity each)
Type	Horizontal, 2 pass, 1 shell
Duty	$27x10^6$ Btu/hr
Shell design	
Fluid	Demineralized water
Flow rate	700,000 lb/hr
Design pressure	175 psig
Design temperature	200^{o}F
Tube design	
Fluid	Service water
Flow rate	1,500,000 lb/hr
Design pressure	150 psig
Design temperature	200^{o}F
RECW HEAD TANK	
Quantity	1
Type	Vertical, cylindrical
Capacity	790 gallons
REACTOR ENCLOSURE CHEMICAL ADDITION TANK	
Quantity	1
Type	Vertical, cylindrical
Capacity	5 gallons

Table 9.2-22

TURBINE ENCLOSURE COOLING WATER SYSTEM DESIGN PARAMETERS

TECW PUMPS	
Quantity	2 (100% capacity each)
Type	Horizontal, centrifugal, single-stage
Capacity	225 gpm
Head	140 feet
Design temperature	100ºF
Motor power rating	15 hp
TECW HEAT EXCHANGERS	
Quantity	2 (100% capacity each)
Type	Horizontal, 2 pass, 1 shell
Duty	$2.5x10^6$ Btu/hr
Shell design	
Fluid	Demineralized water
Flow rate	110,000 lb/hr
Design pressure	100 psig
Design temperature	200ºF
Tube design	
Fluid	Service water
Flow rate	250,000 lb/hr
Design pressure	150 psig
Design temperature	200ºF
TECW HEAD TANK	
Quantity	1
Type	Vertical, cylindrical
Capacity	210 gallons
TURBINE ENCLOSURE CHEMICAL ADDITION TANK	
Quantity	1
Type	Vertical, cylindrical
Capacity	5 gallons

Table 9.2-22 (Cont'd)

CONDENSATE PUMP MOTOR UPPER
BEARING COOLERS

Quantity	3 (100% capacity each)
Type	Coil
Duty	76,350 Btu/hr
Tube design	
Fluid	Demineralized water
Flow rate	6000 lb/hr
Design pressure	100 psig
Design temperature	100°F

CONDENSATE PUMP MOTOR LOWER
BEARING COOLERS

Quantity	3 (100% capacity each)
Type	Coil
Duty	12,725 Btu/hr
Tube design	
Fluid	Demineralized water
Flow rate	6000 lb/hr
Design pressure	100 psig
Design temperature	100°F

Table 9.2-23

DRYWELL CHILLED WATER SYSTEM DESIGN PARAMETERS

WATER CHILLERS	
Type	Centrifugal
Capacity	1500 tons
Power rating	1303 kW
Entering chilled water temperature	65°F
Leaving chilled water temperature	50°F
CHILLED WATER CIRCULATING PUMPS	
Type	Centrifugal, horizontal, split case
Flow rate	2400 gpm
Head	110 feet
Motor power rating	100 hp
HEAD TANK	
Type	Vertical, cylindrical
Volume	300 gallons
Pressure	Atmospheric
CHEMICAL FEED TANK	
Type	Vertical, cylindrical
Volume	5 gallons

Table 9.2-24

CONTROL STRUCTURE CHILLED WATER SYSTEM DESIGN PARAMETERS

WATER CHILLERS (1)	
Type	Centrifugal
Capacity	192 tons
Power rating	289 kW
Entering chilled water temperature	50.5°F
Leaving chilled water temperature	44.0°F
CHILLED WATER CIRCULATING PUMPS	
Type	Centrifugal, vertical, in-line
Flow rate	705 gpm
Head	80 feet
Motor power rating	25 hp
HEAD TANK	
Type	Vertical, cylindrical
Volume	34 gallons
Pressure	Atmospheric
CHEMICAL FEED TANK	
Type	Vertical, cylindrical
Volume	5 gallons

(1) Values specified resulted from changes made to the condenser flow rate documented by ECR 12-00110. Originally, supplied water chiller was rated for 250 tons, 329 kW power rating and an entering chilled water temperature of 52.5°F.

Table 9.2-25

CONTROL STRUCTURE CHILLED WATER SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE		SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
1.	Normal	Normal power supply	Total LOOP	All system components are automatically supplied with power from diesel generators.	Alarm in the control room	No loss of safety function
2.	Accident	Class 1E power supply	Loss of Class 1E power supply to one loop	None. The two redundant systems are powered from separate Class 1E busses. Cooling water to the chiller condensers is supplied from redundant ESW loops.	Alarm in the control room	No loss of safety function
3.	Accident (LOCA or LOCA & LOOP)	Water chillers	Chiller failure	The standby chilled water system is automatically started from the control room. (Note 1)	Alarm in the control room	No loss of safety function
4.	Accident (LOCA or LOCA & LOOP)	Chilled water circulating pump	Pump failure	The standby chilled water pump is automatically started from the control room.	Alarm in the control room	No loss of safety function
5.	Normal or accident	System pressure boundary	Failure of pressure boundary in one loop	Loss of one chilled water loop. Standby chiller and pump are started manually from the control room. A completely redundant piping system is provided for the standby system.	Alarm in control room due to low level in head tank	No loss of safety function

Note 1 - The control structure chiller has several design feature protective trips to prevent chiller damage. If such a chiller trip occurs, the trip must be reset at the local panel before he chiller can be restarted from the control room. The local chiller control panel is located on elevation 200’ in the control structure which is readily accessible from the main control room during accident conditions.

9.3 PROCESS AUXILIARIES

9.3.1 COMPRESSED AIR AND GAS SYSTEMS

The compressed air and gas systems consist of the instrument air system, service air system, condensate filter/demineralizer backwash air system, Perkiomen Creek air system, Schuylkill River air system, and the primary containment instrument gas system. These systems supply plant equipment requiring compressed air and gas, as well as service air outlets located throughout the plant. The systems are shown on drawings M-09, M-15 and M-59 and are not safety-related except for:

a. Those seismic Category I portions of the primary containment instrument gas system provided for long-term ADS valve operation

b. The containment penetrations of the PCIG system (Section 9.3.1.3)

c. The containment penetration of the service air piping (Section 9.3.1.1)

d. The local seismic Category I gas reservoirs provided for valves with safety-related functions (Sections 5.4.5.2 and 5.2.2.4)

e. The local Unit 1 & 2 seismic Category I air reservoirs provided for the refueling floor inflatable seals (1, 2, 3, 4, 7 and 10) with safety-related functions. (See Section 9.3.1.1)

9.3.1.1 Station Air Systems

The station air systems include the instrument air system, service air system, and the condensate filter/demineralizer backwash air system and are shown in drawing M-15.

9.3.1.1.1 Design Bases

a. The instrument air system is designed to provide a continuous supply of filtered, dry, and oil-free air for pneumatic instruments and controls in the plant.

b. Each instrument air compressor unit is powered from a separate electrical bus.

c. Standby onsite power is available to the instrument air compressors, following a LOOP, to replenish compressed air storage as required.

d. The service air system is designed to provide compressed air to service air outlets located throughout the plant, to the refueling floor inflatable seals, and as a backup system for instrument air.

e. The condensate filter/demineralizer backwash air system is designed to provide oil-free air to the condensate filter/demineralizers during the backwashing operation.

f. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the compressed air systems are discussed in Section 3.2.

9.3.1.1.2 System Description

The instrument, service, and condensate filter/demineralizer backwash air systems are shown schematically on drawing M-15. Major equipment design parameters are listed in Table 9.3-1. Units 1 and 2 air systems are identical, except that the Unit 2 air distribution sequence may differ from Unit 1. Sequence of branches is not essential to the system's operation.

The instrument air system includes two identical trains, each consisting of an air intake filter/silencer, a compressor unit, an aftercooler with a built-in moisture separator, an air receiver, two parallel prefilters, a dryer, and two parallel afterfilters. Each train has its own header that branches off into the instrument air subsystems. The headers can be interconnected through a common connecting line.

During normal unit operation, the two instrument air compressors maintain their respective headers at normal operating pressures. Each compressor will automatically load or unload in response to the instrument air system demand as sensed by pressure changes in its respective air receiver. The consequences of a failure of one instrument air train is mitigated by the redundant nature of the instrument air system design. Each instrument air user or their common headers are connected to both instrument air trains and hence would be supplied by the operative instrument air train. In addition, as mentioned in Section 9.3.1.1.1.d, the service air system provides a backup to the instrument air system. The instrument air system uses nonoil lubricated air compressors (cylinders).

The Unit 1 instrument air system supplies air to common areas, except the auxiliary boiler enclosure and the administration building, which are served from the Unit 2 instrument air system. The Unit 1 instrument air system also supplies air to both Units 1 and 2 cooling towers and the chlorination/acid enclosures. The Unit 2 instrument air system also serves as a backup to the entire Unit 1 system and vice-versa. The interconnecting valves are manually operated and normally closed.

The instrument air system provides the purge medium for the primary containment gas desiccant dryers, and also serves as a backup to the primary containment instrument gas system (Section 9.3.1.3). When low pressure is sensed in the instrument gas receiver tank, the station instrument air system can be manually placed into service as a backup. Filters capable of providing filtration of particulate greater than 3.0 microns will be provided at the interconnection of the PCIG system with the instrument air system. The instrument air system is provided with desiccant dryers that dry the gas to a -40°F dew point at line pressure psig and filters that remove 100% of all particles larger than 0.9 micron in diameter. The inservice filter will be switched to the parallel filters when high differential pressure exists across the inservice filter and the spent element will be replaced. The need for desiccant replacement is indicated when the local visual moisture indicating gel turns from blue to pink. In addition, excessive dryer outlet moisture is indicated locally and alarmed in the main control room as part of the dryer trouble alarm. The quality of air in the system will be periodically monitored to ensure that it is maintained within the requirements of the most current ANSI/ISA standard, per SOER 88-01 recommendations.

The dual drying towers of the instrument air dryer package alternately remove moisture from the air stream and expel the moisture to the atmosphere on an automatic cycle. Only one prefilter/afterfilter is normally in service. When the filters become dirty, as indicated on the control panel by differential pressure and alarmed in the control room as part of the dryer trouble alarm, the air flow is manually switched to the clean prefilter/afterfilter.

The instrument air system meets the requirements of ANSI MC11.1 (1976) with the exception that allowable particulate size has been determined based on equipment supplier recommendations and engineering analysis. Most safety-related instrument air or gas users have been verified to be provided with an appropriately sized local, in-line filter connected to the user with copper or stainless steel tubing. Particulate limits for safety-related components not provided with individual filters have been investigated. After consultation with the equipment suppliers and review of applicable operating experience, it has been determined that a limit of no visible particulate (i.e., particles greater than 50 microns) will ensure long term reliable operation of the outboard MSIV and the CRD HCU. Documentation confirming this assessment has been obtained from the equipment suppliers.

Pneumatically operated valves and dampers which have a safety-related function are listed in Table 9.3-4. The valves are designed to fail in the safe position upon loss of air pressure, or are provided with local seismic Category I air reservoirs.

The instrument air system is switched automatically to the standby ac power supply during a LOOP. The compressors are tripped off the standby ac power source upon receiving a LOCA signal. One or more compressors may be restarted manually following a LOCA when diesel loadings allow.

The service air compressor serves as a backup to the instrument air compressors. A low instrument air system pressure signal automatically closes a valve in the service air system discharge header and diverts the capacity of the service air compressor to the instrument air system.

The service air system includes one 100% capacity air compressing train consisting of an air intake filter/silencer, a compressor unit, an aftercooler with a built-in moisture separator, and an air receiver for each unit plus a common backup train.

During normal plant operation the service air compressor is either running continuously or on automatic standby. On automatic standby the compressor automatically starts and stops on pressure signals. The Unit 2 service air system serves as a backup to the entire Unit 1 system and vice-versa. The interconnecting valve is manually operated and normally closed.

The Unit 1 service air system supplies air to common areas, i.e., the radwaste enclosure, water treatment enclosure, etc. Breathing air is normally supplied by the service air system. A single backup air compressor, aftercooler, moisture separator, and receiver tank (comparable to the service air compressors) can supply either Unit 1 or Unit 2 in the case of loss of service air.

The service air system also supplies air to all inflatable seals at the refueling floor of the reactor enclosures. Gas bottles of nitrogen are provided as a backup supply source for additional reliability. A gas bottle supply is automatically connected to each inflatable seal supply header when low pressure is detected in the normal service air supply line. In addition to the nitrogen bottle backup supply, a quick disconnect fitting is provided for connection to an additional gas bottle, if required. The Unit 1 & 2 inflatable seals (1, 2, 3, 4, 7 and 10) which form a secondary containment boundary are provided with a Seismic Category I backup supply source.

The condensate Filter/demineralizer Backwash Air Supply System includes two 35 cfm air compressors in each Unit that discharge to a pair of 125 cubic foot air receivers in Unit 1 and a single 250 cubic foot air receiver in Unit 2 which discharges to their respective air headers to supply backwash air to the Condensate Filter/Demineralizer vessels. These compressors can be operated manually or automatically by a signal from the Condensate Filter/Demineralizer System.

One compressor functions as the controlling compressor and the other functions as the backup compressor and they alternate functions. The air receiver is sized to provide 5130 scfm of air flow at 125 psig to backwash the condensate filter/demineralizers and is controlled by the auto-start and auto-off capabilities of the two compressors.

All of the above air system equipment is located in the turbine enclosure.

9.3.1.1.3 Safety Evaluation

The instrument, service, and condensate filter/demineralizer backwash air systems have no safety-related function other than containment isolation and secondary containment boundary. Failure of the systems will not compromise any safety-related system or component or prevent a safe shutdown of the plant. Service air lines that penetrate containment have two manual normally closed valves for containment isolation. Refer to Section 6.2.4 for details of containment isolation design features. The service, air containment penetration and isolation valves are designed to seismic Category I and ASME Section III, Class 2 requirements as defined in Sections 3.7, and 6.2.

Piping and components to the Unit 1 & 2 seals 1, 2, 3, 4, 7 and 10 are designed to Seismic Category I, ANSI B31.1, Quality Group D for secondary containment boundary as defined in Table 3.2-1. These local safety-related air reservoirs are provided with a low pressure alarm, relief protection and a check valve for automatic isolation in the event of loss of service air.

The outboard MSIV is discussed in Section 5.4.5.2.

9.3.1.1.4 Tests and Inspections

The safety-related portions of the compressed air systems are preoperationally tested in accordance with Regulatory Guide 1.68.3, as stated in Section 14.2. Compliance to Regulatory Guide 1.68.3, position C.11. is demonstrated by the following program:

a. Verification that the specific type or model of safety-related solenoid valves and pneumatic valve actuators (Table 9.3-4) have been tested by the equipment suppliers for the maximum supply system pressure resulting from credible system failures.

b. For safety-related equipment that has not been tested by the equipment supplier, the equipment will be tested onsite at the maximum supply system pressure resulting from credible system failures to ensure that there will be no loss of operability.

c. Safety-related equipment that has been tested by the equipment supplier, but 1) are rated below the maximum credible supply system pressure and/or 2) fails the test in (b) above will be replaced by equipment with a higher service pressure rating or will be provided with appropriate overpressure protection devices.

System operability is demonstrated by use during normal plant operation. In addition, a measured value of less than 40 microns will be verified to exist at several points throughout the instrument air system downstream of the dryers.

Other periodic tests, verifications and maintenance were discussed in Section 9.3.1.1.2.

9.3.1.1.5 Instrumentation Application

Instrumentation is provided for each instrument air and service air compressor train to monitor and automatically control each compressor's operation.

The compressors are tripped on the following signals: low crankcase oil pressure, high crankcase oil temperature, high cooling water discharge temperature, high air pressure in the receiver, and high outlet air temperature. These signals and excessive water levels in the instrument air aftercooler inlet drip leg are annunciated in the control room by common trouble alarms. High air temperature in the aftercooler and moisture separators, and low pressure in the air header are also alarmed in the control room. Instrumentation is also provided for each instrument air dryer package train to monitor and automatically control each dryer's operation. High moisture content in the common instrument air dryer package discharge header is indicated locally and alarmed in the control room as part of the dryer trouble alarm. Also, indicated locally and alarmed in the control room as part of the dryer trouble alarm, are high pressure differential across the filters and dryer controller trouble.

Local pressure indication is provided on each inflatable seal pneumatic supply header. Low pneumatic supply pressure is alarmed locally for each inflatable seal and is also alarmed in the control room as a trouble alarm.

9.3.1.2 Perkiomen and Schuylkill Compressed Air Systems

9.3.1.2.1 Design Bases

a. The Perkiomen Creek intake structure compressed air system provides a continuous supply of filtered air for pneumatic instruments and controls, and for service air use inside the Perkiomen Creek intake structure.

b. The Schuylkill River intake structure compressed air system provides a continuous supply of filtered air to pneumatic instruments and controls, and for service air use inside the Schuylkill River intake structure.

c. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the Perkiomen and Schuylkill compressed air systems are discussed in Section 3.2.

9.3.1.2.2 System Description

The Perkiomen and Schuylkill compressed air systems are shown schematically in drawing M-09. Major equipment design parameters are given in Table 9.3-2. The Perkiomen and Schuylkill intake structures and their related compressed air systems are common to both Units 1 and 2.

The Schuylkill compressed air system includes two identical air compressors with identical receivers, a common filter, an instrument air dryer package, instrumentation, controls, interconnecting piping, and electrical wiring. The air compressors are connected in parallel and discharge to a common header. Instrument air is supplied to the traveling water screen control panel. Service air is supplied to the grease lube pumps and chain lubricator. The compressors are operated automatically to maintain a pre-established compressor tank pressure.

The Perkiomen compressed air system includes two sets of compressors. One set contains identical control valve air compressors connected in parallel to a common header which discharges to a common air receiver tank. The tank provides air to operate the Perkiomen pump control valves. The other set includes two identical pumphouse air compressors with an air receiver, air accumulator, instrumentation, controls, interconnecting pipe, and electrical wiring. The air compressor supplies air to a receiver which is used to backwash the Perkiomen stationary intake screens. In addition, the pumphouse air compressors supply air through a small air filter to an air accumulator tank to operate the Perkiomen rotary strainer and the lube water booster pump control valves, and to service air connections.

9.3.1.2.3 Safety Evaluation

The Perkiomen Creek and Schuylkill River intake structure compressed air systems have no safety-related function. Failure of the systems will not compromise any safety-related system or component or prevent a safe shutdown of the plant.

9.3.1.2.4 Tests and Inspections

System operability is demonstrated by use during normal plant operation.

9.3.1.2.5 Instrumentation Application

Instrumentation is provided for each compressor to monitor and automatically control its operation. Low pressure in the air compressor discharge header and low pressure in the control valve air receiver are monitored and alarmed locally.

9.3.1.3 Primary Containment Instrument Gas System

9.3.1.3.1 Design Bases

a. The PCIG system is designed to provide instrument gas to the pneumatic devices located inside the drywell and suppression chamber.

b. The PCIG system is designed to provide a supply of instrument gas for long-term ADS valve operation.

c. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the PCIG system are discussed in Section 3.2.

9.3.1.3.2 System Description

The PCIG system is shown schematically on drawing M-59. Major equipment design parameters are given in Table 9.3-3. The instrument gas compressors take suction directly from the drywell atmosphere. The system, therefore, prevents a build-up of pressure in the primary containment due to pneumatic operator leakage.

The system provided for each unit consists of two full capacity trains of gas filters, compressors, aftercoolers, moisture separators, dryers, receivers, and associated piping, valves, controls, and instrumentation. Each train has its own distribution header within the primary containment.

The PCIG system meets the requirements of ANSI MC11.1 (1976) with the exception that allowable particulate size has been determined based on equipment supplier recommendations and engineering analysis. Most safety-related instrument air or gas users have been verified to be provided with an appropriately sized local, in-line filter connected to the user with copper or stainless steel tubing. Particulate limits for safety-related components not provided with individual filters (Unit 1 inboard MSIV and Unit 1 ADS SRV) have been investigated. After consultation with the equipment suppliers and review of applicable operating experiences, it has been determined that a limit of no visible particulate (i.e., particles greater than 50 microns) will ensure long-term reliable operation of each component. Documentation confirming this assessment has been obtained from the equipment suppliers.

During normal operation, one of the two instrument gas compressors is selected as the lead compressor and is automatically started or stopped in response to the instrument gas system demand. The other instrument gas compressor serves as a standby. The standby compressor starts automatically if the lead compressor fails, or if the continuous operation of the lead compressor cannot meet the instrument gas system demand. The two trains can be cross-connected via common headers. A backup to the PCIG system is provided by an intertie to the instrument air system via a normally closed valve remote manually operated from the control room. The primary containment instrument gas system uses non-lubricated cylinder type air compressors.

The cooling water supply to the compressors and aftercoolers is regulated by temperature control valves on the cooling water outlets from the compressor cylinder jackets. Valves which are operated by gas pressure in the compressor manifold allow cooling water to flow during compressor operation and shut off cooling water when the compressor stops.

The refrigeration and desiccant dryers employed in this system lower the dew point to -40°F at 100 psig. The need for desiccant replacement is indicated when the local visual moisture indicating gel turns from blue to pink. The quality of air for safety-related PCIG users will be periodically verified to meet the dew point and oil content quality specified in ANSI MC11.1 (1976). A random sample of an inboard MSIV air supply header and an ADS SRV operator manifold will be tested once each refueling cycle. The filters provided at the outlet of the PCIG desiccant dryers are designed to remove particles 3 microns and larger. These filter elements will be inspected and replaced at least on an annual basis. The PCIG system will be periodically monitored to ensure that it is maintained within the particulate limits discussed in Section 9.3.1.3.4, per SOER 88-01 recommendations.

Pneumatically operated valves which have a safety-related function are listed in Table 9.3-4. The valves are designed to fail in the safe position upon loss of gas pressure or are provided with local seismic Category I gas reservoirs.

The PCIG system provides a safety-related gas supply for the ADS valves in the event that the non-safety related normal PCIG supply equipment is unavailable. Two seismic Category 1 gas supplies (nitrogen bottles) have been provided to assure the availability of the ADS valves for long-term ECCS cooling functions and for the alternate shutdown cooling flow path for the RHR system. One set of gas bottles serves three ADS valves; another set serves the other two ADS valves. These long-term gas supplies have been designed to remain operable following a LOOP. Either set of bottles will supply the ADS valves with sufficient nitrogen for seven days of operation and must be connected at all times during normal operation(ready for automatic alignment). Limiting Conditions for Operation and Surveillance Requirements for the long-term ADS gas supplies are specified in the Technical Requirements Manual.

The gas bottle supply will automatically begin supplying the seismic Category 1 ADS valve supply header with nitrogen when low pressure is sensed in the normal PCIG supply line. Thus, although not a design objective, this gas bottle supply will act as a backup for the short-term ECCS cooling operation of the ADS valves if leakage from the ADS valve accumulator boundary is excessive. The ADS valve accumulators are described in Section 5.2.2.4. ADS valve ECCS functions are described in Sections 5.2.2 and 6.3.

A seismic Category 1 external connection is also provided outside the reactor enclosure for post-seven day operation of two ADS valves for the alternate shutdown cooling flow path described in Section 5.4.7.5.

Redundant automatic valves are provided to isolate the seismic Category 1 portion of the PCIG system from the non-seismic Category 1 portions. Redundant manual valves are provided to isolate the seismic Category 1 portions of external connections from non-seismic Category 1 components when connection is not in use.

These two gas supplies are physically separated such that no single failure can prevent the required long-term operation of the ADS valves. Loss of power to the automatic valves that align the bottle supply to the ADS valve supply headers will cause the bottles to be aligned (fail safe positions).

Instruments and controls associated with the safety-related ADS valve gas supplies are discussed in Section 7.6. Other PCIG instruments and controls are discussed in Section 7.7.

9.3.1.3.3 Safety Evaluation

The PCIG system serves a safety-related function by provision of a gas supply for long-term operation of the ADS valves in the event the normal PCIG supply is not available. All components of the long-term ADS gas supply for the minimum required two ADS SRVs are seismic Category I except for the gas bottles. These gas bottles meet DOT standards, 49CFR178.37, Specification 3AA, and Interstate Commerce Commission Specifications, and are supported with seismic Category I supports.

Long-term ADS valve operation is used when the alternate shutdown cooling flow path is used, as discussed in Section 5.4.7.5, and when long-term reactor vessel venting using the ADS valves is desired. The long-term ADS gas supply for the minimum required two SRV's takes no credit for nonsafety-related equipment or instrumentation. This system is capable of performing its function during and following exposure to hostile environments as discussed in Section 3.11. Because leakage from the ADS valve accumulators and associated gas supply piping inside the drywell is anticipated to be very small as compared to the Post LOCA Hydrogen Recombiner flowrate, the gas supplied via the external connection can be either nitrogen or dry air.

Safety-related components, such as inboard MSIVs and ADS MSRVs, are provided with gas accumulators (Sections 5.4.5.2 and 5.2.2.4) for reliable short-term operation without PCIG system operation. The accumulators, however, are not part of the PCIG system.

Instrument gas lines that penetrate containment have isolation valves that automatically close on receipt of an isolation signal except for the seismic Category I gas supply. The seismic Category I gas supply containment penetration does not close on an isolation signal. The ADS gas supply will be isolated only when the gas supply pressure outside containment decreases to 2 psi above

containment pressure. Refer to Section 6.2.4 for details of containment isolation design features. The system containment penetrations and isolation valves are designed to seismic Category I and ASME Section III, Class 2 requirements as defined in Sections 3.7 and 6.2. The system piping located inside the containment is designed to seismic Category I requirements as defined in Section 3.7, and to the Power Piping Code, ANSI B31.1 or ASME Section III, Class 3, and other standards as shown in Table 3.2-1, in the case of the long-term gas bottle supply subsystem.

Design features are also provided in the PCIG system that eliminate a potential source for radiological release during purging of the primary containment gas desiccant dryers as discussed in Section 9.3.1.1.2, and to minimize primary containment bypass leakage via the PCIG system, as discussed in Section 6.2.3.

9.3.1.3.4 Tests and Inspections

The safety-related portion of the PCIG system is tested in accordance with Regulatory Guide 1.68.3, as stated in Section 14.2. Compliance to Regulatory Guide 1.68.3, position C.11. is demonstrated by the following program:

a. Verification that the specific type or model of safety-related solenoid valves and pneumatic valve actuators (Table 9.3-4) have been tested by the equipment suppliers for the maximum supply system pressure resulting from credible system failures.

b. For safety-related equipment that has not been tested by the equipment supplier, the equipment will be tested onsite at the maximum supply system pressure resulting from credible system failures to ensure that there will be no loss of operability.

c. Safety-related equipment that has been tested by the equipment supplier, but 1) are rated below the maximum credible supply system pressure and/or 2) fails the test in (b) above will be replaced by equipment with a higher service pressure rating or will be provided with appropriate overpressure protection devices.

System operability is demonstrated by use during normal plant operation. Containment isolation valves will be tested in accordance with the requirements of Technical Specifications. In addition, although visible particulate is greater than 50 microns, a measured value of less than 40 microns will be verified to exist in the PCIG system downstream of the dryers.

Other periodic tests, verifications, and maintenance were discussed in Section 9.3.1.3.2.

The alarms and isolation initiation instrumentation associated with the ADS long-term gas supply system will be calibrated at least once per operating cycle. Leak testing of the ADS long-term gas supply system is performed by use of a surveillance test as part of the primary containment leak rate testing program. Leakage from the bottles will be monitored daily by checking bottle pressures.

9.3.1.3.5 Instrumentation Applications

Instrumentation is provided for each compressor train to monitor and automatically control each compressor's operation. Switches monitoring the following parameters trip their respective compressor: low lube oil level, high discharge gas temperature, high receiver pressure, low suction pressure, and high suction temperature. The compressors are also tripped on compressor motor

overload and loss of control power. Refrigerated dryer motor overload trips the dryer. Any compressor or refrigerated dryer trip actuates a common trouble alarm in the control room.

The condition of low instrument gas system receiver tank pressure is alarmed in the control room. The alarm is unspecific with respect to individual ADS accumulators.

The instrumentation associated with the ADS gas supply is as follows:

a. Pressure instrumentation is provided to automatically align the ADS long-term gas bottle supply to the ADS valve supply header.

b. Pressure instrumentation is installed in each of the two ADS gas supply piping branches outside containment to provide pressure indication in the control room. High or low pressure in the ADS long-term gas bottle supply header is alarmed in the control room.

c. Pressure instrumentation is provided to close the ADS gas supply containment isolation valves when system pressure decreases to 2 psi above primary containment pressure.

d. Position indication for the containment isolation valves and solenoid valves on the ADS gas supply is provided in the control room.

e. Local pressure indication is provided on each ADS long-term gas bottle supply header.

9.3.2 PROCESS SAMPLING SYSTEM

The process sampling system provides remote sampling facilities and the capability for sampling liquids of various process systems during normal plant power operation and shutdown conditions. The process sampling system is not safety-related.

Radiation monitoring of gaseous and liquid process streams is discussed separately in Section 11.5.

9.3.2.1 Design Bases

a. The portion of the process sampling system running from the RCPB to and including the first isolation valve outside the containment is constructed in accordance with ASME Section III, Class 1. Every other sample line, from the point where it connects to the process system including the first process shutoff valve (root valve), is the same classification as the system piping to which it connects. All sample lines downstream of the first isolation valve outside the containment or downstream of the root valves are in accordance with ANSI B31.1.

b. Lines connected to reactor water or main steam systems are of sufficient length to permit decay of short-lived nuclides so that sampling station personnel are not unnecessarily exposed to radiation. Additionally, shielding is installed at points on sampling piping to further curtail exposures (as described in Chapter 12) and ensure that they are kept below the limits of 10CFR20.

c. The process sampling systems are designed to ensure that representative samples of all appropriate process fluids are obtained.

d. The process sampling system is designed to permit effective line purging with a minimum loss of fluid volume.

e. The process sampling system is designed to provide the capability to conduct continuous analysis as well as to provide the facility for analysis of discrete samples (grab samples) in the laboratory.

f. The process sampling system is designed to prevent hazards to operating personnel from high pressure, temperature, or radiation levels of the process fluid during all modes of operation.

g. The process sampling systems for each unit are designed to be functionally similar, but operationally independent.

h. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the process sampling system are discussed in Section 3.2.

9.3.2.2 System Description

The process sampling system is illustrated schematically on drawing M-23. Locations of sample points are shown on the appropriate system P&IDs for the systems to be sampled. The process sampling system consists of sampling lines, valving, sample coolers, sample sinks, instrumentation, and analyzers.

Sampling stations are located in the water treatment area, yard area near the cooling towers and in the reactor, turbine, auxiliary boiler, and radwaste enclosures. The liquid radwaste collection sample station and the auxiliary boiler sample station are common for Units 1 and 2. The reactor and turbine enclosure sample stations are operationally independent systems with the following exception: the condensate transfer pumps discharge sample and the refueling water pumps discharge sample are located on the Unit 1 turbine station.

The reactor and turbine enclosure stations are equipped with analyzers that continuously monitor the critical parameters in the samples drawn from process lines. Portable instruments are used for periodic calibration of the analyzers. Grab samples may be taken periodically from each point at each station to determine chlorides or other constituents. When working with grab samples, the operator is protected by a fume hood that exhausts through the ventilation duct-work. The reactor, turbine and radwaste enclosure sampling stations are provided with demineralized water for washdown.

Sample flow rates to the monitors are adjusted to provide the following:

a. Ensure turbulence in the sample line to prevent plateout of radioactive materials

b. Minimize lag time to monitors

c. Slow the sample flow rate as required for the decay of radioactive nitrogen prior to entering the stations

d. Minimize the waste of high purity water and input to the radwaste system

Representative samples are drawn from process lines by sample nozzles extending into the pipe. Sample lines are as short as possible, consistent with the length required for radioactive decay, avoiding traps, dead legs, and dips upstream of the sample stations. The connecting tubing is sized for optimal flow rates to the stations.

At each station, samples are adjusted for pressure and temperature as required by the monitoring instruments and for the operators' safety. The individual sample coolers provide samples for measurement at the reference temperature of 25°C. Deep bed condensate demineralizer system (DBCDS) turbine enclosure sample waste is returned to the hotwell make-up reject line. All other turbine enclosure sample waste is returned to the condensate drain tank except for the condensate pumps discharge sample sink which grains into the dirty radwaste drains. All other sample wastes are returned to the radwaste collection system except for the auxiliary boiler sample waste, cooling tower sample waste, and the high pressure condenser circulating water sample waste, which are returned to the normal waste system.

Tubing arrangement within the sample stations for selected sample lines susceptible to contamination allows purging into the sample sink or sink drain header by connecting the demineralized water hose to the grab sample outlet while shutting off the sample inlet valve. Tube fitting leakages are contained by a catch basin or sink.

9.3.2.3 Safety Evaluation

The process sampling system has no safety-related function. Failure of the system will not compromise any safety-related system or component, or prevent a safe shutdown of the plant. The process sampling lines, connected to the RCPB through the first isolation valve outside containment, are designed to seismic Category I requirements as defined in Section 3.7. Process sampling lines connected to other seismic Category I components are seismic Category I from the component through the first normally shut valve.

Sample lines that penetrate the containment are provided with isolation valves in accordance with GDC 55, as described in Section 6.2.4.

9.3.2.4 Testing and Inspection

The system will be preoperationally tested in accordance with the requirements of Chapter 14. System operability is demonstrated by use during normal plant operation.

9.3.2.5 Instrumentation Applications

Temperature and flow indicators are used to facilitate manual operation and to verify sample conditions before samples are drawn.

The DBCDS analytical variables are entered into the DBCDS PLC computers located in the radwaste control room. All other analytical variables are recorded at the sample stations or in the control room. The main variables pertaining to the quality of the reactor coolant are entered into the station computer. All monitored variables have alarm trips that signal when preset limits have been exceeded. DBCDS common trouble alarm is transmitted to the radwaste control room.

DBCDS effluent high conductivity alarm and other common trouble alarms are transmitted to the control room.

9.3.3 PLANT DRAINAGE SYSTEMS

The plant drainage systems consist of the equipment and floor drainage radwaste systems, the normal waste system, the oily waste system, the acid waste system, the storm drainage system, and the sanitary waste system.

The equipment and floor drainage radwaste system, shown in drawing M-61, is the only drainage system which transfers potentially radioactive liquid wastes, and is described in detail in this section. The remaining drainage systems are also briefly described in this section. The plant drainage systems have no safety-related function except for the containment penetrations and the drywell boundary extension of the drywell drainage system.

9.3.3.1 Design Bases

a. The equipment and floor drainage radwaste systems serve the following major structures and enclosures: primary containment, reactor enclosure, turbine enclosure, and radwaste enclosure. Plant general arrangement is shown in drawings C-2, M-110, M-111, M-112, M-113, M-114, M-115, M-116, M-117, M-118, M-119, M-120, M-121, M-122, M-123, M-124, M-125, M-126, M-127, M-128, M-129, M-130, M-131, M-132, M-133, M-134, M-135, M-136, M-137, M-138, M-140, M-141, M-142, M-143, M-144, M-145, M-146, M-388, M-389, and M-390. Nonradioactive drainage systems are provided for the collection and disposal of storm drainage, sanitary waste, oily waste, acid wastes, and normal waste.

b. The plant drainage system is designed to collect waste liquids from their points of origin and transfer them to a suitable processing or disposal area.

c. The plant drainage system is designed to handle the maximum anticipated influent without overflowing.

d. The plant drainage systems are designed and arranged to preclude inadvertent transfer of radioactive or potentially radioactive fluids to nonradioactive systems.

e. The drywell floor and equipment drain sumps, and the associated containment penetrations and instrumentation are designed to seismic Category I and quality group B requirements.

f. Vent lines from sumps containing potentially radioactive wastes are connected to filtered ventilation systems.

g. The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the plant drainage systems are discussed in Section 3.2.

9.3.3.2 System Description

9.3.3.2.1 General Description

The plant drainage systems that provide for collection of various liquid wastes are listed below:

a. Equipment and floor drainage radwaste systems:

   1. The liquid radwaste, collection subsystem collects potentially radioactive, liquid wastes from equipment and floor drainage of the primary containments, the reactor, turbine, and radwaste enclosures, and the control structure. All such drainage is conveyed by gravity to sumps within the respective enclosures and pumped from there to the collection tanks, except for the drywell sumps which are gravity drained to the respective collection tanks.

   2. The chemical waste collection subsystem collects corrosive, potentially radioactive liquid wastes from the washdown areas, floor and equipment drain filters, condensate and fuel pool filter/ demineralizers, laboratory drains, radwaste enclosure decontamination shower, and other miscellaneous sources in the turbine and radwaste enclosures. Nonradioactive, high conductivity wastes from the condensate demineralizer cell cooling coil drains and the RECW system drains from Units 1 and 2 are also collected by this system. Liquid wastes from the hot maintenance shop are collected in the shop sump and pumped to the chemical waste subsystem.

   3. The laundry waste collection subsystem collects rain water from within the yard dikes for CST tanks (Units 1 & 2) and Refueling Water Storage Tank.

   4. Treatment of the above wastes is discussed in Section 11.2.

b. Nonradioactive liquid wastes:

   1. Oily waste drainage systems collect liquid wastes from the nonradioactive equipment areas in which oil is expected to be present. These areas include, turbine enclosures, the circulating water pump structure, diesel generator enclosures, transformer areas, lube and diesel oil storage tank areas, oil unloading areas, and the auxiliary boiler enclosure.

   2. Acid waste drainage systems collect liquid wastes possibly containing nonradioactive chemicals and corrosive substances from the water treatment enclosure.

   3. Storm drainage systems collect water resulting from precipitation on enclosure roofs and areaways, and paved and unpaved surface areas outside the enclosures.

   4. The normal waste system collects liquid wastes from the nonradioactive equipment and floor drains, and is routed to the holding pond. Two parallel 750 gpm gravity differential oil separators, located immediately upstream of the holding pond, treat all flows entering the holding pond except for floor drainage from the holding pond treatment enclosure, cooling tower blowdown water flow and diverted power block roof and yard storm drains which are routed directly to the holding pond. If necessary,further treatment at the holding pond includes oil separation.

5. The sanitary drainage system collects liquid wastes and entrained solids discharged by all plumbing fixtures located in areas with no sources of potentially radioactive wastes and conveys them to a public sanitary sewage collection and treatment system. The drainage system may also be temporarily diverted to an on-site holding tank in the event isolation from the public sewer system becomes necessary. Drawing C-47 shows the yard drainage piping for the sanitary waste system.

The plant drainage systems consist of collection piping, equipment drains, floor drains, vents, traps, cleanouts, collection sumps, sump pumps, tanks, and instrumentation.

The arrangement is such that the open nonradioactive drain systems serve only nonrestricted areas where no radioactivity potential is present, exclusive of the lavatory wastes in the access control areas that are collected by the sanitary waste systems.

The plant areas with nonradioactive waste floor drains were reviewed for the potential for radioactive fluid to enter. The nonradioactive systems floor drains are either located in separate compartments and/or separated by curbs from the nearest radwaste drains, except as discussed below.

The following areas have normal waste or oily waste and radwaste drains located near one another, without curbs or other liquid barriers:

Area	Elevation	Drains	Description
1, 5	269	oily waste/ radwaste drains	Turbine Deck
8	304	normal waste/ radwaste drains	Control Room HVAC Area
6, 7 9, 10	302	normal waste/ radwaste drains	Turbine Enclosure HVAC Area
22	257	normal waste/ radwaste drains	Radwaste Enclosure HVAC (supply) Area
15, 16 17, 18	313	storm drains/ radwaste drains	Reactor Enclosure/ Refueling Area HVAC (supply) Area

Plugs are installed in all normal waste or oily waste floor drains in the first four of the above areas to prevent radioactive fluids from entering the nonradioactive drainage system. These plugs will be removed only for equipment maintenance or cleaning purposes. Plugs are installed in the radwaste drains located near storm drains in the last above area to maintain secondary containment integrity. The storm drains in this area are normally diverted to the holding pond where any inadvertent leakage of Drywell Chilled Water supplying the fan cooling coils can be held up for decay of trace amounts of Na-24 which may be present.

Rooms north of column lines N, at either end of the turbine enclosure (Areas 1, 5, el 217') have floor drains to oily waste. Three condensate lines (feedwater heater drains) are routed through the overhead of the compartments in separate, steel shielded pipe chases. In the unlikely event of a pipe failure, condensate could flow onto the floors of these rooms, and into air compressor rooms 328 and 357. For this reason, plugs have been installed in all oily waste floor drains of these four rooms. These plugs will be removed only for equipment maintenance or cleaning purposes.

In the event unidentified liquids collect at the location of a plugged floor drain, the collected liquids will be sampled to determine radioactive content prior to opening the floor drain or otherwise processing or disposing of liquids.

The drainage sources and expected inputs from areas of potential radioactivity are shown in Table 11.2-6.

9.3.3.2.2 Component Description

Components of the plant drainage systems are described in the following paragraphs. Major components and design parameters are listed in Table 9.3-5.

All plumbing and drainage systems are installed in accordance with ANSI A40.8, National Plumbing Code, and applicable local or state codes.

In areas of potential radioactivity, the collection system piping for the liquid system is carbon steel. Potentially radioactive laboratory and decontamination waste, regeneration waste, and detergent waste collection system piping is stainless steel. The fabrication and installation of the piping provides for a uniform slope which induces waste to flow in the piping at a velocity of not less than 2 ft/sec. Equipment drainage piping is terminated approximately 6 inches above the finished floor or drain receiver at each location where the discharge from equipment is to be collected. The final connections are made after the equipment is installed in its proper location.

All floor drains are installed with rims flush with the low point elevation of the finished floor. Floor drains in areas of potential radioactivity are welded directly to the collection piping and are threaded to permit the installation of threaded plugs, with the exception of the drains listed in Section 9.3.3.2.1, which are provided with friction-type plugs. The plugs may be used to seal off the floor drains for pressure testing of the drainage system. They may also be installed to prevent aspiration of radioactive particulates between compartments or installed in designated floor drains of the turbine building to prevent intrusion of EHC fluid or other undesirable fluids. They can also be installed in nonradioactive floor drains to prevent radioactive fluid from entering into the normal waste system.

Inlets to all drainage systems (except radwaste and storm drain systems) are provided with a vented P-trap water seal to minimize entry of vermin, foul odors, and toxic, corrosive, or inflammable vapors into the enclosure, unless an evaluation has been performed which determined such vented P-traps to be unnecessary. Vent lines to the outside atmosphere are provided downstream of the P-traps to prevent excessive back pressures that could cause blowout or siphoning of the water seal. Traps are not installed on radwaste system inlets in order to reduce the accumulation of radioactive debris.

Cleanouts are provided (when practicable) in all collection system piping where the change of direction is 90^{o} or at maximum intervals of 50 feet in horizontal piping runs. Cleanouts for the potentially radioactive collection systems are welded directly to the piping.

Potentially radioactive collection sumps are provided with a fitted checker plate access cover for convenient maintenance access. All sumps except for the drywell are recessed in concrete and are located at the lowest elevation of the area served. The drywell sumps are located below the drywell slab. Each turbine, reactor, and radwaste enclosure and the hot maintenance shop sump is fitted with a vent pipe to exhaust potential sump gases to a ducted, filtered, enclosure exhaust system. The drywell sumps vent back into the drywell. Floor drain sumps in the reactor, turbine,

and radwaste enclosures and the hot maintenance shop are provided with traveling belt-type oil removal equipment.

The drywell equipment drain sump and the reactor enclosure equipment drain sump are provided with cooling coils to keep the wastes at or below a temperature of 140°F.

The sanitary drainage system is normally aligned to the public sewer system. The on-site sewage treatment and retention system is not used, but the equipment remains intact and serves as a backup collection and holding system in the event the public sewer system cannot be used. Drawing M-6389 shows the mechanical and structural components of the on-site sewage treatment and holding facility.

9.3.3.2.3 System Operation

The various floor and equipment drains drain directly to the appropriate collection point by gravity. Radwaste collected in the drywell floor drain sump (tank) and drywell equipment drain sump (tank) is gravity drained to the liquid radwaste system for processing. Sump discharge valves automatically open on a predetermined sump high level and close on a predetermined sump low level. All other radwaste collection sumps are provided with sump pumps that automatically start on a predetermined sump high level and stop on a predetermined low level. Sump discharge is pumped to the liquid radwaste system for processing. The drywell equipment drain sump and the reactor enclosure equipment drain sump are equipped with cooling coils.

Leakage inside the drywell drains to the drywell floor drain sump (except for piped valve and pump seal leak-offs and piping vents and drains which are routed to the drywell equipment drain sump).

Washdown of liquids to the plant radwaste floor drains will be administratively restricted to limit introduction of oils and other organic compounds to the radwaste system. Most oils that enter the area floor drain sumps are removed from the sump liquids before they can be transferred to the radwaste system. Sump pump setpoints are chosen to prevent pump-down of the top several inches of the sump contents, including any oils or other organic compounds collected on the surface of the sump liquid. Sumps are routinely inspected for presence of oils. Traveling belt-type oil removal equipment is provided and operated as necessary in the sumps to ensure that accumulated oils are not transferred to the radwaste system. Oils removed by the belts are gravity drained to a collection drum for disposal. Other organic compounds present in the sump liquid and not removed by the oil removal equipment are transferred with the dirty radwaste to the floor drain collection tank for processing (Section 11.2.2.1). Treated waste is collected in sample tanks, mixed by recirculation, and sampled. The treated waste is recycled to the condensate storage tanks for reuse only when samples indicate that it meets condensate storage water quality specifications. Treated waste that contains unacceptable levels of organic compounds is not transferred to the condensate storage tanks, but reprocessed in the liquid radwaste system or discharged from the plant.

The storm drainage system collects water resulting from precipitation on enclosure roofs and areaways, paved and unpaved surfaces, and irrigation runoffs outside the enclosures, and conveys it to Possum Hollow Run and the Schuylkill River. A Drain/Dewatering line has been added to aid in Condenser draining during outage periods. This line ties into the storm drainage system.

Five 150 gpm oil interceptors are installed in yard areas to intercept accidental oil spills near the points of oil storage and use. Effluent from the oil interceptors, as well as other normal waste drainage, is routed to the holding pond via two parallel 750 gpm oil separators.

Equipment drains that have the potential for oil contamination are gravity drained to the oily waste drainage system. This system drains through an oil intercepter to the oily waste sump. The separated water is drained to the normal waste sump and is pumped from the sump to the 5000 gallon normal waste holding tank. The reactor feed pump turbine lube oil reservoirs are enclosed within curbed areas, which are drained to the oily waste sump through oily waste plumbing. The main turbine lube oil reservoir and the lube oil storage tanks are enclosed within diked areas, which can be drained directly to the 7500 gallon oily waste holding tank. All the waste oil collected in the oily waste sump is transferred to the holding tank for transport offsite.

The acid waste system collects liquid waste possibly containing chemicals and corrosive substances discharged by laboratory fixtures, accidental spills and demin water sampling equipment. The acid waste system also serves the drains which are located in the water treatment enclosure, and conveys the liquid waste directly to the chemical waste sump. With the retirement of the demineralizer trains, chemical and corrosive discharges to the acid waste system chemical waste sump have been virtually eliminated.

The liquid wastes in the chemical waste sump will be pumped to the water treatment enclosure sump. Clarifier blowdown, filter backwash, and other floor drainage in the water treatment enclosure are also routed to the water treatment enclosure sump. Discharge of the water treatment enclosure sump is directed to the setting basin. The settling basin effluent is routed to the holding pond.

The connection to the public sewer system is sized to carry the maximum anticipated sewage flow from the site. The on-site sewage treatment and storage facility will be operated only in the event that the public sewer system is not available or if sampling of the LGS sewage discharge indicates the presence of radiological contaminants. An isolation valve in the primary discharge line allows flow to be diverted to the on-site collection system. Sewage collected in the holding tanks may be transported via truck to an alternate public sewage treatment facility. Alternate methods of dealing with sewage treatment and disposal may be implemented as long as the method is analyzed to ensure compliance with State and Local requirements for sewage disposal.

9.3.3.3 Safety Evaluation

Except for the containment penetrations and the drywell boundary extension of the drywell drainage system, the plant drainage systems have no safety-related function. The containment penetrations are designed to seismic Category I and quality group B requirements, and are discussed in Section 6.2.4.

To provide assurance that the floor drain and equipment drain sump pumps do not automatically transfer water to the radwaste enclosure, these pumps are tripped on a containment high radiation signal.

If prolonged isolation of the sumps is necessary, the sump contents can be pumped to the suppression pool via a small pipe intertie. Operator actions necessary to change the valve lineup and restore pump operation are performed in accessible locations outside the reactor enclosure.

The liquid radwaste equipment and floor drain sumps are located within the primary containment (drywell), reactor enclosure, turbine enclosure, control structure, administration building (hot maintenance shop) and radwaste enclosure. As discussed in Section 9.3.3.2.2, the sumps are

located at the lowest elevation in the respective structure to provide gravity drainage from all elevations.

The liquid radwaste from the drywell floor drain sump and drywell equipment drain sump is gravity fed down to the radwaste enclosure to the floor drain and equipment drain collection tanks, respectively. Backflooding from these drywell sumps could cause flooding on the drywell floor slab, which would be drained through the downcomers to the suppression pool. All safety-related equipment in the drywell is located above the floor slab and therefore is not subject to the effects of flooding.

The equipment and floor drain sumps are designed to remove floodwater from enclosures containing safety-related equipment such that the capability to achieve safe shutdown would not be compromised. Flooding due to a HELB or moderate energy line break is addressed in Section 3.6.1.

Credit is not taken for the operability of any nonseismic Category I plant drainage system piping, equipment and instrumentation in ensuring the safe shutdown of the plant, mitigating the consequences of an accident, or ensuring that offsite doses do not exceed 10CFR50.67 limits.

The loss of integrity of all nonseismic Category I piping, equipment and instrumentation due to a SSE is not credible and therefore the flooding which may accompany this type of failure is not explicitly included in the design basis for LGS. Studies have indicated that earthquakes do not cause significant piping failures (Reference 9.3-1).

There are no nonseismic Category I piping, equipment and instrumentation in the ECCS compartments which are fluid filled during normal operations. Even so, all nonseismic Category I piping, equipment and instrumentation in the ECCS compartments, including check valves and drain lines, have been assessed for SSE loads to verify that their integrity will be retained.

Although it is not expected that any materials in the ECCS compartments could cause the drains to become plugged, plugging of any single ECCS compartment drain would not impact safe shutdown. Flooding of any single ECCS compartment will not cause the failure of more than one redundant safety-related train.

In the event of drain line plugging in other areas of the plant, floodwaters would be drained to the lower elevations of the plant via stairwells, elevator shafts and equipment hatches.

As discussed above, significant flooding due to the failure of piping, equipment and instrumentation in the reactor enclosure is not expected. However, in the event that significant quantities of water are conveyed to the sumps at el 177', backflow into the ECCS compartments is prevented by the inclusion of a check valve where the dedicated drain line from each ECCS compartment (2 per RHR compartment) terminates in the sump. Each ECCS compartment is provided with separate drain lines from the compartment to the sump. Thus, failure of any check valve will not result in flooding of more than one ECCS compartment. An assessment has been performed to verify the ability of the check valves to remain functional following an SSE.

All nonseismic Category I piping, equipment and instrumentation in the reactor enclosure (including the check valves in the sump) have had 10CFR50, Appendix B quality assurance criteria applied to them commensurate with their importance to safety:

a. Each item has been assessed to verify that it will retain its integrity during and following an SSE.

b. The check valves have been designed to remain operable for an SSE.

c. Installation was performed by the same craftsmen and qualified welders as those installing Q-list systems.

d. Quality control inspections of the installation were conducted in accordance with criteria similar to the criteria for inspections of Q-list systems.

The check valves on the ends of the ECCS compartment drain lines and the portions of the ECCS compartment drain lines between the sump pit wall and the check valves will be placed on the Project Q-List to ensure that maintenance activities and any modifications will be performed in accordance with the applicable requirements of 10CFR50, Appendix B.

The seismic Category IIA drain lines which run through the ECCS compartments will be identified in an appendix to the Project Q-List to ensure that any maintenance of or modifications to these drain lines will employ the level of quality assurance necessary to retain their seismic Category IIA classification.

The reactor enclosure sump is located adjacent to the ECCS pump compartments at el 177'. Each ECCS compartment is provided with a separate drain line to the reactor enclosure sump inlet header. In addition, each ECCS compartment is provided with watertight walls, floors, and doors to prevent flooding of multiple ECCS compartments. Flooding of multiple compartments by backflow from the sump through the drain system is prevented by check valves or plugs installed in the drain lines.

A piping failure in an ECCS compartment could flood both the ECCS compartment and the sump room and adjoining corridor. Level instrumentation is installed and alarms provided in the control room to alarm on high water level in the ECCS compartment. If the level instrumentation should fail, the loss of one ECCS compartment is an acceptable consequence of flooding due to equipment separation.

Backflooding from the reactor enclosure sump room up to el 201' is highly unlikely. Water entering the sump room and adjoining corridor through openings in the sump cover plate must fill the sump room before backing up onto an upper elevation. Because the sump room is large, sufficient time will be available to isolate the leak before filling the compartment.

Analysis of the reactor enclosure sumps and the drywell tank drainage systems has determined that the drywell floor drain tank and the drywell equipment drain tank will drain in less than 10 minutes regardless of whether one or two of the respective reactor enclosure drain sump pumps are running. Worst case drain times are adequate to ensure that reactor coolant pressure boundary leak detection capability is maintained consistent with Regulatory Guide 1.45 guidelines. As a result of the automatic drywell tank drain during reactor enclosure sump pump operation, unacceptable flooding is avoided.

Failure of the equipment and floor drain sumps in the turbine enclosure and in the control structure will not cause flooding damage to safety-related compartments because all safety-related equipment is located at higher elevations and the sump rooms are sufficiently large to allow enough time to isolate the leak before filling the compartments. The turbine enclosure and control

structure share the same equipment and floor drain sumps on el 180' of the turbine enclosure. The lowest elevation of the turbine enclosure and control structure that contains safety-related equipment is el 200'.

Flooding due to failure of the equipment and floor drain sumps in the radwaste enclosure is of no consequence because the radwaste enclosure does not contain any safety-related equipment.

9.3.3.4 Tests and Inspections

All waste collection piping is tested prior to its embedment in concrete. Potentially radioactive drainage piping is pneumatically tested to 20±5 psig air for a minimum of 10 minutes, in accordance with ANSI B31.1 (1973). When in-place pressure testing is not practical, the tie-in welds will be examined via NDE per ANSI B31.1. Nonradioactive oily, acid, sanitary, and storm drainage piping is hydrostatically tested to the equivalent of a 10 foot head of water for a minimum of 15 minutes. The operability of the plant drainage systems is checked by normal use and by the instrumentation provided in the sumps and the control room.

9.3.3.5 Instrumentation Application

High and low level switches are provided in each sump to start and stop the sump pumps automatically. A separate level switch set at a higher level is provided to start the second pump.

The levels in the drywell floor and equipment drain sumps are alarmed in the control room. Levels on all other sumps are alarmed locally.

Flow from the drywell sumps is totalized each time a sump tank drains, and an alarm is actuated in the control room when a predetermined excessive volume is exceeded. All other radwaste sumps have automatic timers on the sump pumps to record the total cumulative run time for the pumps, and thus provide a means to determine the flow rate from each sump. The temperatures in the drywell and reactor enclosure equipment drain sumps are indicated and alarmed in the control room. Sight flow glasses are provided in nonembedded radwaste piping to aid in identifying the source of any excessive leakage.

9.3.4 CHEMICAL AND VOLUME CONTROL SYSTEM

Not applicable to boiling water reactors

9.3.5 STANDBY LIQUID CONTROL SYSTEM

9.3.5.l Design Bases

The SLCS has a safety-related function and the components required to meet that function are designed as a seismic Category I system. It meets the following design bases:

a. 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.

b. 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 margin, to assure complete shutdown from the most reactive condition at any time in core life.

c. 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. However, its performance ensures compliance with the criteria imposed for the postulated events of anticipated transients without scram.

d. 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. Demineralized water, rather than the actual neutron absorber solution, can be injected into the reactor to test the operation of all components of the system.

e. The neutron absorber will be dispersed within the reactor core in sufficient quantity to provide a reasonable margin for dilution, leakage, and imperfect mixing.

f. 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 is minimized.

g. The system shall be capable of injecting sodium pentaborate into the reactor vessel to maintain the suppression pool water inventory at a pH of 7.0 or higher following a LOCA.

9.3.5.2 System Description

The SLCS (drawing M-48) is designed to be manually initiated from the control room to cause a sodium pentaborate solution to be pumped into the reactor if the operator determines that the reactor cannot be shut down or kept shut down with the control rods.

The SLCS is also designed to be manually initiated from the control room to pump sodium pentaborate into the reactor within 13 hours of the onset of a large break LOCA to maintain suppression pool pH at a level of 7.0 or higher. (Ref. 9.3-4)

The SLCS is also automatically initiated upon receipt of a signal from the RRCS logic. The sodium pentaborate solution is injected through the core spray line and sparger, which is used by the HPCI system. With two pumps operating, the SLCS can begin to deliver the control liquid to the Core Spray line within about 53 seconds after actuation. The actuation signal starts the two in-service pumps and actuates the associated explosive valves. However, the SLCS is not expected to be actuated because the CRD system, backed up by the ARI design, can shut down the reactor when required. Low vessel water level (level 2), high vessel pressure, or manual initiation of the RRCS starts a timer. If the core power is not downscale at the end of a predetermined time-delay, the SLCS injection as described above is initiated.

The boron solution tank, the test water tank, the three positive displacement pumps, the three explosive valves, the motor-operated stop-check shutoff valve, and associated local valves and controls are located in the reactor enclosure. The solution is pumped into the core spray line

downstream of the air-operated testable check valve that leads to sparger B. It is sprayed radially over the top of the core (Sections 3.9.3, 3.9.5, 5.3, and 6.3.2).

The boron absorbs thermal neutrons and, when present in sufficient quantity in the reactor, will cause the reactor to become subcritical.

The specified neutron absorber solution is an aqueous solution of sodium pentaborate decahydrate ($Na_2B_{10}O_{16}\bullet 10H_20$). It is prepared by dissolving either sodium pentaborate decahydrate or stoichiometric quantities of borax and boric acid in the SLCS tank with demineralized water so that the solution fills the tank to at least the low level alarm point. The solution can be diluted with water to allow for evaporation losses or to lower the solution saturation temperature, provided that solution concentration requirements are met. 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.

Whenever the reactor is critical, the SLCS is able to deliver enough sodium pentaborate solution into the reactor to ensure reactor shutdown.

The minimum temperature of the solution in the tank and piping is consistent with that obtained from Figure 9.3-7 for the solution temperature. The saturation temperature is about 60°F with the solution at the recommended concentration of 13.4%. (Figure 9.3-7). Refer to Technical Specification 3/4.1.5 and Figure 3.1.5-1 for SLCS Boron-10 weight, sodium pentaborate concentration and temperature limits. The equipment containing the solution is installed in an area in which the air temperature is designed to be maintained within the range of 65ºF to 106ºF. An electrical resistance heater system consisting of a cycling heater, a mixing heater, and heat tracing provides backup heat sources to prevent precipitation of the sodium pentaborate from solution. The cycling heater is rated at 10 kW and operates automatically between 75°F and 85°F. The mixing heater is rated at 40 kW, is manually operated, and is used to facilitate chemical mixing. Heat tracing with automatic temperature control is provided between the storage tank and pump inlet to prevent sodium pentaborate precipitation in the pipe. Any portion of the electrical resistance heater system can be removed from service without affecting operation of the SLCS, as long as the temperature of the solution in the tank and heat traced piping remains above 70°F. High or low temperature, or high or low liquid level, causes an alarm in the control room.

The upper limit concentration of 13.8% has been established as a reasonable limit to prevent precipitation of the sodium pentaborte in the event of a loss of tank heating, which will allow the solution to cool.

Each positive displacement pump is sized to inject the solution into the reactor at 43 gpm. The pump and system design pressure between the explosive valves and the pump discharge is 1400 psig. The setpressure for the three relief valves is set at approximately 1400 psig. To prevent bypass flow from one pump, in case of relief valve failure in the line of another pump, a check valve is installed downstream from each relief valve line in the pump discharge pipe. An accumulator is installed downstream from each pump to damp out pump pulsations.

The three explosive actuated injection valves provide assurance of opening when needed, and ensure that the solution will 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 that 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 control room if either circuit opens. Indicator lights show which primary circuit opened.

The SLCS is actuated by a three-position, key-locked switch on the control room console. This ensures that switching from the NORMAL position is a deliberate act. If the switch is in the RUN position and the storage tank level is above the zero level setpoint, the pump will start and the corresponding explosive actuated valve will open. In addition, a signal is sent to close RWCU isolation valve to prevent the loss or dilution of the control liquid.

A green light in the control room indicates that power is available to the pump motor contactor and that the contactor is de-energized (pump not running). A red light indicates that the contactor is energized (pump running).

Storage tank liquid level, pump discharge pressure, and loss of continuity on the explosive valves indicate that the system is functioning. Local switches are provided for testing the SLCS pumps. There is a keylocked Normal/Test switch, a pushbutton start switch and a pushbutton stop switch. These switches do not prevent the pumps from being started by the RRCS or manually from the control room when SLCS injection is needed. Pump discharge pressure, tank solution level, valve injection status, and Lo-Lo level alarm are indicated in the control room. The SLCS pump can be shut off from the control room by positioning the switch in the stop position. Manual shutoff is possible even when an automatic RRCS signal is present. The pumps are shut off automatically at tank zero level using two-out-of-two logic for each pump.

Equipment drains and tank overflow are not piped to the radwaste system, but to separate containers (such as 55 gallon drums) that can be removed and disposed of independently of the radwaste system to prevent any trace of 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 9.3-6 contains the process data for the various modes of operation of the SLCS. Seismic category and quality class design criteria are included in Table 3.2-1. System testing requirements are discussed in Section 9.3.5.4. Environmental conditions for the SLCS are described in Section 3.11.

9.3.5.3 Safety Evaluation

The SLCS 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.

The SLCS is also a chemical control system and is required to be operable whenever the potential for a LOCA exists. The addition of sodium pentaborate to the suppression pool maintains the pool pH at a minimum of 7.0 to minimize iodine releases from primary containment. SLCS pumps sodium pentaborate to the reactor vessel, where it is mixed with the reactor coolant which flows to the suppression pool through the LOCA pipe break. The SLCS addition must occur within 13 hours following a LOCA to ensure pH is maintained at 7.0 or above.

To ensure the availability of the SLCS, three sets of the components including necessary instruments and control logic devices are used in parallel redundancy to actuate the system active redundant mechanical components (such as pumps and explosive valves).

The system is designed to bring the reactor from rated power to a cold shutdown condition at any time in core life. The reactivity compensation provided will 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.

The minimum average concentration of natural boron required in the reactor core to provide adequate shutdown margin, after operation of the SLCS, is 660 ppm (parts per million), or the equivalent concentration of enriched boron. With the use of enriched boron having a minimum boron-10 enrichment of 29 atom percent, the minimum weight of boron-10 available for injection into the reactor is 185 lbs. This quantity is based on the equivalent average concentration of natural boron (660 ppm) in the reactor coolant (including RHR system in the shutdown cooling mode and recirculation loops), at 68°F with vessel water level at level 8. This result includes an increase of 25% to allow for imperfect mixing and leakage.

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 approximately 6 hours to bring the vessel to subcooled conditions. The maximum concentration of boron is required after xenon concentration reaches zero at the subcooled conditions.

The boron injection capability of the SLCS meets the requirements of the ATWS Rule (10CFR50.62) in conjunction with the new rod line developed for the ARTS/MELLLA program. As a result of this program it is determined that the boron-10 enrichment was required to be increased to a minimum of 29 atom percent to prevent exceeding a maximum suppression pool temperature of 190°F. Compliance with the ATWS Rule is demonstrated by periodic verification that the actual solution concentration, boron 10 enrichment, and pumping capacity satisfy the following equation:

$$\frac{C}{13\%\text{ wt.}} \times \frac{E}{29\text{ atom }\%} \times \frac{Q}{86\text{ gpm}} \geq 1$$

where:

C = Sodium pentaborate solution concentration (% by weight)
Q = Two-pump flow rate (gpm)
E = Boron 10 enrichment (atom % Boron 10)

The SLCS equipment essential for injection of neutron absorber solution into the reactor and for suppression pool pH control is designed as seismic Category I (Chapter 3). Evaluation of the SLCS with respect to the following areas is discussed in separate sections as indicated:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5

d. Protection against dynamic effects associated with the postulated rupture of piping — Section 3.6

e. Environmental design — Section 3.11

f. Fire protection — Section 9.5.1

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 ac power supplies. Redundant components are powered and controlled from separate buses and circuits so that a single active failure of a power supply does not prevent system operation. The storage tank heaters are non-safeguard loads powered from safeguard buses and are tripped on a LOCA signal. The heaters can be manually re-energized after 10 minutes if required.

The SLCS pumps have sufficient pressure margin, up to the system relief valve set pressure 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 1170 psig. Therefore, the SLCS positive displacement pumps cannot overpressurize the nuclear system.

Only one of the three SLCS pumps is needed to meet the design basis of Section 9.3.5.1. Two pumps are required to meet the requirements of the ATWS Rule (10CFR50.62). If a redundant component (e.g., one pump) is found to be inoperable, there is no threat to shutdown capability, and reactor operation can continue during repairs.

The SLCS is evaluated against the applicable GDC as follows:

a. GDC 2 and GDC 4: Refer to Sections 3.3, 3.4, 3.5, 3.6 and 3.11.

b. GDC 21: GDC 21 is applicable to protection systems only. The SLCS is a reactivity control system and should be evaluated against GDC 29 (see below).

c. GDC 26: The CRD system provides reactivity control under normal operation and anticipated operational occurrences The system is capable of holding the core subcritical under cold shutdown conditions. The recirculation flow control system is capable of accommodating reactivity changes during normal operation conditions (power changes and xenon burnout) . The SLCS provides an independent capability for achieving cold shutdown should the normal reactivity control by control rod drive system become inoperable. These systems, taken together, satisfy the requirements of GDC 26.

d. GDC 27: This criterion applies no specific requirements to the SLCS and therefore is not applicable. See Section 3.1 for discussion of combined capability.

f. GDC 29: The SLCS consists of three redundant pumps and injection valve loops. The SLCS also has test capability. A special test tank is supplied for providing test fluid for a 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 injection squib valves. A system level, qualitative-type

FMEA evaluation, relative to this system's ability to meet active single failure criteria, is discussed in Section 15.9.

The SLCS is evaluated against the applicable regulatory guides as follows:

a. Regulatory Guide 1.26: Because the SLCS is a reactivity control system, all mechanical components are at least Quality Group B or equivalent. The SLCS storage tanks and all three of the Unit 1 and one of the Unit 2 accumulator vessels are constructed to alternate specifications as discussed in Sections 3.2.2.k and 3.2.2.1. Those portions which are part of the RCPB are Quality Group A. This is shown in Table 3.2-1.

b. Regulatory Guide 1.29: All components of the SLCS which are necessary for injection of the neutron absorber into the reactor and for suppression pool pH control following a LOCA are seismic Category I as shown in Table 3.2-1.

c. BTP APCSB 3-1 & BTP MEB 3-1: SLCS equipment is protected from a pipe break as discussed in Section 3.6.

d. Regulatory Guide 1.183: The adoption of Alternative Source Terms (AST) requires the use of SLCS to maintain the suppression pool inventory at a minimum pH of 7.0 following a LOCA. All components of SLCS necessary to perform this function are evaluated as required per Reg. Guide 1.183. (Ref. 9.3-3)

This system is used in special plant capability demonstration events cited in Section 15.9 (specifically Events 51 and 53), which are extremely low probability nondesign basis postulated incidents.

9.3.5.4 Testing and Inspection Requirements

Operational testing of the SLCS is performed in at least two parts to avoid the inadvertent injection of boron into the reactor.

With the storage tank outlet valve and the maintenance valve downstream of the explosive valve closed, and valves on the test tank discharge line and return line opened, demineralized water can be recirculated by locally starting a pump. This test can be accomplished during normal plant operation while the other loops are capable of injecting the control liquid in response to an initiation signal.

During a refueling or maintenance outage, all pumps and automatic valves can be tested. In the test mode, demineralized water is pumped from the test tank through the explosive valves into the vessel upon receiving a manual start signal. Seperate tests verify a simulated ATWS signal from the RRCS logic would cause an injection. During testing, the storage tank outlet valve is closed while the test tank discharge valve is open.

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 drawing M-48.

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 control room indicate that the local valve is closed for

tests or open and ready for operation. Leakage through the first check valve can be detected by opening the test connection shutoff valves in the line between the inner check valve and the outer containment motor-operated stop-check globe valve when the reactor is pressurized or during a refueling outage.

The test tank contains demineralized water for at least 5 minutes of pump operation. Demineralized water is available for refilling and flushing the system.

Should the boron solution ever be injected into the reactor, either intentionally or inadvertently, then after making certain that the normal reactivity controls will keep the reactor subcritical, the boron is removed from the RCS by flushing for gross dilution followed by operating the RWCU system.

The concentration of the sodium pentaborate in the solution tank is determined periodically by chemical analysis.

The boron-10 enrichment of the sodium pentaborate will be verified to be ≥29 atom percent prior to adding chemicals to the storage tank.

Electrical supplies and relief valves are also subjected to periodic testing.

The SLCS preoperational test is described in Chapter 14.

9.3.5.5 Instrumentation Requirements

The instrumentation and control system for the SLCS is designed to allow the injection of sodium pentaborate solution into the reactor and to maintain the solution well above its saturation temperature. A further discussion of the SLCS instrumentation is found in Section 7.4.

9.3.6 REFERENCES

9.3-1 "Seismic Performance of Piping in Past Earthquakes," ASCE Conference Report; R.L. Cloud Associates, Inc., (1980).

9.3-2 "Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Limerick Generating Station Units 1 and 2," NEDC-32193P, July 1993.

9.3-3 Regulatory Guide 1.183, “Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors,” July 2000.

9.3-4 Design Analysis LM-0642, “Suppression Pool pH Calculation for Alternative Source Terms.”

Table 9.3-1

STATION AIR SYSTEMS DESIGN PARAMETERS

INSTRUMENT AIR COMPRESSOR	
Quantity	2
Type	Two-stage, double-acting, reciprocating
Capacity, each	397 acfm @14.7 psia, 95°F
Pressure rating	110 psig
Motor power rating	100 hp
INSTRUMENT AIR AFTERCOOLER AND MOISTURE SEPARATOR	
Quantity	2
Type	Shell and tube
Duty	74,100 Btu/hr
Shell design	
Fluid	Water
Flow rate	9 gpm
Design pressure	150 psig
Design temperature	400°F
Tube design	
Fluid	Air
Flow rate	397 acfm
Design pressure	150 psig
Design temperature	400°F
INSTRUMENT AIR RECEIVERS	
Quantity	2
Type	Vertical, cylindrical
Capacity, each	223 ft^3
Design pressure	125 psig
Design temperature	650°F
INSTRUMENT AIR DRYER PACKAGE	
Quantity	2
Type	Automatic, dual drying chamber, adsorbent
Capacity, each	750 scfm
Pressure	110 psig
Temperature	110°F
Inlet moisture content	Saturated
Outlet moisture content	-40°F dew point at line pressure

Table 9.3-1 (Cont'd)

SERVICE AIR COMPRESSOR[(2)]

Quantity	1
Type	Two-stage, double-acting, reciprocating
Capacity	397 acfm @14.7 psia, 95°F
Pressure rating	110 psig
Motor power rating	100 hp

SERVICE AIR AFTERCOOLER AND MOISTURE SEPARATOR[(2)]

Quantity	1
Type	Shell and tube
Duty	74,100 Btu/hr
Shell design	
Fluid	Water
Flow rate	9 gpm
Design pressure	150 psig
Design temperature	400°F
Tube design	
Fluid	Air
Flow rate	397 cfm
Design pressure	150 psig
Design temperature	400°F

SERVICE AIR RECEIVER[(2)]

Quantity	1
Type	Vertical, cylindrical
Capacity	223 ft^3
Design pressure	125 psig
Design temperature	650°F

CONDENSATE FILTER/DEMINERALIZER BACKWASH AIR COMPRESSOR[(2)]

Quantity	2
Type	Two-stage
Capacity	reciprocating
Pressure rating	35 cfm
Motor power rating	125 psi
	10 hp

CONDENSATE FILTER/DEMINERALIZER BACHWASH AIR RECEIVER[(2)]

Quantity	1 [(1)]
Type	Horizontal, cylindrical
Capacity	250 ft^3
Design pressure	125 psig
Design temperature	200°F

(1) Unit 1: Two (2) tasks manifolded together.
(2) Per Unit unless noted otherwise.

Table 9.3-2

PERKIOMEN AND SCHUYLKILL COMPRESSED AIR SYSTEMS
DESIGN PARAMETERS

PERKIOMEN PUMPHOUSE AIR COMPRESSORS

Quantity	2
Type	Piston
Capacity	72 scfm
Pressure rating	175 psig
Motor power rating	20 hp

PERKIOMEN PUMPHOUSE AIR RECEIVER

Quantity	1
Type	Vertical, cylindrical
Capacity	66.84 ft^3
Pressure rating	150 psig

PERKIOMEN PUMPHOUSE AIR ACCUMULATOR

Quantity	1
Type	Vertical, cylindrical
Capacity	1.33 ft^3
Pressure rating	275 psig

PERKIOMEN CONTROL VALVE AIR COMPRESSOR

Quantity	2 (100% capacity each)
Type	Piston
Capacity	22.2 scfm
Pressure rating	175 psig
Motor power rating	5 hp

Table 9.3-2 (Cont'd)

PERKIOMEN CONTROL VALVE AIR RECEIVER

Quantity	1
Type	Vertical
Capacity	53.5 ft^3
Pressure rating	200 psig

SCHUYLKILL AIR COMPRESSORS

Quantity	2 (100% capacity each)
Type	Piston
Capacity	9.6 scfm
Motor power rating	3 hp

SCHUYLKILL AIR RECEIVER

Quantity	2
Type	Horizontal, cylindrical
Capacity	8.02 ft^3
Pressure rating	(not available in our records)

Table 9.3-3

PRIMARY CONTAINMENT INSTRUMENT GAS SYSTEM DESIGN PARAMETERS

INLET FILTER	
Quantity	2 (100% capacity each)
Type	Dry-type with renewable media
Rating	99% of 10 micron particles
COMPRESSORS	
Quantity	2 (100% capacity each)
Type	Reciprocating, wye, single acting, single-stage, water-cooled, nonlubricated
Capacity	10 acfm
Pressure rating	110 psig
Motor power rating	5 hp
AFTERCOOLERS	
Quantity	2 (100% capacity each)
Type	Shell and tube with tube bundle and baffled water circuits
Duty, each	2791 Btu/hr
Shell design	
Fluid	RECW
Flow rate	450 lb/hr
Design pressure	200 psig
Design temperature	300°F
Tube design	
Fluid	Air or nitrogen
Flow rate	10 cfm
Design pressure	150 psig
Design temperature	300°F

Table 9.3-3 (Cont'd)

MOISTURE SEPARATORS

Quantity	2 (100% capacity each)
Type	Vertical, with built-in float-type drain trap
Capacity, each	50 cfm
Design pressure	150 psig
Design temperature	300°F

DRYERS

Quantity	2 (100% capacity each)
Type	Refrigerant-type with moisture separator zone
Capacity, each	10 cfm
Humidity at inlet	Saturated
Outlet moisture content	34°F dew point at 105 psig
Quantity	2 (100% capacity each)
Type	Desiccant-type with electric heaters for regeneration
Capacity, each	10 cfm
Inlet conditions	
Pressure	90 to 115 psig
Temperature	55°F
Dew point	34°F at 105 psig
Outlet conditions	
Dew point	-40°F at 100 psig

OUTLET FILTER (DESICCANT DRYER)

Quantity	2 (100% capacity each)
Type	Dry-type with renewable media
Rating	99.99% of 3 micron particles

GAS RECEIVERS

Quantity	2 (100% capacity each)
Type	Vertical, ASME Code stamp
Capacity, each	80 ft^3
Pressure rating	125 psig

Table 9.3-3 (Cont'd)

OUTLET FILTER (Gas Receiver)

Quantity	2 (100% capacity each)
Type	Dry type with renewable media and built-in float-type drain trap
Rating	99.99% of 0.03 micron particles

Table 9.3-4

SAFETY-RELATED PNEUMATICALLY OPERATED VALVES AND DAMPERS[2]

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
A. EMERGENCY SERVICE WATER[3] (Drawing M-11)					
HV-11-041&071	Unit 1, Div 1 ESW return	ESW heat removal from Unit 1, Loop A coolers	Closed	Open	Open
HV-11-042&072	Unit 1 HPCI ESW return	ESW heat removal from Unit 1 HPCI pump-room coolers	Closed	Open	Open
HV-11-044&074 Unit 1, Div II ESW return ESW heat removal from Unit 1,	Closed	Open Loop B coolers	Open		
HV-11-121&123	Unit 1, Div I service water return	Isolation of Loop A coolers from service water system	Open	Closed	Closed
HV-11-125&126	Unit 1, Div II service water return	Isolation of Loop B coolers from service water system	Open	Closed	Closed
HV-11-043&073	Unit 1 HPCI service water Return	Isolation of HPCI pump-room coolers from service water system	Open	Closed	Closed
HV-11-124&128	ESW supply to Unit 1 RECW, heat exchangers	Isolation of RECW heat exchangers from ESW system	Closed	Closed	Closed
HV-11-127	ESW return from Unit 1, RECW heat exchangers	Isolation of RECW heat exchangers from ESW system	Closed	Closed	Closed
HV-11-101A-H & 201A-H	Inlet to core spray pump-room unit coolers	Heat removal from core spray pump-room unit coolers	Closed	Open	Open
HV-11-103A&B & 203A&B	Inlet to HPCI pump-room unit coolers	Heat removal from HPCI pump-room unit coolers	Closed	Open	Open
HV-11-106A&B & 206A&B	Inlet to RCIC pump-room unit coolers	Heat removal from RCIC pump-room unit coolers	Closed	Open	Open

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
HV-11-104A-H & 204A-H	Inlet to RHR pump-room unit coolers	Heat removal from RHR pump-room unit coolers	Closed	Open	Open
HV-11-046&076	Unit 2, Div I ESW return	ESW heat removal from Unit 2, Loop A coolers	Closed	Open	Open
HV-11-049&079	Unit 2, RCIC ESW return	ESW heat removal from Unit 2, RCIC pump-room coolers	Closed	Open	Open
HV-11-047&077	Unit 2, Div II ESW return	Heat removal from Unit 2, Loop B coolers	Closed	Open	Open
HV-11-221&223	Unit 2, Div I service water return	Isolation of Loop A coolers from service water system	Open	Closed	Closed
HV-11-225&226	Unit 2, Div II service water return	Isolation of Loop B coolers from service water system	Open	Closed	Closed
HV-11-048&078	Unit 2, RCIC service water Return	Isolation of RCIC pump-room coolers from service water system	Open	Closed	Closed
HV-11-224&228	ESW supply to Unit 2, RECW heat exchangers	Isolation of RECW heat exchangers from RECW system	Closed	Closed	Closed
HV-11-227	ESW return from Unit 2, RECW heat exchangers	Isolation of RECW heat exchangers from RECW system	Closed	Closed	Closed

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
B. NUCLEAR BOILER (Drawing M-41)					
HV-41-1F022A,B,C&D(1)	Main steam piping inside containment	Isolation	Open	Closed	Closed
HV-41-1F028A,B,C&D(1)	Main steam piping outside containment	Isolation	Open	Closed	Closed
HV-41-1F074A,B	Feedwater Inlet Check valve	Isolation	Open	Closed	Closed
HV-41-1F084	Main steam sample from main steam line "C"	Isolation	Closed	Closed	Closed
HV-41-1F085	Main steam sample from main steam line "C"	Isolation	Closed	Closed	Closed
PSV-41-1F013 E,H,K,M,S(1)	Main steam relief valves	Reactor depressurization (automatic depressurization)	Closed	-	-
PSV-41-1F013 A,B,C,D,F, G,J,L,N	Main steam relief valves	Reactor depressurization	Closed	-	-
C. REACTOR RECIRCULATION (Drawing M-43)					
HV-43-1F019&1F020	Recirculation pump discharge process sample line	Sample line isolation	Closed	Closed	Closed
D. CRD HYDRAULIC (Drawing M-41)					
XV-47-1F010	SDV vent valve	Isolation	Open	Closed	Closed
XV-47-1F011	SDV drain valve	Isolation	Open	Closed	Closed
XV-47-1-26	Scram inlet valve	Scram inlet	Closed	Open	Open
XV-47-1-27	Scram exhaust valve	Scram exhaust	Closed	Open	Open
XV-47-1F180	SDV drain valve	Isolation	Open	Closed	Closed
XV-47-1F181	SDV drain valve	Isolation	Open	Closed	Closed

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
E. REACTOR CORE ISOLATION COOLING (Drawing M-49)					
HV-49-1F025	Steam drain line	Isolation	Open	Closed	Closed
HV-49-1F026	Steam drain line	Isolation	Open	Closed	Closed
LV-49-1F054	Steam drain line	Bypass	Closed	Closed	Closed
HV-50-1F004	Drain line on the RCIC	Drain isola ion vacuum tank condensate pump	Closed	Closed	Closed
HV-50-1F005	Drain line on the RCIC	Drain isola ion vacuum tank condensate pump	Open	Closed	Closed
F. RHR SYSTEM (Drawing M-51)					
HV-51-142A,B,C&D	LPCI pump discharge lines	Inboard testable check valve bypass to equalize pressure for testing check valves	Closed	Closed	Closed
HV-51-151A&B	Shutdown cooling return Lines	Inboard testable check valve bypass to equalize pressure for testing check valves	Closed	Closed	Closed
HV-51-1F079A&B & 1F080A&B	RHR heat exchanger discharge	Sample line isolation process sample line	Closed	Closed	Closed
HV-51-1F074	RHRSW intertie line drain	Drain line isolation	Open	Closed	Closed
HV-C-51-103A,B	RHR heat exchanger outlet bypass valve	Isolation	Closed	Closed	Closed
HV- 51-1F041A,B,C,D	LPCI injection testable check valve	Isolation	Closed	Closed	Closed
HV- 51-199A,B	RHR heat exchanger sample valve	Isolation	Open	Closed	Closed

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
HV-51-156A&B & 157A&B	Demineralized water supply to RHR heat exchangers (tube side)	Isolation of demineralized water system from RHRSW	Closed	Closed	Closed
HV-51-158A&B	Demineralized water flush for RHR heat exchangers (tube side)	Shutoff demineralized water flush for RHR heat exchangers	Closed	Closed	Closed
G. CORE SPRAY SYSTEM					
HV-52-1F039A&B	Core spray pump discharge Line	Inboard testable check valve bypass to equalize pressure for testing check valves	Closed	Closed	Closed
HV-52-1F006A,B	A(B) loop testable check PCIV	Isolation	Closed	Closed	Closed
HV-51-108	B loop ou board discharge A/O check PCIV	Isolation	Closed	Closed	Closed
H. HIGH PRESSURE COOLANT INJECTION (Drawing E41-1020-G-002)					
HV-55-1F028	Steam drain line	Isolation	Open	Closed	Closed
HV-55-1F029	Steam drain line	Isolation	Open	Closed	Closed
HV-55-1F054	Steam drain line	Bypass	Closed	Closed	Closed
HV-56-1F025	Drain line on the HPCI	Drain isola ion vacuum tank condensate pump	Open	Closed	Closed
HV-56-1F026	Drain line on the HPCI vacuum tank condensate pump	Drain isola ion	Closed	Closed	Closed
I. CONTAINMENT ATMOSPHERIC CONTROL (Drawing M-57)					
HV-57-121	Nitrogen purge supply to drywell	Containment isolation	Closed	Closed	Closed
HV-57-123	Purge air inlet to drywell	Containment isolation	Closed	Closed	Closed
HV-57-124	Purge air inlet to suppression chamber	Containment isolation	Closed	Closed	Closed
HV-57-131	Nitrogen purge supply to suppression chamber	Containment isolation	Closed	Closed	Closed

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESCRIPTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
HV-57-104	Purge exhaust from suppression chamber	Containment isolation	Closed	Closed	Closed
HV-57-117	Purge exhaust from drywell	Containment isolation	Closed	Closed	Closed
HV-57-118	Purge exhaust from suppression chamber	Containment isolation	Closed	Closed	Closed
HV-57-114	Purge exhaust from drywell	Containment isolation	Closed	Closed	Closed
J. PRIMARY CONTAINMENT INSTRUMENT GAS (Drawing M-59)					
HV-59-129A,B	Instrument gas supply to primary containment	Containment isolation	Open	Closed	Closed
HV-59-131	Instrument gas supply to TIP indexing mechanisms	Containment isolation	Open	Closed	Closed
HV-59-102	Instrument gas suction from primary containment	Containment isolation	Open	Closed	Closed
HV-59-135	Instrument gas supply to primary containment vacuum relief valves	Containment isolation	Open	Closed	Closed
K. LIQUID RADWASTE COLLECTION (Drawing M-61)					
HV-61-110	Drywell floor drain sump containment isolation valve	Drain and isolation	Open	Closed	Closed
HV-61-111	Drywell floor drain sump containment isolation valve	Drain and isolation	Closed	Closed	Closed
HV-61-130	Drywell equipment drain sump containment isolation valve	Drain and isolation	Open	Closed	Closed

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
HV-61-131	Drywell equipment drain sump containment isolation valve	Drain and isolation	Closed	Closed	Closed
L. REACTOR ENCLOSURE HVAC[(2)] (Drawing M-76)					
HV-76-030&031	Drywell purge exhaust System	Isolation of drywell purge fans from SGTS	Closed	Closed	Closed
HV-76-107&108	Reactor enclosure air supply system	Isolation of system from outside air	Open	Closed	Closed
HV-76-117&118	Refueling area air supply System	Isolation of system from outside air	Open	Closed	Closed
HV-76-141&142	Reactor enclosure equipment compartment air exhaust system	Isolation of system from outside air	Open	Closed	Closed
HV-76-151&152	Reactor enclosure equipment compartment air exhaust to RERS inlet duct	Divert equipment compartment exhaust air to RERS inlet	Closed	Open	Open
HV-76-157&158	Reactor enclosure air exhaust system	Isolation of system from outside air	Open	Closed	Closed
HV-76-159&160	Reactor enclosure air exhaust to RERS inlet duct	Divert reactor enclosure exhaust air to RERS inlet	Closed	Open	Open
HV-76-167&168	Refueling area air exhaust System	Isolation of system from outside air	Open	Closed	Closed
HV-76-196&197	Reactor enclosure RERS discharge to SGTS inlet duct	Open air flow path from RERS to SGTS system on isolation signal	Closed	Open	Open
HV-76-019&020	Refueling Area to SGTS inlet duct	Open air flow path from refueling area to SGTS system on isola ion system	Closed	Open	Open

Table 9.3-4 (Cont'd)

SYSTEM AND VALVE OR DAMPER NO.	DESCRIPTION	DESIGN FUNCTION	NORMAL POSITION	FAIL POSITION	SAFE POSITION
M. CONTROL STRUCTURE HVAC (Drawing M-78)					
HV-78-021A,B	Control room normal fresh air intake duct	Isolation of control room from nonfiltered outside air during radiation or toxic gas isolation	Open	Closed	Closed
HV-78-052A,B	Control room exhaust air Duct	Isolation of control room exhaust air duct from outside air during radiation or toxic gas isolation	Open	Closed	Closed
HV-78-057A,B & 071A,B	Control room toilet exhaust Duct	Isolation of control room toilet exhaust air duct from outside air during radiation or toxic gas isolation	Open	Closed	Closed
HD-78-053A,B	Control room return air Duct when open; in closed position air diverted to purge exhaust	Parallel dampers to allow return air to supply units Standby, Closed	Operating, Open Open	 Open Open	 Open
HD-78-090 A-F HD-78-091 A-F	Battery rooms exhaust/ return ducts	Series dampers to close upon loss of normal power to battery room exhaust fans	Open	Closed	Closed
HD-78-092A,B HD-78-093A,B	Emergency switchgear and battery room air conditioning unit inlet duct from battery rooms	Parallel dampers to open upon loss of normal power to battery room exhaust fans to allow recirculation and mixing of battery room return air	Closed	Open	Open
HD-78-030A,B	Control room exhaust purge selec ion	Parallel dampers to allow directional flow of purged air and smoke across control room in event of fire	Open	Open	Open

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(1) Includes local, seismic Category I accumulators
(2) Unless otherwise noted only valves and dampers in Unit 1 are listed. Valves and dampers in Unit 2 are identical, and the valve or damper number begins with a 2 or 5, rather than a 1 or 4, respectively. Valves or dampers whose number begins with a 0 are common to bo h units.
(3) System is common to both units, valves for both units are listed.

Table 9.3-5

PLANT DRAINAGE SYSTEMS COMPONENT DESCRIPTION [1]

	SUMPS			PUMPS					
DRAINAGE SYSTEM	QUANTITY	TYPE	WORKING CAPACITY (gal)	EACH QUANTITY	TYPE	TOTAL DISCHARGE HEAD (ft)	FLOW RATE EACH (gpm)	HP	DESIGN PRESS/TEMP (psig/°F)
Drywell equipment drains	1	Horizontal, SS, tank with cooling coil	500	None	-	-	-	-	-
Drywell floor drains	1	Horizontal, SS, tank	500	None	-	-	-	-	-
Reactor enclosure equipment drains	1	Lined sump	1000	2	Vertical, centrifugal	70	50	5	150/140
Reactor enclosure floor drains	1	Lined sump	1000	2	Vertical, centrifugal	80	100	5	150/140
Radwaste enclosure equipment drains[2]	1	Lined sump	1000	2	Vertical, centrifugal	60	50	3	150/140
Radwaste enclosure floor drains[2]	1	Lined sump	1000	2	Vertical, centrifugal	60	50	3	150/140
Turbine enclosure condensate backwash area equipment drains	1	Lined sump	1000	2	Vertical, centrifugal	70	50	5	150/140
Turbine enclosure condensate backwash area floor drains	1	Lined sump	1000	2	Vertical, centrifugal	70	50	5	150/140
Turbine enclosure condensate pump area equipment drains	1	Lined sump	1000	2	Vertical, centrifugal	70	50	5	150/140
Turbine enclosure condensate pump area floor drains	1	Lined sump	1000	2	Vertical, centrifugal	70	50	5	50/140
Water treatment enclosure chemical waste drains[2]	1	Horizontal cylinder, brick lined	2100	2	Vertical, centrifugal	55	150	5	50/120
Water treatment enclosure normal waste drains[2]	1	Rectangular concrete	4500	2	Vertical, centrifugal	40	100	7 5	50/120
Turbine enclosure oily waste drains	1	Rectangular concrete	2500	2	Vertical, centrifugal	40	100	5	50/160
Turbine enclosure normal waste drains	3	Rectangular concrete	1700	6	Vertical, centrifugal	35	100	2	50/160
Circulating water pump structure normal waste drains	1	Rectangular concrete	2000	2	Vertical, centrifugal	35	100	2	30/140
Hot Maintenance Shop[2]	1	Lined Sump	1000	2	Vertical, centrifugal	80	50	5	150/140

(1) Component description is based on one unit.
(2) This equipment is common to Units 1 and 2.

Table 9.3-6

STANDBY LIQUID CONTROL SYSTEM OPERATING PRESSURE/TEMPERATURE CONDITIONS

	TEST MODES							
	STANDBY MODE [1]		CIRCULATION TEST[1]		INJECTION TEST[2]		OPERATING MODE	
PIPING	PRESS[3] (psig)	TEMP (°F)	PRESS[3] (psig)	TEMP (°F)	PRESS[3] (psig)	TEMP (°F)	PRESS[3] (psig)	TEMP (°F)
Pump suction	Storage tank static head	65/106[4]	Test tank static head[5]	65/106	Test tank static head[5]	65/106	Storage head sta ic head	65/106
Pump discharge to explosive valve inlet	Storage tank static head	65/106	0/1220	65/106	40 plus reactor sta ic head	65/106	(70 plus reactor static head) to 1220	65/106
Explosive valve outlet to but not including first motor-operated-stop-check (shutoff) globe valve	Reactor static head to 1205[6]	65/106	Reactor static head to 1205[6]	65/106	<40 plus reactor static head	65/106	(<70 plus reactor static head to <1220	65/106
Motor-operated stop-check globe valve to the reactor	Reactor static head to 1205[6]	65/560[7]	Reactor static head to 1205[6]	65/560[7]	Reactor static head[2]	<140[2]	Reactor static head to 1205[6]	65/560[7]

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(1) The pump flow rate is zero (pump not operating) during the standby mode and at rated flow during the test and operating modes.

(2) Reactor to be at 0 psig and <140 F before changing from the standby mode to he injection test mode.

(3) Pressures tabulated represent pressure at the points identified below. To obtain pressure at intermediate points in the system, the pressures tabulated must be adjusted for eleva ion difference and pressure drop between such intermediate points and he pressure points identified below:

Piping	Pressure Point
Pump suction	Pump suction flange inlet
Pump discharge to explosive valve inlet	Pump discharge flange outlet
Explosive valve outlet to but not including first isolation check valve	Explosive valve outlet
First isola ion check valve to the reactor	Reactor sparger outlet

(4) During chemical mixing, the liquid in the storage tank will be at a maximum temperature of 160 F.

(5) Pump suction piping will be subject to demineralized water supply pressure during flushing and filling of the piping and during any testing where suction is taken directly from the demineralized water supply line rather than the test tank.

(6) Maximum reactor operating pressure is 1205 psig at reactor standby liquid control sparger outlet.

(7) 560°F represents maximum sustained operating temperature.

9.4 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS

9.4.1 CONTROL ROOM AND CONTROL STRUCTURE VENTILATION SYSTEMS

The following systems are covered in this section:

a. Control room HVAC system (Section 9.4.1.1)

b. Auxiliary equipment room HVAC system (Section 9.4.1.2)

c. Emergency fresh air supply system (Section 9.4.1.3)

d. Control structure HVAC systems from turbine enclosure (Section 9.4.1.4)

e. SGTS equipment compartment HVAC systems (Section 9.4.1.5)

f. Emergency switchgear and battery compartments HVAC system and battery compartments system (Section 9.4.1.6)

9.4.1.1 Control Room HVAC System

The control room HVAC system is common to Units 1 and 2. It provides ventilation, cooling, and control of environmental conditions in the control room and the adjacent support offices, toilet, and utility rooms.

The control room HVAC system is safety-related. The toilet room exhaust fan, electric heating coils, roll filters and humidification systems are not safety-related.

9.4.1.1.1 Design Bases

a. The control room HVAC system maintains the space relative humidity for personnel comfort and equipment performance under normal operation.

b. The control room HVAC system maintains the space temperature for personnel comfort and ensures the operability of control room equipment and instruments under normal and accident conditions.

c. The control room HVAC system active components are designed with redundancy to meet the single active failure criteria.

d. The control room HVAC system equipment is served by redundant power supplies that are designed to meet IEEE 279 and IEEE 308.

e. The control room HVAC system monitors radioactive contamination in the outside air intake. It isolates the normal fresh air intake and reroutes contaminated fresh air through the emergency charcoal filters upon high radiation detection. A positive pressure is maintained in the control room to inhibit the infiltration of outside air.

f. The control room HVAC system monitors chlorine and offsite toxic chemical contamination in the outside air intake. This system automatically isolates the control room upon chlorine detection or provides indication for manual isolation of

the control room upon offsite toxic chemical detection and recirculates control room air through charcoal filters.

The logic of the isolation signals with the control room HVAC system initially in the radiation isolation mode is such that a single failure of the chlorine detection system could allow the filtered outside air intake to remain open, and thus, the control room HVAC system would remain in the radiation isolation mode. Under these circumstances, once the chlorine has been detected and alarmed in the control room, manual action can be taken to realign the system to the chlorine isolation mode. Analysis of this event assumes that the system remains in the radiation isolation mode with 525 cfm of outside air being mixed with recirculated control room air for a total of 3,000 cfm being passed through the charcoal adsorber filter trains, and that the filter has no effect on removal of chlorine. The results of the analysis indicate that, with the control room HVAC system in the radiation isolation mode, the necessity for automatic chlorine isolation is not required to satisfy General Design Criterion (GDC) 19 of 10CFR50 of Appendix A, and that the control room operators would have sufficient time to don breathing apparatus after an alarm is sounded in the control room (as shown in Table 2.2-6).

g. Provision is made for purging areas served by the control room HVAC system of smoke from a fire by using a 100% fresh air supply and exhausting 100% of the air.

h. The control room HVAC system is designed to seismic Category I requirements, with the exception of the humidification equipment, roll-filters, electric duct heaters and toilet room exhaust fan. Seismic category, quality group classification, and corresponding codes and standards that apply to the control room HVAC system are discussed in Section 3.2. The electric duct heaters are seismic Category IIA. The roll-filter frame and supports are seismic Category I but not the filter media. The humidifier is supported by seismic Category I supports and is enclosed within a seismic Category I debris grille structure.

i. The equipment, ducts, and accessories for the control room HVAC system are missile-protected as discussed in Section 3.5.

j. The fresh air intake ducts are designed to withstand the pressure effects of a tornado.

k. The control room HVAC system is designed to operate during normal, shutdown, and accident conditions without loss of function.

l. Isolate exhaust duct of Unit 2 toilet room in the event of a high energy pipe break in the turbine enclosure.

m. The control room HVAC system is a subsystem of the control room emergency fresh air supply system (CREFAS) and provides the flowpath to and from the control room whenever the CREFAS is in operation.

9.4.1.1.2 System Description

The control room HVAC and auxiliary equipment room systems are similarly designed. The system description for both systems is given in Section 9.4.1.2.2.

9.4.1.2 Auxiliary Equipment Room HVAC System

The auxiliary equipment room HVAC system is common to Units 1 and 2, and it serves the auxiliary equipment room, remote shutdown room, computer room, control structure fan rooms, SGTS access area, and SGTS room.

The safety-related function of the auxiliary equipment room HVAC system is to provide cooling to the PGCC (located in the auxiliary equipment room), the remote shutdown room, and the control structure fan rooms. The humidification components, roll filters, and electric duct heaters are not safety-related.

9.4.1.2.1 Design Bases

a. The auxiliary equipment room HVAC system maintains the space temperature for personnel comfort (except the fan rooms, which are 104°F maximum and the SGTS access area EL. 377'-0 which is 107°F) and ensures the operability of the equipment under normal and accident conditions.

b. The auxiliary equipment room HVAC system maintains the space relative humidity as required for computer performance under normal operation.

c. The auxiliary equipment room HVAC system active components are designed with redundancy to meet the single active failure criteria.

d. The auxiliary equipment room HVAC system equipment is served by redundant Class 1E power supplies that are designed to meet IEEE 279 and IEEE 308.

e. Provision is made for purging areas served by the auxiliary equipment room HVAC system of smoke from a fire by selecting a 100% fresh air supply and 100% exhaust.

f. The auxiliary equipment room HVAC system is designed to seismic Category I requirements, with the exception of roll-filters, electric duct heaters, and the humidification equipment. The electric duct heaters are seismic Category IIA. The roll-filter frame and supports are seismic I but not the filter media. Seismic category, quality group classification, and corresponding codes and standards that apply to the auxiliary equipment room HVAC system are discussed in Section 3.2.

g. The equipment, ducts, and accessories for the auxiliary equipment room HVAC system are missile-protected as discussed in Section 3.5.

h. The auxiliary equipment HVAC system (except for humidification, roll-filter motors, and the electric duct heaters) is designed to operate during normal, shutdown, and accident conditions without loss of function.

9.4.1.2.2 System Description

The control room and auxiliary equipment room HVAC systems are similarly designed. Both systems are shown in drawing M-78. Design parameters for the control room and auxiliary equipment room HVAC systems are listed in Tables 9.4-1 and 9.4-2.

Each system is served by two 100% capacity redundant supply air handling units and two 100% capacity return air fans (one operating and one on standby). Each supply unit contains a roll-filter, chilled water cooling coils, a vaneaxial fan, and a humidifier. The air handling units are connected to a common seismic Category I supply and return duct system that distributes supply air throughout the space and returns room air to the units. The return air is cooled by chilled water cooling coils. The control room and the auxiliary equipment room air conditioning equipment are located within the seismic Category I control structure. Equipment in each redundant system is powered from an independent Class 1E power source, except for the electric humidifiers, roll-filter motors and the electric duct heaters.

The chilled water for the cooling coils in each system is supplied by a seismic Category I independent chilled water supply system. The chilled water systems are interlocked with their respective supply air fans in the same division. The chilled water system is described in Section 9.2.10.

When the fan starts, the chilled water pump in the same division automatically starts. Failure of any of the control room fans is annunciated in the control room. Following failure of any control room fan, the standby division air systems and chilled water pump start automatically. Some procedures direct manual operation of the control room HVAC system during plant operations to support testing, inspection, repair, replacement activities and normal system operation. When the control room HVAC system is operated in this manual mode, procedures direct the manual initiation of standby equipment and the use of an operator to compensate for the temporary removal of the automatic start of the fan(s) in "Off". During periods when the fan(s) may be left in "Off", the operator will be a dedicated operator in addition to the Technical Specifications minimum required staffing levels for the control room. Failure of any of the auxiliary equipment room fans is annunciated on the local panel with a common panel alarm annunciating in the control room. Following failure of any auxiliary equipment room fan, the standby division air systems and chilled water pump start automatically.

Fan selector switches in the control room panel allow manual selection of the control room fans. Fan selector switches on local panels OAC101 and OBC101 allow manual selection of the auxiliary equipment fans.

Each air system is provided with an air temperature controller that regulates the temperature of the room air. The controller modulates a three-way mixing valve to control chilled water flows through the cooling coils.

Each system supplies a minimum quantity of outside air and recirculates conditioned air to maintain space requirements; space humidity is controlled during normal operations.

The outside air is taken from an outside air intake system, which is described in the emergency fresh air supply system in Section 9.4.1.3.2. The control room and auxiliary equipment room HVAC systems are supplied with outside air through branch ducts from the outside air intake system. A preset quantity of outside air is provided for these systems. This branch outside air duct connects with the fan intake plenum which is equipped with an electric duct heater. Temperature elements sensing both the supply air and the return air provide input signals to an instrument loop that transmits a controlling signal to the electric heater to modulate the air temperature in the

supply fan intake plenum. The duct heater unit is seismic Category IIA and is a non-Class 1E circuit.

A humidification system is provided for the control and auxiliary equipment room HVAC system. A humidistat mounted in the control room return air duct regulates a controller to maintain humidity in the control room. The humidification system is designed for normal operation only and is not a safety-related system.

The SGTS room is supplied by conditioned air from the control enclosure auxiliary equipment room supply system. This air is humidity controlled based on maintaining 50% ±5% relative humidity at 76°F in the auxiliary equipment room. During normal operation, the maximum SGTS room temperature is 104°F based on worst case outside temperature and humidity. Outside air is limited to 8% of total supply air during normal operation. The mixed air is dehumidified by the supply unit cooling coil. The SGTS room is further dehumidified, to below the auxiliary equipment room control point relative humidity, by the higher temperature in the SGTS room. This results in exhaust air humidity to the charcoal adsorbers well below 70%.

The areas served by the control room HVAC system are designed to be maintained at a positive pressure during the high radiation isolation mode and normal operation.

During normal operation, the pressurized air in the control room areas is relieved through a pressure differential control damper to the control room exhaust stack.

The operation of the control room HVAC system during the isolation phase is described in Section 6.4.

The toilet exhaust fan system is not safety-related. The hand control switches for the fan are located on the local control panel. The operation of this fan is strictly manual. Since the control room may be directly exposed to the outside environment through the control room toilet exhaust system, fail-closed, redundant isolation valves in series are installed at the intake of the toilet exhaust fan. These isolation valves are automatically closed by the high outside air radiation or chlorine signals or are remote manually closed following a high offsite toxic chemical signal.

Two steam flooding isolation dampers in series are provided in the exhaust duct of the Unit 2 turbine enclosure toilet room (drawing M-78) that could be exposed to a turbine enclosure high energy pipe break. The turbine enclosure toilet room has a common exhaust with the control room toilet room. Each damper is provided with a pressure differential switch that trips the release mechanism to close the damper on sensing high pressure developed inside the Unit 2 turbine enclosure. The leakage rate for isolation damper is 1 cfm/ft^2 maximum.

9.4.1.3 Emergency Fresh Air Supply System

The emergency fresh air supply system is common to Units 1 and 2. It is designed to provide filtration for control room fresh air and recirculated air during a high radiation accident and to provide filtration for control room recirculated air during a chlorine or offsite toxic chemical release accident to maintain control room habitability.

The emergency outside air supply system is safety-related and designed to seismic Category I requirements. Additional discussion of this system appears in Sections 6.4 and 6.5.1.

9.4.1.3.1 Design Bases

a. The emergency fresh air supply system is activated automatically by detection of radiation or chlorine or remote manually by detection of offsite toxic chemicals at the control room HVAC system outside air intake.

b. The emergency fresh air supply system is designed to recirculate and clean up control room air when offsite toxic chemicals or chlorine is present in the outside air.

c. The emergency fresh air supply system is designed to maintain filtered outside air supply to the control room areas during radiation accident conditions.

d. The emergency fresh air supply system is designed to maintain a positive pressure above atmospheric to inhibit air leakage into the control room areas during radiation isolation. The fresh air system is totally isolated, with the filters in a recirculation mode, only during a chlorine or offsite toxic chemical isolation.

e. The emergency fresh air supply system is designed to operate during and after an accident and isolation mode conditions without loss of function.

f. The emergency fresh air supply system active components are designed with redundancy to meet the single active failure criteria.

g. The emergency fresh air supply system equipment is served by redundant Class 1E power supplies, which are designed to meet IEEE 279 and IEEE 308.

h. The emergency fresh air supply system is designed to seismic Category I requirements.

i. The equipment, ducts, and accessories for the emergency fresh air supply system are housed in a missile-protected structure.

j. The emergency fresh air intake ducts are designed to withstand the pressure effects of a tornado.

k. The emergency fresh air supply system utilizes the control room HVAC system as a flowpath to and from the control room during operation.

9.4.1.3.2 <u>System Description</u>

The emergency fresh air supply system consists of two 100% seismic Category I filter trains complete with fans, as described in Sections 6.4 and 6.5.1. Each train is powered from an independent Class 1E power source.

The system is shown in drawing M-78. Design parameters are listed in Tables 9.4-1 and 9.4-2.

Each filter train is connected to a common seismic Category I duct system. The emergency fresh air supply system is located within the seismic Category I control structure.

As discussed in Section 6.4.3, not all of the return air from the control room passes through the CREFAS system when the outside air intake is closed. As indicated in Table 9.4-1, the CREFAS system is designed to process 3000 scfm, while the control room supply unit is designed for 26,200 scfm. Therefore, approximately 11% of the total control room air passes through the CREFAS

system. During CREFAS system operation, valves HV-078-021A and HV-078-021B are closed, forcing any outside air entering the control room through the CREFAS system. By adjusting dampers PDC-078-013A,B and PDC-078-014A,B, a portion of the control room return air is allowed to mix with the fresh air from processing through the CREFAS system. The mixing of outside air and return air is controlled by the room pressure and return air through the CREFAS system maintains the control room radiation doses below the allowable levels, as demonstrated by the analysis in Section 15.6.5.

When the emergency fresh air supply system is in operation, the volume of air flowing in the fan discharge duct is continuously indicated on a local panel. The filter train pressure differential is continuously indicated on a local control panel. The loss of airflow automatically trips and isolates the operating train and starts the standby train. Both loss of airflow and high pressure differential across the filter train are alarmed in the control room. Temperature detectors monitor the temperature of the charcoal adsorber. The temperature is alarmed and indicated in the control room. The fire protection water valves are manually actuated, if required. Actuation of the fire protection system will produce an alarm in the control room.

ESF atmosphere cleanup systems are accessible during normal operation and during anticipated transients. ESF atmosphere cleanup systems operate only after an accident or during drywell purge. This allows records to be kept of periodic tests performed during normal operation on all ESF atmosphere cleanup systems, which ensures that prefilters and HEPA filters are either changed on high pressure readings or checked on abnormal readings.

The outside air for the control room HVAC system and auxiliary equipment room HVAC system are taken from a common outside air intake. The outside air intake is missile-protected and connected to seismic Category I design duct systems.

During normal operation, the outside air is drawn through the ducts and distributed to each system as described above.

Each charcoal train is continuously purged with 1 cfm of dry instrument air; however, any amount of dry air continuously purged through the adsorbers and HEPA filters will entrain moisture and maintain moisture levels at a minimum because the duct-work is gas-tight and there is no internal humidity source. (The periodic operation of the ESF atmosphere cleanup train could introduce additional moisture into the system and increase moisture levels above those normally maintained.)

When high radiation is detected at the outside air intake, the control room outside air is automatically diverted through the emergency fresh air filter system. All isolation valves in the control room HVAC system close, except those on the emergency fresh air intake.

When offsite toxic chemical or chlorine is detected at the outside air intake, the high chlorine or toxic chemical signal is annunciated in the control room. All isolation valves in the control room HVAC system close automatically on detection of chlorine will be manually closed after a toxic chemical is detected. These include:

a. Exhaust isolation valves

b. Control room relief air duct isolation dampers

c. Outside air isolation valves, including the normal and emergency fresh air valves

The logic of the isolation signals with the control room HVAC system initially in the radiation isolation mode is such that a single failure of the chlorine detection system could allow the filtered outside air intake to remain open, and thus, the control room HVAC system would remain in the radiation isolation mode. Under these circumstances, once the chlorine has been detected and alarmed in the control room, manual action can be taken to realign the system to the chlorine isolation mode. Analysis of this event assumes that the system remains in the radiation isolation mode with 525 cfm of outside air being mixed with recirculated control room air for a total of 3,000 cfm being passed through the charcoal adsorber filter trains, and that the filter has no effect on removal of chlorine. The results of the analysis indicate that, with the control room HVAC system in the radiation isolation mode, the necessity for automatic chlorine isolation is not required to satisfy General Design Criterion (GDC) 19 of 10CFR50 of Appendix A, and that the control room operators would have sufficient time to don breathing apparatus after an alarm is sounded in the control room (as shown in Table 2.2-6).

The control room HVAC system is automatically isolated before an offsite chlorine release reaches the intake isolation valves. After control room isolation is completed, the emergency fresh air system is started and operated to recirculate and clean up space air in the control room. The outside air intake valves remain closed during this mode of operation.

9.4.1.4 Control Structure HVAC Systems from Turbine Enclosure

The Unit 1 and 2 turbine enclosure HVAC systems provide heating, ventilating, and air conditioning during normal plant operation for given nonsafety-related areas on el 180', el 200', el 217', and el 254' in the control structure. These HVAC systems are not safety-related except the steam flooding isolation dampers, which are safety-related.

9.4.1.4.1 Design Bases

The turbine enclosure HVAC systems are designed to accomplish the following objectives during normal plant operation:

a. Maintain temperatures in the various spaces within specified limits (104°F maximum for access areas, pump-rooms, and cable spreading rooms; 112°F maximum for recombiner compartments, 122°F maximum for condensate backwash receiving tank compartment)

b. Meet the specified cooling and ventilation requirements to ensure the operability of the equipment and instruments without loss of function

c. Provide HEPA and charcoal filtration of potentially contaminated equipment compartment exhaust air prior to release to the atmosphere

d. Isolate supply and exhaust ducts and infiltration openings of compartments containing high energy pipes in the event of a pipe break.

9.4.1.4.2 System Description

The turbine enclosure HVAC systems serving the control structure are shown in drawings M-75, M-76, M-78 and M-79. Several areas of the control structure are served by the turbine enclosure Unit 1 and Unit 2 supply air, exhaust air, and filtered equipment compartment exhaust air systems. These areas are the condensate backwash receiving tank and pump compartments and the recombiner compartment on el 180', the control room chiller and analyzer compartments on el 200', the auxiliary switchgear room (makeup air) on el 217', and the cable spreading room on el 254'. These systems maintain the required design temperatures, supply ventilation air, and provide filtered exhaust for equipment compartments that may be contaminated. These systems do not operate on LOOP and are not safety-related.

Two steam flooding isolation dampers in series are provided on supply and exhaust ducts of selected compartments (drawing M-78) containing high energy piping. Each damper is provided with a pressure differential switch that trips the release mechanism to close the damper on sensing high pressure developed inside the room. The leakage rate for isolation damper is 1 cfm/ft^2 maximum.

9.4.1.5 SGTS Equipment Compartment HVAC Systems

The SGTS equipment compartment HVAC systems are common to Units 1 and 2.

The SGTS equipment compartment filtered exhaust system is designed to filter exhaust ventilation from the SGTS equipment compartment during normal plant operation. The SGTS room and SGTS access area unit coolers are designed to provide emergency cooling for the SGTS equipment compartment during SGTS operation under emergency conditions.

The SGTS equipment compartment filtered ventilation exhaust system is not a safety-related system. Conformance with Regulatory Guide 1.140 (March 1978) is discussed in Table 9.4-18. The SGTS room unit coolers and SGTS access area unit coolers are safety-related.

9.4.1.5.1 Design Bases

a. The SGTS equipment compartment HVAC systems are designed to maintain temperatures in the space within a range suitable for equipment performance.

b. The SGTS equipment compartment HVAC systems are designed to maintain adequate air flow for ventilation.

c. The SGTS room and SGTS access area unit coolers active components are designed with redundancy to meet the single active failure criterion.

d. The SGTS room and SGTS access area unit coolers are served by redundant Class 1E power supplies designed to meet IEEE 279 and IEEE 308.

e. The SGTS room and SGTS access area unit coolers are designed to seismic Category I requirements.

f. The SGTS room and SGTS access area unit coolers, ducts and accessories are housed in a missile-protected structure.

9.4.1.5.2 System Description

The SGTS equipment compartment HVAC systems are shown in drawing M-78. Design parameters are listed in Table 9.4-1.

Normal ventilation air for the SGTS equipment compartment is supplied from the auxiliary equipment HVAC system. The exhaust air is treated by a redundant, charcoal filtered, ventilation exhaust system prior to being discharged to the atmosphere. During standby diesel generator operation, redundant emergency SGTS unit coolers automatically cycle on room temperature to provide cooling. The normal ventilation exhaust system is supplied from a non-Class 1E circuit.

9.4.1.6 Emergency Switchgear and Battery Compartments HVAC System and Battery Compartments Exhaust System

The emergency switchgear and battery compartments HVAC system is common to Units 1 and 2. The emergency switchgear and battery compartments HVAC system is safety-related and is designed to provide ventilation and cooling for the Class 1E switchgear, batteries, inverters, and chilled water pump motors for both Units 1 and 2 under normal and abnormal station conditions. The battery rooms exhaust system is not safety-related and exhausts battery compartment air during normal station operation.

These systems are shown in drawing M-78. Equipment design parameters are listed in Table 9.4-1.

9.4.1.6.1 Design Bases

a. The emergency switchgear and battery compartments HVAC system is designed to maintain ambient temperatures suitable for equipment operation.

b. The active components of the emergency switchgear and battery compartments supply and return systems are designed with redundancy to meet the single active failure criterion.

c. The emergency switchgear and battery compartments supply and return systems equipment is served by redundant power supplies designed to meet IEEE 279 and IEEE 308.

d. The emergency switchgear and battery compartments supply and return system is designed to seismic Category I requirements.

e. The emergency switchgear and battery compartments HVAC system is housed in a missile-protected structure.

f. The battery compartments normal exhaust system is not safety-related and does not operate during LOOP. The battery compartments air is returned to the supply unit intake during emergency operation.

9.4.1.6.2 System Description

9.4.1.6.2.1 Battery Compartments Exhaust System

The system consists of redundant exhaust fans and isolation dampers. The system is designed to operate with one fan on standby and one operating. The branch ducts to each battery compartment are connected to a common duct system.

The battery compartments' makeup air is introduced by the turbine enclosure HVAC system. The exhaust fan system is designed to exhaust air from each battery compartment and discharge through the north vent stack to the atmosphere.

Two steam flooding isolation dampers in series are provided on exhaust ducts to the turbine enclosure (drawing M-78) that could be exposed to steam flooding breaks from energy piping. Each damper is provided with a pressure differential switch that trips the release mechanism to close the damper on sensing high pressure developed in the turbine enclosure. The leakage rate for isolation dampers is 1 cfm/ft^2 maximum.

During standby diesel generator operation (loss of offsite power), the battery compartment exhaust fans do not run, and the return from the battery rooms is diverted to the return duct-work for the emergency switchgear and battery compartment supply fans, diluted, and recirculated.

9.4.1.6.2.2 Emergency Switchgear and Battery Compartment Supply and Return Air System

The system consists of two 100% capacity seismic Category I air handling units (one operating and one standby). The systems are safety-related. Each air handling unit contains a roll-filter, a cooling coil, and a vaneaxial fan. The units are connected to a common seismic Category I supply and return duct system, which distributes supply air and returns compartment air from the two control structure chilled water pump motor locations on el 200', the control structure battery compartments on el 217' and el 239', the emergency switchgear compartments on el 239', and the inverter compartments on el 254'. The supply air is cooled by chilled water cooling coils. The emergency switchgear and battery compartment air conditioning equipment is located within the seismic Category I control structure. All equipment in each redundant system is powered from an independent Class 1E power source with the exception of the roll-filter motor.

The chilled water for the cooling coils in each system is supplied by a seismic Category I independent chilled water supply system. The chilled water systems, described in Section 9.2.10, are interlocked with their respective supply air fans in the same division.

When the supply fan starts, the chiller pump on the same division automatically starts. Failure of any of these fans is annunciated on the local panel, with a common panel alarm annunciating in the control room. When the standby fan starts, the standby division chilled water system starts automatically.

Fan selector switches on the local panel allow manual selection of systems.

Each air system is provided with an air temperature controller that regulates the temperature of the supply air. The controller modulates a three-way mixing valve to control the chilled water flow through the cooling coils.

9.4.1.7 Safety Evaluation

Safety-related control structure and control room HVAC systems are designed to maintain functional integrity during and after an SSE. Each system is provided with redundant equipment and controls to maintain uninterrupted room air circulation, and cooling, for personnel comfort and instrument functioning. Safety-related equipment is located within the control structure, a protected seismic Category I structure. During LOOP, standby power is automatically provided from the standby diesel generators for the continued operation of all safety-related equipment.

The single failure criterion for active safety-related equipment is met by using redundant equipment and controls and automatically switching from one redundant system to the other where actions are immediately required in response to accidents. The redundant control room air supply fan is manually started when required if a high operating supply fan discharge temperature occurs. Control room cooling can then be re-established in sufficient time, using manual actions, to maintain control room temperatures to support equipment and instrumentation functioning and operator comfort. Some procedures direct manual operation of the control room HVAC system during plant operations to support testing, inspection, repair, replacement activities and normal system operation. When the control room HVAC system is operated in this manual mode, procedures direct the manual initiation of standby equipment and the use of an operator to compensate for the temporary removal of the automatic start of the fan(s) in "Off". During periods when the fan(s) may be left in "Off", the operator will be dedicated operator in addition to the Technical Specifications minimum required staffing levels for the control room. Active equipment such as fans, controls, dampers, pumps, and chillers is redundant. Passive system components such as supply and return duct-work systems are common. Since redundant systems are provided for all temperature control functions of safety-related HVAC systems, temperature limits are not exceeded, and no degradation of equipment performance is anticipated.

This essential area has been provided with redundant HVAC equipment to maintain the required air flows and temperatures under normal and accident conditions. For failure mode and effects analysis, see Table 9.4-3 for both normal and accident conditions.

The control room HVAC system is designed to maintain environmental conditions within the space as specified for habitability and equipment operation under normal and abnormal operating conditions. The control room, which is the only critical manned area, will not exceed the comfort zone defined by ASHRAE during normal operating conditions. Equipment in the system is designed to seismic Category I requirements, except for the humidification equipment, roll filters, and electric duct heaters (seismic Category IIA). All duct-work and supports for the safety-related systems meet seismic Category I requirements. Habitability systems are further discussed in Section 6.4.

A radiation monitoring system is provided in the outside air intake to detect high radiation and initiate measures to ensure that personnel safety and equipment functions are not impaired and that the requirements of 10CFR20 are satisfied. In the event of a high radiation condition, the normal outside air supply to the control room HVAC system is diverted through the emergency fresh air filter train before being delivered to the control room. All isolation valves in the control room HVAC system close, except those on the emergency fresh air intake. These operations are annunciated in the control room.

The emergency fresh air filter train and the control room shielding are designed to limit the occupational dose level, as required by GDC 19.

The introduction of a controlled quantity of outside air maintains the control room and the other areas served by the control room HVAC system at a positive pressure with respect to surrounding areas. This positive pressure is maintained during all the plant operating conditions, except when the system is in the recirculation mode.

Offsite toxic chemical and chlorine detectors are provided at the outside air intake to detect toxic chemical or chlorine in the environment. In the event of a high chlorine or toxic chemical concentration, all isolation valves in the control room HVAC system close automatically for chlorine or manually for all other toxic chemicals, including those on the emergency fresh air intakes. The control room HVAC system is switched to the recirculation mode to cycle room air through the emergency fresh air filter train (charcoal adsorber) system. The filter system is discussed in Section 6.5.1.

The logic of the isolation signals with the control room HVAC system initially in the radiation isolation mode is such that a single failure of the chlorine detection system could allow the filtered outside air intake to remain open, and thus, the control room HVAC system would remain in the radiation isolation mode. Under these circumstances, once the chlorine has been detected and alarmed in the control room, manual action can be taken to realign the system to the chlorine isolation mode. Analysis of this event assumes that the system remains in the radiation isolation mode with 525 cfm of outside air being mixed with recirculated control room air for a total of 3,000 cfm being passed through the charcoal adsorber filter trains, and that the filter has no effect on removal of chlorine. The results of the analysis indicate that, with the control room HVAC system in the radiation isolation mode, the necessity for automatic chlorine isolation is not required to satisfy General Design Criterion (GDC) 19 of 10CFR50 of Appendix A, and that the control room operators would have sufficient time to don breathing apparatus after an alarm is sounded in the control room (as shown in Table 2.2-6).

> Note: the possibility exists for a chlorine accident to occur while the control room HVAC system is operating in the radiation isolation mode for testing purposes or as required by the Action statement of an associated Technical Specifications Limiting Condition of Operation, and likewise, a high radiation accident could occur while the control room HVAC system is operating in the chlorine isolation mode for the same purposes. The mode of system operation with the control room HVAC system in these initial system configurations is described in Sections 2.2.3, 6.4.3 and 15.6.

A smoke purge system is provided with a capability to purge the control room or auxiliary equipment room areas. In the event of smoke as a result of fire in the control room areas or auxiliary equipment room areas, the operating personnel may elect to purge the space by manually switching the supply and exhaust systems to purge mode of operation, which repositions outside air and exhaust dampers so that 100% fresh air and 100% exhaust air provides once-through purge ventilation until the smoke is removed; then manually switch back to normal operation. The purge system is shown in drawing M-78.

The steam flooding isolation dampers have an active safety-related function in the control enclosure HVAC system. The function of the dampers is to contain the steam resulting from a pipe break within the equipment compartment in which the break occurs and preclude the spread of the steam through HVAC openings or duct-work into adjacent spaces which may contain safeguard equipment. The dampers are redundant series mounted fast closing counterweighted or spring-operated back pressure dampers. The dampers are normally open. Closure of the dampers is actuated by a pressure switch sensing the rise in pressure created by the discharge of fluid from a

broken pipe. The switch activates a solenoid which disengages a pin and allows the damper blade to free fall or spring action into the closure position.

Each trouble alarm on the local control panel is alarmed in the control room as a panel group alarm. Indicating lights on the local panel identify the failed damper, which can be manually reset to the open position.

Refer to the following sections for further safety considerations included in the design:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

9.4.1.8 Tests and Inspections

The control room and control structure HVAC systems and their components are thoroughly tested in a program consisting of the following:

a. Factory and component qualification tests (Table 9.4-4)

b. Onsite preoperational testing (Chapter 14)

c. Onsite subsequent periodic testing (Chapter 16)

Written test procedures establish minimum acceptable values for tests. Test results are recorded as a matter of performance record, thus allowing early detection of faulty performance.

All equipment is factory-inspected and tested in accordance with the applicable equipment specifications, codes, and quality assurance requirements. Refer to Table 9.4-4 for details of inspection and testing.

9.4.1.9 Instrumentation Requirements

The hand switches and the associated status indicating lights of safety-related equipment of the control room HVAC systems are located in the control room. Control switches for isolation valves are located in the control room, and indicating lights for isolation valves are located on local control panels.

Although the indicating lights for isolation valves are remote from the control room, the redundant isolation valves are in series and are designed to fail-safe in the closed position. In addition, the

control logic is designed so that the redundant isolation signals of the isolation dampers override their corresponding control switch.

The control switches and status indicating lights for the remaining control structure HVAC equipment are located on the equipment, local panels, or local control stations.

Safety-related control room equipment failures, such as fans failing to establish airflow when required, are alarmed in the control room on one of two separate division annunciators. In addition, the following are alarmed or indicated in the control room:

a. High chlorine gas in the outside air

b. High offsite toxic gas in the outside air

c. High radiation in the outside air

d. High temperature (preignition) in the charcoal adsorber of the emergency fresh air supply systems

e. High-high temperature (desorption) in the charcoal adsorber of the emergency fresh air supply systems

f. High-high-high temperature (ignition) in the charcoal adsorber of the emergency fresh air supply system

A failure of other control structure HVAC equipment is alarmed on local control panels and is retransmitted to the control room as a trouble alarm.

Instruments of the safety-related systems are seismically and environmentally qualified and redundant to meet the single failure criterion. Environmental qualification is discussed in Section 3.11.

9.4.2 REACTOR ENCLOSURE AND REFUELING AREA VENTILATION SYSTEMS

The following systems are covered in this section:

a. Nonsafety-related reactor enclosure and refueling area HVAC systems for normal operation and safety-related HVAC duct isolation (Section 9.4.2.1)

b. Safety-related reactor enclosure air cooling systems (Section 9.4.2.2)

The RERS and the SGTS are described in Section 6.5.1.

9.4.2.1 Reactor Enclosure and Refueling Area HVAC Systems for Normal Operation

The secondary containment is divided into three isolated ventilation zones. Zones I and II consist of the reactor enclosures which surround the primary containments of Units 1 and 2, respectively, below the floor at el 352'. Zone III consists of the common refueling area above the floor at el 352'. These zones are shown in Figures 6.2-27 through 6.2-35.

This section discusses Unit 1 reactor enclosure and refueling area HVAC systems. The Unit 2 reactor enclosure and refueling area HVAC systems are identical to those described for Unit 1. Each of the ventilation zones is provided with independent HVAC systems designed to operate during normal plant operation and during shutdown. The common refueling area has a separate Unit 1 and Unit 2 ventilation system. Zone III systems function during normal fuel handling and storage operation. The RERS, SGTS, and REIS are used after a postulated LOCA or on loss of differential pressure in Zone I or Zone II. The SGTS and RAIS may be used after a fuel handling accident or on a loss of differential pressure in Zone III. Table 6.2-28 identifies the associated secondary containment ventilation system automatic isolation valves that are required for normal separate zone alignment.

The ability to procedurally combine each of the reactor enclosure secondary containment zones to the common refueling area secondary containment zone exists. Refer to Section 6.2 for details of the interlock.

9.4.2.1.1 Design Bases

The portion of the reactor enclosure and refueling area ventilation systems that are associated with the RERS, SGTS and secondary containment isolation systems are safety-related. The remaining portion of the duct-work within the secondary containment boundary is not safety-related; however, it is seismically designed and analyzed to ensure that it will not damage the safety-related equipment and systems. Seismic classifications are shown in drawing M-76. Secondary containment isolation and isolation of the steam flooding dampers are the only active safety-related functions of the normal operation of the reactor enclosure and refueling area HVAC systems. These HVAC systems are designed to accomplish the following objectives during stable and transient operating conditions, from startup to full power to shutdown:

a. Provide filtered outside air at approximately 6.0 air changes per hour below the refueling floor and approximately 2.3 air changes per hour per unit in the refueling area above the refueling floor

b. Maintain air flow from areas of lesser to areas of greater potential contamination

c. Maintain space temperature so as not to exceed the maximum temperature of 104ºF in the Refueling Area El. 352'-0", RERS Filter Compartments, Ventilation Fan Room El.313'-0", Access East El. 313'-0, North and South Corridors, Neutron Monitoring Area (Unit 1), Neutron Monitoring Area (Unit 2) and El. 177'-0" Access Areas; 110°F in the LPCI Isolation Valve Compartments, Core Spray Isolation Valve Compartment, Drywell Spray Isolation Valve Compartment and Backwash Receiving Tank Compartment; 112°F in the RWCU System Isolation Valve compartment; 113°F in the Piping Access El. 313'-0" and the RWCU System Non-Regenerative Heat Exchanger Compartments; 114°F in the RCIC Piping Area and 120°F in the HPCI Piping Area; 120°F in the Pipe Access (Nort) l. 201'-0" and North Pipe Access El.177'-0"; 122°F in the Main Steam Tunnel and Containment Isolation Valve Compartments El. 217'-0"; 123°F in the Pipe Tunnel El. 217'-0; 135°F in the Drywell Equipment Access (Southeast) El. 253'-0" and Drywell Equipment Access (Northwest) El. 253'-0"; 107°F in the South Cleanup Pump Room El. 313'-0" and in the Access (West) El. 201'-0"; and 106°F in the various remaining area of the reactor enclosure.

d. Maintain space temperature so that the minimum temperature is not below 65°F

e. Maintain the secondary containment at a negative pressure to prevent potential exfiltration of contaminated air.

f. Supply ventilation or purge air to the primary containment

g. Provide ventilation, cooling, and heating to the ECCS pump compartments during normal plant operation. (For safety-related cooling see Section 9.4.2.2).

h. Filter air exhausted from areas of greater potential contamination (equipment compartments - Zones I and II)

i. Monitor radiation in the unfiltered air from the refueling area (Zone III) exhaust system and isolate the refueling area on a high radiation signal

j. Monitor radiation in the reactor enclosure exhaust vent and isolate the reactor enclosure HVAC system on a high radiation signal

k. Provide for a transit time of exhaust air from the radiation monitors to the isolation valves of the refueling area unfiltered exhaust system so that the transit time is greater than the valve closing time plus the radiation monitor response time

l. Isolate appropriate ventilation zone or zones and start the RERS and/or SGTS upon receipt of the secondary containment isolation signal in the affected area

m. Isolate supply and exhaust ducts of compartments containing high energy pipes after a pipe break

n. Ensure that the secondary containment HVAC systems isolation valves and actuators are redundant, to meet the single active failure criterion

o. Ensure that the secondary containment HVAC systems isolation valve motor actuators are served by redundant power supplies that meet IEEE 279 and IEEE 308

p. Ensure that the HVAC isolation valves and actuators are designed to seismic Category I requirements

q. Ensure that the duct-work associated with the RERS, SGTS, and the secondary containment isolation systems are designed to seismic Category I requirements

Monitoring of radiation levels in the spent fuel pool area is discussed in Section 11.5.

9.4.2.1.2 System Description

The HVAC system P&ID for the reactor enclosure and refueling area is shown in drawing M-76. System design parameters are listed in Table 9.4-5. Chilled water is supplied to the air cooling coils in the HVAC systems by the DCWS, described in Section 9.2.10. The controls and instrumentation associated with each system are an integral part of the system.

All the equipment of the Unit 1 nonsafeguard air handling systems is located in two heating and ventilation equipment rooms (el 313' and el 332'). The two rooms are outside the secondary containment boundary.

Access to any zone from outside the zone or between the zones is through airlocks with airtight doors.

9.4.2.1.2.1 Reactor Enclosure Unit 1 (Zone I) Supply System (V-202) and Refueling Area (Zone III) Unit 1 Side Supply System (V-201)

Each system supplies its respective zone with conditioned 100% outdoor air. Each system includes, in the direction of air flow: outdoor air intake; roll filters; steam heating coils; chilled water cooling coils; three 50% capacity fans; two butterfly-type isolation valves in series; distribution duct-work with dampers; supply air outlets; and associated controls.

9.4.2.1.2.2 Reactor Enclosure Unit 1 (Zone I) Equipment Compartment Exhaust System (V-206)

This system exhausts air from equipment compartments with the higher potential for radioactive contamination. The system includes, in the direction of air flow: distribution duct-work with exhaust registers and dampers; two butterfly-type isolation valves in series; two 100% capacity filter trains; two 100% capacity fans; system discharge duct-work connecting to the reactor enclosure exhaust vent south stack; and associated controls. Each filter train contains prefilters, upstream HEPA filters, a charcoal absorber (2 inch deep vertical bed), and downstream HEPA filters.

Conformance of the equipment compartment exhaust air filter plenum to Regulatory Guide 1.140 is discussed in Table 9.4-18.

9.4.2.1.2.3 Reactor Enclosure Unit 1 (Zone I) Exhaust System (V-205) and Refueling Floor (Zone III) Unit 1 Side Exhaust System (V-204)

Each system exhausts air from the respective zone areas of lesser radioactive contamination potential. Each system includes, in the direction of air flows: distribution duct-work with exhaust registers and dampers; two butterfly-type isolation valves in series; three 50% capacity fans; discharge duct-work connecting to the reactor enclosure exhaust vent south stack; and associated controls.

9.4.2.1.2.4 Normal System Operation

During normal plant operation, the reactor enclosure and refueling area ventilation systems maintain the design temperature and pressure in the respective zones of Units 1 and 2. The supply air systems (V-202 and V-201) supply the respective zone with a constant air volume. Variable-pitch fan blades of exhaust systems V-205 and V-204 are modulated by appropriate pressure differential controllers to maintain a negative pressure in the secondary containment.

Each supply system is provided with two air temperature controllers (one for heating and one for cooling) to control the temperature of the air leaving the fans. The output of the steam heating coils is off-on, with face and bypass control. Chilled water flow through the cooling coils is modulated by three-way mixing valves controlled by the cooling controller. The cooling coils may be utilized during periods of high outside air temperature or periods of refueling outages.

The ventilation systems are designed to prevent high relative humidity during normal operation. The operation of the reactor enclosure equipment compartment exhaust system is similar to the operation of the turbine enclosure equipment compartment exhaust system (Section 9.4.4.2). The

further heating of the access area air as it passes through the equipment compartments results in a relative humidity of less than 70% to the charcoal adsorbers.

Two of three 50% capacity fans of systems V-202, V-205, V-204, and V-201 operate during plant normal operation. When failure of a running fan or its discharge damper is detected the respective standby fan automatically starts. On failure of a fan or its discharge damper, the preferred air flow pattern is not affected.

Failure of the exhaust system results in an automatic shutdown of the supply ventilation systems in that zone. Failure of the reactor enclosure supply ventilation system resulting in high area negative pressure results in the automatic shutdown of the corresponding exhaust systems V-205 and V-206. Failure of the refueling area supply ventilation system resulting in high area negative pressure differential would automatically shut down the refueling area exhaust systems V-204.

Redundant radiation monitors are provided in the ducts of V-204 (refueling area exhaust system) upstream of the system isolation valves. A high radiation signal from any monitor automatically isolates the refueling area, as described in Section 9.4.2.1.3. The exhaust air transit time between the monitors and the V-204 system isolation valves is greater than the combined time of valve closure and the monitor response. The exhaust air transit time is 10 seconds and the combined monitor response and valve closing time is 4-6 seconds.

Redundant radiation monitors are also provided in the ducts of V-205 (reactor enclosure normal exhaust system) upstream of the system isolation valves. The isolation valves in this duct trip upon receipt of a high radiation signal as well as a LOCA signal (Section 9.4.2.1.3). The valve closure time is 3-5 seconds. The reactor enclosure normal exhaust air is not held up to assure closure of the valve prior to the exhaust air reaching the valves as the reactor enclosure normal exhaust system exhausts areas of the reactor enclosure which have a low release potential. If an accident (LOCA) were to occur which resulted in radioactivity escaping into those areas, isolation of this exhaust duct would be initiated upon receipt of a LOCA signal.

Isolation by this means would occur before any significant radioactivity is discharged due to the travel time from the affected compartments to the isolation valves. In any event, isolation will occur within about 5 seconds after receipt of a high radiation signal. Releases during this short time period will be a very small fraction of 10CFR50.67 limits.

The systems' intake louvers and exhaust vents are not safety-related and are outside the secondary containment; therefore, no provisions for missile protection are made for these portions.

All panel-mounted instruments and controls, including fan manual switches, are installed on local control panels. A group alarm from each panel is annunciated in the control room.

Two steam flooding isolation dampers in series are provided on supply and exhaust ducts of selected compartments (drawing M-76) containing high energy piping. Each damper is provided with a pressure differential switch that trips the release mechanism to close the damper, on sensing high pressure developed inside the room. The maximum design leakage rate for isolation dampers is 1 cfm/ft^2 at maximum delta P.

The primary containment is purged at a rate of 11,000 cfm. This amount of air is diverted to the primary containment from the reactor enclosure supply system. From there the air is filtered through the SGTS filter and exhausted to the environment via the north vent stack.

The reactor enclosure exhaust is provided with a radiation sampler in the south stack. A high radiation level in the exhaust air in the south stack is alarmed in the control room.

9.4.2.1.3 Safety Evaluation

The reactor enclosure ventilation system is housed within the seismic Category I reactor enclosure. The following safety design criteria are discussed in the following sections:

Wind and tornado protection	Section 3.3
Flood design	Section 3.4
Missile protection	Section 3.5
Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
Environmental design conditions	Section 3.11

The secondary containment isolation is an active safety-related function of the reactor enclosure and refueling area HVAC systems during normal operation. The passive safety-related function of the system is the use of related duct-work in the reactor enclosure recirculation mode, which is discussed in Section 6.5.1.

The isolation valves used for secondary containment isolation are redundant (two in series), fail closed, butterfly-type valves, operated by a spring-loaded air cylinder. If an active failure disables one of the two valves, the other one still performs the isolation function.

The appropriate ventilation zones of the secondary containment are automatically isolated upon receipt of one of the following signals:

Signal	Isolates Zone(s)
High radiation in the refueling area exhaust ducts	I(*), II(*), or III
High radiation in the reactor enclosure exhaust ducts	I, II, or III(*)
Low differential pressure in the referenced zone (after appropriate time delay)	I, II, or III
LOCA signal as described below	I, II, or III(*)
A manual isolation signal from the control room	I, II, or III

The LOCA signal, as applied to the HVAC isolation signal, consists of low reactor water level or high drywell pressure.

(*) The ability to procedurally combine each of the reactor enclosure secondary containment zones to the common refueling area secondary containment zone exists. When the zones

are combined, the isolation signals for either of the zones will isolate all of the combined zones as required.
See Table 6.2-29.

Any of the above isolation signals results in the following automatic sequence for the affected zone or zones:

a. Close normally open isolation valves (two in series separating safety-related from nonsafety-related portions of each system) - Zones I, II, or III

b. Upon initiation of isolation valve closure, trip all running ventilation fans and prevent standby units from operating - Zones I, II, or III

c. Open normally closed isolation valves (two in parallel) on each duct connecting the RERS and SGTS fans and filters to the ventilation system duct-work used in the recirculation mode of operation - Zones I or II

d. Open normally closed isolation valves (two in parallel) located in the duct connecting the SGTS fans and filters to the refueling area, - Zone III

e. Start the RERS (Section 6.5.1) - Zones I or II

f. Start the SGTS (Section 6.5.1) - Zones I, II, or III

The steam flooding isolation dampers also have an active safety-related function in the reactor enclosure HVAC system. The function of the dampers is to contain the steam resulting from a pipe break outside containment within the equipment compartment in which the break occurs and preclude the spread of the steam through HVAC openings or duct-work into adjacent spaces which may contain safeguard equipment. The dampers are redundant series mounted fast closing counterweighted or spring-operated back pressure dampers. The dampers are normally open. Closure of the dampers is actuated by a pressure switch sensing the rise in pressure created by the discharge of fluid from a broken pipe. The switch activates a solenoid which disengages a pin and allows the damper blade to free fall or spring action into the closed position.

The failure of a steam flooding isolation damper in a closed position results in a loss of ventilation for the equipment compartment affected. Each trouble alarm on the local control panel is alarmed in the control room as a panel group alarm. Indicating lights on the local panel identify the failed damper, which can be manually reset to the open position.

The operational degradation of ventilation system components can be detected by direct equipment status indication (e.g., indicating lights for damper position or fan running status) or can be determined from abnormal temperature, differential pressure, alarms, and indication. Corrective action can then be taken.

Reactor enclosure and refueling area ventilation systems have been provided with redundant HVAC equipment to maintain the required air flows and temperatures under normal and accident conditions. See Table 9.4-7 for a failure modes and effects analysis of safety-related modes of operation. An FMEA during normal operation is not provided for the reactor enclosure for the following reasons:

a. Safety-related equipment in the ECCS compartments is cooled by individual redundant ECCS compartment coolers whenever the ECCS pumps start or the compartment temperature reaches 100°F as described in Section 9.4.2.2.2.

b. If the normal reactor enclosure ventilation system is lost, the SGTS and RERS will automatically start operating.

c. Safety-related equipment in the reactor enclosure is designed to perform safety functions under the environmental conditions resulting from a loss of the normal ventilation system.

9.4.2.1.4 Tests and Inspections

The reactor enclosure and refueling area HVAC systems and their components are thoroughly tested in a program consisting of the following:

a. Factory and component qualification tests (Table 9.4-4)

b. Onsite preoperational testing (Chapter 14)

c. Onsite subsequent periodic testing

Written test procedures establish minimum acceptable values for all tests. Test results are recorded as a matter of performance record, thus enabling early detection of faulty performance.

All equipment is factory-inspected and tested in accordance with the applicable equipment specifications, codes, and quality assurance requirements.

9.4.2.1.5 Instrumentation Requirements

See Section 9.4.2.2.5 for instrumentation requirements.

9.4.2.2 Safety-Related Reactor Enclosure Air Cooling System

The RHR, HPCI system, RCIC system, and core spray system pump compartment unit coolers and systems are covered in this section.

9.4.2.2.1 Design Bases

The reactor enclosure ECCS and RCIC pump compartment unit coolers are designed to accomplish the following objectives:

a. Maintain temperatures at a calculated maximum of 127ºF in the HPCI pump compartment, 140ºF in the RHR pump compartments, and 140ºF in the Core Spray pump compartments after a DBA and 125.5ºF in the RCIC pump compartment when RCIC is in operation. Allowable calculated maximum temperatures in the HPCI pump compartment (164ºF) and RCIC pump compartment (155ºF) have been established to permit HPCI and RCIC operability in the event of a loss of the pump compartment unit coolers.

b. Initiate automatic operation when the appropriate equipment in the ECCS/RCIC pump compartment starts

c. Initiate automatic operation upon a rise in temperature to 100°F in the ECCS/RCIC pump compartment served by the unit cooler

d. When the standby unit cooler is in service, initiate automatic operation of the standby unit cooler if the temperature in the ECCS/RCIC pump compartment increases to 110°F

e. Provide air flow over the ECCS/RCIC pump motors/turbines for cooling

f. Ensure that each RHR and Core Spray pump is provided with a separate ventilation system. Each ventilation system consists of two unit coolers. Each unit cooler is designed to accommodate 100% of the associated pump heat load. One cooler is required to support operability of each pump.

g. Ensure that the reactor enclosure ECCS/RCIC pump compartment unit coolers are served by redundant power supplies that meet IEEE 279 and IEEE 308

h. Ensure that the reactor enclosure ECCS/RCIC pump compartment unit coolers meet seismic Category I requirements

9.4.2.2.2 System Description

The safety-related air cooling systems are shown schematically on drawing M-76. System design parameters are shown in Table 9.4-6. All coolers are supplied by the normal service water system or ESW, if normal service water is not available. The controls and instrumentation associated with each system are an integral part of that system.

Each ECCS/RCIC pump compartment unit cooler recirculates and cools its respective compartment air and is capable of carrying the following cooling loads:

a. RHR and core spray pump compartment coolers - total cooling load associated with operation of ECCS pump(s) assuming a single active failure. See FMEA Table 9.4-7 for more details.

b. RCIC and HPCI pump compartment coolers - the total compartment cooling load

Each unit cooler consists of a cabinet with a cleanable cooling coil and a direct drive vaneaxial fan mounted outside of the cabinet. The unit coolers are mounted adjacent to the pumps they serve, and the lead cooler starts automatically when the respective pump starts or when the room temperature exceeds 100°F. When the standby cooler is inservice, the standby cooler will start automatically if either the lead unit cooler fails to start when its respective pumps starts or if the compartment temperature rises to 110°F. Each cooler is also provided with a hand switch in the local panel for manual operation. During normal plant operation, the reactor enclosure ventilation system is used to maintain the design conditions in the ECCS and RCIC pump compartments (Section 9.4.2.1).

9.4.2.2.3 Safety Evaluation

The safety related reactor enclosure air cooling system provides cooling to the ECCS/RCIC compartments as described in Section 9.4.2.2.2. The system is provided with HVAC equipment to maintain the required air flows and temperatures under normal and accident conditions. See Table 9.4-7 for a failure modes and effects analysis of safety-related modes of operation.

Safety-related equipment within the HPCI and RCIC compartments have equipment qualification requirements which enable HPCI and RCIC system operability during periods when there is a loss of unit cooler function.

All unit coolers, duct-work and supports, and other systems components meet seismic Category I requirements. Each unit cooler is designed to accommodate 100% of the associated pump heat load. For RHR/Core Spray, one cooler is required to support operability of each pump. For RHR, any two coolers in one RHR compartment are sufficient to support both pumps and all other EQ components located in the compartment. See Section 9.2.2.2 and Table 9.4-7 for more details.

9.4.2.2.4 Tests and Inspections

The system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16.

9.4.2.2.5 Instrumentation Requirements

Hand switches, equipment status indicating lights, flow, temperature and pressure indicators and alarms for nonsafety- related reactor enclosure HVAC systems are located on local panels. General trouble alarms for each panel are located in the control room. These alarms are activated by any specific alarm on the local panel.

Hand switches for the isolation system are located in the control room. Status indicating lights for the isolation valves are located on the local panel.

Hand switches and status indicating lights for the unit coolers are located on local HVAC control panels.

The following alarms are annunciated in the control room:

a. Equipment status for safety-related equipment that may require operator action (refer to Section 7.3 for safety-related equipment alarm locations)

b. High radiation in refueling area or reactor enclosure exhaust ducts and the downscale signal from radiation monitors

c. Secondary alarms caused by closure of any of the steam flooding isolation dampers

d. Group alarm from each HVAC local control panel that has local alarms

e. Manually induced inoperability of safety-related systems is alarmed

f. Preignition temperatures for all charcoal filters

g. Low pressure differential in each zone

In addition, the following conditions are alarmed on the local HVAC control panels and transmitted to the control room as a group alarm:

a. Equipment status for nonsafety-related equipment and safety-related equipment that does not require immediate operator action (refer to Section 7.3 for safety-related alarm locations)

b. Elevated nonsafety-related charcoal filter temperature

All instruments and controls performing safety-related functions are qualified to seismic Category I requirements and are environmentally qualified as discussed in Section 3.11.

The redundancy and separation of instrumentation and controls conform to the redundancy and separation requirements of the equipment they control or monitor.

9.4.3 RADWASTE ENCLOSURE AND CHEM LAB EXPANSION VENTILATION SYSTEM

The radwaste enclosure and chem. lab. expansion ventilation system maintains area air temperatures and quality in the radwaste enclosure and chem. lab. expansion . The radwaste enclosure ventilation system is not safety-related.

9.4.3.1 Design Bases

The radwaste enclosure and chem lab expansion ventilation system is designed to operate during normal conditions and accomplish the following objectives:

a. Provide a supply of filtered and tempered outside air to areas in the structure.

b. Maintain airflow from areas of lesser to areas of greater potential contamination.

c. Maintain a suitable environment in the enclosure spaces for equipment, operation, and/or personnel comfort.

d. Maintain the enclosure at a slightly negative pressure to prevent potential exfiltration of contaminated air.

e. Filter, through HEPA filters, air exhausted from all areas, except the noncontaminated general areas indicated in drawing M-79.

f. Provide HEPA filtration for gases vented from radwaste tanks and pump sumps.

g. Discharge all exhaust air to the reactor enclosure north vent stack.

9.4.3.2 System Description

The radwaste enclosure and chem. lab. expansion ventilation system is shown schematically in drawing M-79. Equipment design parameters are listed in Tables 9.4-8 and 9.4-8A. The chilled water system supplying the cooling coils in the HVAC supply units is described in Section 9.2.10.

The radwaste enclosure supply air fans, plenums, and related control panel are located in the heating and ventilation equipment room on el 257'. The exhaust air fans, filter housings, and related control panels are located in the heating and ventilation equipment rooms on el 237' and el 257'.

The supply and exhaust fans are controlled to maintain a slightly negative building pressure; air is supplied to "clean" areas and exhausted from potentially contaminated compartments. Air exhausted from potentially contaminated compartments is filtered. All exhausted air is sampled by radiation monitors and is discharged to the north vent stack.

All major systems are provided with redundant fans (and exhaust filters) on automatic standby. The charcoal filter serving the tank and sump vents is equipped with a fire protection water spray system (Section 9.5.1).

9.4.3.2.1 Radwaste General Areas

The supply air unit for the corridors, heating and ventilation equipment areas, and other general compartments consists of two 100% capacity fans, with discharge dampers, connected to a common housing containing a roll-type filter, face and bypass dampers, steam heating coils, and a cooling coil. With air flow established in the exhaust systems for the general areas and equipment compartments, one supply fan is started manually by a local hand switch; this switch also opens the discharge damper and the control air supply valve. Filtered and tempered outdoor air is distributed by duct-work to the aforementioned low contamination areas. Corridor air flows to the pump and equipment compartments (higher potential contamination). The fan blade pitch is automatically adjusted to maintain the corridors at a pressure lower than the turbine enclosure. Failure of the operating fan automatically activates the standby supply fan and its accessories. Failure of an associated exhaust system stops the supply fans.

Air in the radwaste supervisor room, radwaste control room, technician's room, monorail and access areas, crane control room, and heating and ventilation equipment areas is removed by two 100% capacity exhaust fans. One exhaust fan is started manually; this also opens the fan inlet and outlet dampers and the control air supply valve. The fan blade pitch is automatically adjusted to vary static pressure in the exhaust duct to ensure negative enclosure pressure. Failure of the operating exhaust system automatically activates the standby exhaust fan and its dampers.

9.4.3.2.2 Radwaste Equipment Compartments

The equipment and tank compartments are supplied with air from the corridors. Some compartments also have steam unit heaters, as indicated in drawing M-79.

Many of the equipment compartments have individual exhaust duct air flow regulators to modulate air flow in response to compartment temperature. The solid radwaste compartments have individual exhaust filter trains (prefilters and HEPA filters) that discharge into the equipment compartment exhaust duct.

The radwaste tanks and radwaste drainage sumps are mechanically vented through a HEPA filter by a single exhaust fan that also discharges into the equipment compartment exhaust duct.

Exhaust air collected from the equipment compartments, tank vents, and other potentially contaminated compartments indicated in drawing M-79 is removed by one of two 100% capacity exhaust units. One equipment compartment exhaust filter train is activated manually at the local

control panel by opening the filter isolation dampers. The filter housing has prefilters and HEPA filters. The exhaust fan is also started manually at the local control panel which opens the fan inlet and outlet dampers. The fan blade pitch is automatically adjusted to maintain constant static pressure in the exhaust duct to ensure negative pressure in the tank and equipment compartments. Failure of the operating exhaust fan automatically activates the standby fan; however, switch-over to the standby filter train requires manual operator action. No humidity control of the air entering the radwaste enclosure tank filters is provided. The air entering these filters could be greater than 70% relative humidity, therefore no credit is taken for iodine adsorption in the offsite dose calculations.

Conformance with Regulatory Guide 1.140 is discussed in Table 9.4-18.

9.4.3.2.3 Radwaste Service and Control Area

The supply air unit V-302 for the service and control areas indicated on drawing M-79 consists of two 100% capacity fans, cooling coils, humidifiers, and discharge dampers connected to a housing containing a roll-type filter, inlet damper, and steam heating coil. Both fans discharge through a steam duct reheat coil. With air flow established in one chemistry lab exhaust unit, one supply fan is manually started; this also opens its discharge damper and the common inlet damper. Outdoor air is filtered, tempered, and humidified for the control and service areas (which have personnel occupancy). The supply air design temperature is maintained by a discharge duct thermostat, which is reset by a thermostat in the radwaste enclosure control room. Failure of the operating fan automatically activates the standby fan and its accessories. Failure of the service and control area exhaust units stops the service and control area supply fans. Individual air conditioning units are provided in the laboratories and offices to augment the cooling of the rooms. Data Acquisition Room is maintained at 68° F±/-2°F and 50% relative humidity ±5% with individual air conditioning units and humidifier.

The radwaste control room, radwaste supervisor room, health physics room, and washroom are exhausted by the general areas exhaust fans. The source storage/standards preparation room, counting room, decontamination, and change area are exhausted by the chemistry laboratory air exhaust system, which contains two 100% capacity exhaust units. One service area exhaust fan (with associated filter train) is activated manually, which also opens the filter/fan isolation dampers. The filter housing contains prefilters and HEPA filters. Technician's Area is exhausted by the equipment compartment air exhaust system V-305.

9.4.3.2.4 Chemistry Laboratory Expansion

The Chemistry Laboratory Air Supply System and the Chemistry Laboratory Air Exhaust System are designed and constructed to serve the Radiologically Controlled Area only. The office Area and the Cold Lab are served by another system. The following are within the Radiologically Control Area:

- Hot Lab
- Frisk Area/Corridor
- Count Room
- Instrument Lab
- Mechanical Penthouse

The Count Room and Instrument Lab is designed for 68°F ± 2°F and 50% relative humidity ± 5% and the rest of the Chemistry Laboratory is designed for personnel comfort at 75°F ± 5°F and 50% relative humidity ± 10%. The thermostats are capable of being set and adjusted in 1°F increments.

A new HVAC supply system is provided for the Chemistry Laboratory. The Chemistry Laboratory Air Supply System includes low efficient filters (55%), high efficiency filters (95%), electrical heating coils, cooling coils, and fans. This supply system consists of two redundant 100% capacity fans, coils, and filters. Cooling is provided through two redundant 100% capacity air cooled, roof mounted condensing units. Roof top mounted mechanical equipment is provided with vibration isolators to minimize vibration problems. High efficiently filters are installed in the supply units to minimize lab dusting problems. The supply unit manufacturers's direct digital control package is provided for a constant volume system.

The count Room and Instrument Lab have stringent temperature and humidity requirements. Each of these rooms is provided with its individual environment control unit that will provide continuous complete control of temperature, humidity, and air cleanliness.

The existing Radwaste Service and Control Air Exhaust system (V-306) are renamed and used as the Chemistry Laboratory Air Exhaust System. The existing system contains two redundant 100% capacity filtration units, prefilters and HEPA filters. The rated capacity of the existing filtration units, fans and duct to the north vent stack is 2,850 cfm. The gas chromatograph, plasma spectrophotometer, and TOC's are exhausted through the Chemistry Laboratory Exhaust system.

The Chemistry Laboratory exhaust fans are interlocked with the supply fans to ensure exhaust fan operation prior to supply fan operation . The Chemistry Laboratory is maintained at a slight negative pressure with respect to atmospheric pressure. The Hot Lab, Instrument Lab and Source Storage/Standards Preparation Room are maintained at a slight negative pressure with respect to the corridors. The Count Room is maintained at a slight positive pressure relative to the corridors.

An HVAC control panel contains instrumentation, handswitches, and annunciators for HVAC system trouble, and high filter differential pressure. A local panel trouble alarm is located in the Radwaste Control Room.

Electric unit heaters are located in the mechanical Penthouse to maintain penthouse temperature above 50°F.

The Office Area and Cold Lab are not in the Radiologically Controlled Area. A separate HVAC system is provided for these areas. The following areas are outside the Radiologically Controlled Area:

- Office Area
- Conference/Lunch Area
- Cold Lab
- Locker Area
- Rest Rooms
- Kitchenette Area

All areas of the Chemistry Laboratory Office Area are designed, installed, and tested in accordance with Section X of Division 3 of Specification NE-130.

Each Cold Lab fume hood is exhausted through its individual exhaust fan. Another exhaust fan is provided for the Rest rooms, Locker Area, and Kitchenette Area. Effluent from these three exhaust fans will not be filtered or radiologically monitored.

Exhaust duct pressure is varied by modulating the inlet damper to ensure negative pressure in the service areas. Failure of the operating exhaust unit automatically activates the standby fan and filter train.

9.4.3.2.5 Fume Hoods

The makeup air unit for the fume hoods in the chemistry laboratory and in the source storage/standard preparation room, radwaste enclosures consists of two 100% capacity fans, electric heating coils, high efficiency filters, (95%), low efficiency prefilters (65%) and discharge dampers. With air flow established in one fume hood exhaust unit, one supply fan is manually started, and its dampers are opened. Outdoor air is filtered, heated, and ducted to the fume hoods. Failure of the operating fan automatically activates the standby fan and its accessories. Failure of the fume hood exhaust system stops the fume hood supply fans.

The fume hoods are exhausted by two 100% capacity exhaust units. One exhaust fan (with associated filter train) is activated manually, which also opens the filter/fan isolation dampers. The filter housing contains prefilters and HEPA filters. Constant exhaust duct pressure is maintained by modulating the inlet damper to ensure negative pressures in the fume hoods. Failure of the operating exhaust unit automatically activates the standby fan and filter train.

The Fume Hood Air Exhaust System is interlocks with the Fume Hood Auxiliary Air Supply System to ensure exhaust fan operation prior to supply fan operation.

9.4.3.2.6 Charcoal Tank Vaults

The charcoal tank vaults for the offgas treatment system are air conditioned.

The primary and standby air conditioning systems each have 100% capacity. Each system consists of a refrigerant condensing unit, and three direct-expansion unit coolers ducted to the tank vaults. The primary system starts automatically on a temperature signal from any one of the three vaults. Failure of the primary system alarms the control room. The standby air conditioning system starts automatically on a high temperature signal from any of the three vaults. Both systems can be manually operated both locally and from the radwaste control room.

The air conditioning equipment for the offgas treatment charcoal tank vaults is located in the offgas treatment equipment room and access corridor on el 195'.

The charcoal tank rooms are also exhausted as described in Section 9.4.3.2.2.

9.4.3.3 Safety Evaluation

The radwaste enclosure ventilation system has no safety-related functions. Failure of the system does not compromise any safety-related system or component or prevent a safe shutdown of the plant.

9.4.3.4 Tests and Inspections

All HVAC equipment is inspected and tested during manufacture, installation, and startup. Air and water flows are measured and adjusted to design requirements with calibrated instruments.

9.4.3.5 Instrumentation Requirements

All hand control switches for the radwaste enclosure ventilation system are on local control panels in the radwaste enclosure. The local panels transmit any HVAC alarm signal to general trouble alarms located in the main control room. The following abnormal conditions are alarmed:

a. Air flow failure (all ducted fans)

b. Low pressure differential with respect to the turbine enclosure

c. Supply air heating coil failure

d. High general area exhaust temperature

e. High equipment compartment exhaust temperature

f. High pressure differential across an exhaust filter train

g. High pressure differential across supply filters

h. Supply filter media run-out

i. Charcoal tank room refrigeration equipment failure

All control for the Chemistry Laboratory Expansion ventilation system are on local control panels in the building penthouse. The local panels transmit a common "HVAC" Trouble alarm signal to the Radwaste Control Room. Local alarms for various trouble conditions are provided.

The system includes sensors, controllers, time delays, switches, and indicators to automatically switch or stop fans; open and close isolation dampers; advance roll-filter media; modulate control dampers; open or close steam heating coil valves; open, close, or modulate cooling coil valves; modulate steam humidifier control valves; adjust fan blade pitch; modulate duct regulators; start unit heaters; and indicate temperatures and filter pressure differentials.

9.4.4 TURBINE ENCLOSURE VENTILATION SYSTEM

The function of the turbine enclosure ventilation system is to maintain design air temperatures and quality in the turbine enclosure. The turbine enclosure ventilation system is not safety-related.

9.4.4.1 Design Bases

The turbine enclosure ventilation system is designed to operate during normal conditions and accomplish the following objectives:

a. Provide a supply of mixed, filtered, and tempered air to the turbine enclosures and to el 180', el 200', el 217', and el 254' in the control structure

b. Maintain airflow from areas of lesser to areas of greater potential contamination

c. Maintain the enclosure spaces within the following temperature ranges:

Electrical equipment areas	65°F to 106°F

Mechanical equipment areas	65°F to 117°F
Condenser/feedwater areas	65°F to 122°F
Control structure equipment compartments	65°F to 104°F
Control structure tank compartments	65°F to 122°F

d. Maintain the equipment compartment areas at slightly negative pressure to prevent potential exfiltration of contaminated air

e. Exhaust air from potentially contaminated spaces through particulate and charcoal filters

f. Discharge all exhaust air to the north vent stack

g. Provide cooling air to the Unit 2 MG sets

9.4.4.2 <u>System Description</u>

The schematic diagrams for the turbine enclosure and ventilated areas in the control structure are shown in drawings M-75 and M-78, respectively. Equipment design parameters are listed in Table 9.4-9. The chilled water system supplying the cooling coil banks and unit coolers is described in Section 9.2.10.

The turbine enclosure supply air unit, main exhaust fans, filters, and control panel are located in the HVAC equipment room at el 302'. The battery room exhaust fan is located outside the battery room. Individual unit coolers and unit heaters are located in the areas that they serve, as indicated in drawing M-75.

High relative humidity in normal ventilation exhaust systems is prevented. During outside conditions of high temperature and high humidity, the inlet air to the turbine enclosure passes through cooling coils resulting in dehumidification. Inside air is also recirculated through the coils. Equipment compartments use infiltration air from access areas which is exhausted through the turbine enclosure equipment compartment exhaust charcoal adsorbers. This yields a further temperature increase and dehumidification of this exhaust air which results in a relative humidity of less than 70% entering the charcoal adsorbers during worst case conditions.

Potentially contaminated compartments are only exhausted; makeup air is drawn from negative pressure "clean" areas (rather than direct supply) to prevent exfiltration from the compartments and from the structure. Potentially contaminated air is filtered and discharged, along with air from the noncontaminated areas, through the reactor enclosure north stack, which is monitored for radiation.

All major systems are provided with redundant fans on automatic standby. The equipment compartment exhaust fan motors, which are connected to 4 kV safeguard switchgear (because of their large size), are automatically deactivated upon a LOCA signal or LOOP.

The charcoal filters (in the filter housings serving the equipment compartments) are equipped with water spray fire protection systems. High charcoal temperatures are alarmed directly in the control room, as well as locally.

The systems described are for the Unit 1 turbine enclosure. Unit 2 systems are similar.

9.4.4.2.1 Supply System (V101)

The supply air unit for the turbine enclosure consists of three 50% capacity fans, with individual discharge dampers, connected to a common housing containing mixing dampers, a roll-type filter, face and bypass dampers, and a steam heating coil. The fans discharge into a common plenum and through two cooling coil banks, one for the reactor recirculation pump MG set area, and one for the other areas in the turbine enclosure and part of the control structure.

Two supply fans are started manually by local hand switches which also opens their respective discharge dampers. Outside and return air is mixed, filtered, heated or cooled, and distributed by duct-work to the operating floor, MG set area, equipment compartments, and part of the control structure.

Failure of an operating supply fan automatically activates the standby fan and its discharge damper. Loss of negative pressure in the sampled area will activate the local panel alarms and control room annunciators.

9.4.4.2.2 Unit Coolers

The following areas have individual chilled water unit coolers in addition to ventilation from the main supply unit:

a. Condensate transfer and refueling pump access

b. Feedwater heater compartments and access

c. RFPT compartment access

d. Mechanical vacuum pump compartment

The following areas have individual service water unit coolers in addition to ventilation from the main supply unit:

a. Main condenser compartment

b. Condensate pump compartment

There is at least one standby unit cooler in each of the above areas. The unit coolers can be started manually or automatically (by signals from inlet air thermostats).

9.4.4.2.3 Unit Heaters

Steam unit heaters are installed in the majority of the areas listed in tables A, C, E, F, and G of drawing M-75. The unit heaters are started automatically by local thermostats.

9.4.4.2.4 Return/Exhaust Air System (V105)

Air in the noncontaminated areas indicated in drawing M-75 is removed by three 50% capacity fans with individual discharge dampers. The fans discharge into a common duct, and the air is either exhausted to the reactor enclosure north stack or returned to the supply air unit and mixed with outside air.

Any two of the three turbine enclosure fans are started manually by local hand switches; this also opens their respective discharge dampers. A pressure differential controller automatically adjusts the blade pitch of the operating fans to maintain a negative pressure in the turbine enclosure. Failure of one operating exhaust fan automatically activates the standby fan and its dampers. An interlock with the Unit 2 reactor recirculation pump MG set controls prevents the starting of the Unit 2 MG sets when the exhaust fans are not operating.

9.4.4.2.5 Equipment Compartment Exhaust System (V106)

Air in the potentially contaminated equipment compartments indicated in drawing M-75 is filtered before being exhausted. Air vented from the condensate pump area sumps is filtered through individual prefilters and HEPA filters before being ducted to the main filter bank. Air from the condensate transfer and refueling pump access at el 200' is cooled by duct mounted chilled water coils and used to cool the holding pump compartments and condensate filter/demineralizer cells before being ducted to the exhaust filter bank.

The two 50% capacity filter banks each contain a prefilter, HEPA filter, charcoal adsorber, final HEPA filter, and inlet and outlet dampers. There is also a 50% capacity bypass duct for use when one of the filter banks requires servicing. The 50% capacity bypass duct is provided with a diffusion plate to simulate the pressure drop across the filter banks. There are two 100% capacity exhaust fans, each with inlet guide vanes and discharge damper. One exhaust fan and both filter trains are activated manually by local

hand switches. An air flow controller automatically adjusts the inlet guide vanes on the operating fan to maintain constant air flow from the equipment compartments. In the automatic mode, loss of flow from the operating fan deactivates that fan and activates the standby fan by use of a pneumatic electric relay (to provide divisional separation). The bypass duct diffusion plate may be removed under administrative control to achieve 100% bypass of filter banks when it is determined that filtration is not required to limit offsite doses.

The equipment compartment exhaust fans are fed from the respective 4 kV safeguard buses. However, they are automatically tripped on a LOCA signal or LOOP.

Conformance with Regulatory Guide 1.140 is discussed in Table 9.4-18.

9.4.4.2.6 Battery Compartment Exhaust Fan (V108)

The battery compartment is continuously exhausted by a single fan that is started manually by a hand switch on a local panel.

9.4.4.3 Safety Evaluation

The turbine enclosure ventilation system has no safety-related functions. Failure of the system does not compromise any safety-related system or component or prevent a safe shutdown of the plant.

9.4.4.4 Tests and Inspections

All HVAC equipment is inspected and tested during manufacture, installation, and startup. Air and water flows are measured and adjusted to design requirements, and the instruments are calibrated.

9.4.4.5 Instrumentation Requirements

All hand control switches for the turbine enclosure ventilation system are on local control panels in the turbine enclosure. The local panels transmit any ventilation alarm signal on to the control room panel. The following abnormal conditions are annunciated:

a. Air flow failure (all ducted fans)

b. Supply air heating coil failure

c. Supply air cooling coil failure

d. High motor or generator exhaust temperature

e. High general area exhaust temperature

f. High equipment compartment exhaust temperature

g. High charcoal adsorber temperature

h. High demineralizer cell exhaust temperature

i. High compartment temperature (compartments with unit coolers only)

j. High pressure differential across supply filter

k. High pressure differential across equipment compartment exhaust filter train

l. Supply filter media run-out

There are various sensors, controllers, switches, time delays, and indicators to automatically switch or stop fans, open and close isolation dampers, advance roll-filter media, modulate control dampers, open steam heating coil valves, open or modulate cooling coil valves, adjust fan blade or inlet guide vane pitch, start unit coolers and unit heaters, and indicate temperature, enclosure pressure, and filter resistance.

9.4.5 PRIMARY CONTAINMENT VENTILATION SYSTEM

Ventilation of the primary containment is provided by two systems: the containment atmospheric control system and the drywell air cooling system.

9.4.5.1 Containment Atmospheric Control System

The CAC system incorporates features for accomplishing a number of functions, including inerting of the primary containment with nitrogen, purging of the primary containment, limiting the differential pressure between drywell and wetwell, monitoring of hydrogen and oxygen concentrations in the primary containment, and controlling combustible gas concentrations in the primary containment after a LOCA. Those functions relating to post-LOCA combustible gas monitoring and control are discussed in Section 6.2.5, whereas all other functions are described in this section.

The CAC system serves the drywell and suppression chamber in various modes of operation during reactor operation, reactor shutdown, and postaccident conditions. Portions of the system are safety-related.

9.4.5.1.1 Design Bases

a. The CAC system is designed to provide a means by which nitrogen gas can be introduced into the primary containment at a high flow rate, thereby displacing air originally in the containment volume, for the purpose of reducing the oxygen concentration in the containment atmosphere.

b. The CAC system, operating in conjunction with the reactor enclosure ventilation system, is designed to provide a high volume purge flow to the drywell and suppression chamber to provide the proper atmosphere for early personnel access following shutdown of the reactor.

c. The CAC system is designed to control the containment pressure and oxygen concentration during all modes of reactor operation by supplying nitrogen gas to and/or releasing gases from the primary containment in a controlled manner.

d. The CAC system, operating in conjunction with the reactor enclosure ventilation system, the RERS, and the SGTS, is designed to remove radioactive contaminants from all primary containment gas prior to its release to the environment.

e. The combustible gas analyzer of the CAC system is designed to operate either in standby or continuous mode during normal operation to monitor the hydrogen and oxygen of the primary containment. However, the combustible gas analyzer is required to continuously monitor hydrogen and oxygen concentrations in the primary following a LOCA.

f. The CAC system is designed to provide a means of hydrogen and oxygen recombination with sufficient capacity to prevent the accumulation of a combustible concentration of gases within the primary containment following a LOCA.

g. The CAC system is designed to permit a controlled purge of the primary containment atmosphere at a low flow rate following a LOCA, as a backup means of combustible gas control.

h. The CAC system is designed to automatically isolate the lines that penetrate primary containment to ensure the integrity of the containment boundary during accident conditions.

i. The CAC system is designed to monitor the pressure and the temperature in both the drywell and suppression chamber.

j. The CAC system is designed to limit the differential pressure that can develop across the diaphragm slab.

k. The safety-related portions of the CAC system are designed to remain functional after an SSE.

l. The CAC system is designed so that a single failure of any active component, assuming LOOP, cannot result in the loss of a safety function.

9.4.5.1.2 System Description

The CAC system is shown schematically in drawing M-57. With the exception of the liquid nitrogen facility, which is located outdoors, the system is located entirely within the reactor enclosure.

9.4.5.1.2.1 Nitrogen Inerting

During power operation of the reactor, the oxygen content of the primary containment atmosphere is maintained at a concentration no greater than 4% by volume. This limit is established to preclude the attainment of a combustible gas mixture inside the containment if combustible gases are released into the containment atmosphere following a postulated accident.

This low oxygen atmosphere is achieved by displacing air in the primary containment with nitrogen gas. The nitrogen is supplied from a liquid nitrogen facility, which consists of two liquid nitrogen storage tanks and one steam heated water bath vaporizer. The liquid nitrogen facility is common to both reactor units. Gaseous nitrogen from the discharge of the vaporizer is supplied to the drywell and/or the suppression chamber as selected by the operator. The flow rate of nitrogen is controlled to a value that is also selected by the operator. Gases released from the primary containment during nitrogen inerting are processed through the filters of the SGTS (Section 6.5.1.1) before release to the environment.

During the inerting operation, nitrogen is supplied to the containment and gases are released from the containment through the four high volume purge penetrations. Once the specified oxygen concentration in the primary containment has been achieved, nitrogen flow is terminated and the isolation valves in the high volume purge lines are closed.

9.4.5.1.2.2 High Volume Purge

High volume purging is performed during periods of reactor shutdown to maintain a well ventilated environment for personnel occupancy of the primary containment. High volume purging may also be performed during the operational modes of startup, power operation, and hot shutdown for the purpose of inerting and deinerting the primary containment.

High volume purging during the latter three operational modes will be restricted as follows:

a. Inerting will be terminated within 24 hours after reactor thermal power exceeds 15% of rated thermal power following startup.

b. Deinerting will be initiated no more than 24 hours prior to reducing reactor thermal power to 15% of rated thermal power preliminary to a planned reactor shutdown.

c. The 18” and 24” primary containment purge valves are required to be closed except for inerting, de-inerting, pressure control, ALARA or air quality considerations for personnel entry, or Surveillances that require the valves to be open.

The inert atmosphere (diluted with nitrogen to <4% 0_2) is purged from containment in anticipation of outages requiring containment access to allow inspections and limited repairs while the reactor is at some reduced power level. Inspections are also performed during power ascension prior to the inerting of containment. These inspections facilitate the early detection and location of coolant system leaks which could have an impact on unit reliability and safety if uncorrected.

High volume purge air is supplied to the CAC system by the reactor enclosure HVAC system, which is described in Section 9.4.2. The purge air is maintained within the normal temperature range for the reactor enclosure HVAC system. Gases exhausted from the primary containment during the high volume purge mode are processed by the SGTS (Section 6.5.1.1) prior to release to the environment. The number of high volume purge lines in use during the operational modes of startup, power operation, and hot shutdown will be limited to one supply line and one exhaust line. Purging and venting operations are normally performed through one 24 inch supply penetration and one 24 inch exhaust penetration. Only one SGTS train shall be used for purge gas filtration during the modes of startup, power operation, and hot shutdown. During such operations, the redundant SGTS train is isolated to ensure that both filter trains are not damaged if a LOCA were to occur during the purging or venting operations.

Because the purge and vent valves are opened during only a limited period of power operation (only open for inerting, de-inerting, pressure control, ALARA or air quality considerations for personnel entry, or Surveillances that require the valves to be open), it is unlikely that a LOCA will occur while the valves are open. If a LOCA were to occur during this time, the containment isolation valves would close rapidly (6 seconds or less after receipt of isolation signal) and would terminate the release. Isolation will be complete long before any fuel damage or significant offsite exposure could occur. The containment isolation valves used have been specifically designed and qualified for this service as described in Section 6.2.4.2. It is possible in such cases, however, for the downstream duct-work and/or SGTS filters to be damaged by the pressure surge preceding valve closure and/or the moisture content of the released gases.

Analyses have been performed to determined the potential for, and significance of, the above described sequence of events at LGS. Calculations indicate that the design pressure of the duct-work and the design differential pressure of the SGTS filters may be exceeded if the DBA LOCA occurred during purging. This could:

a. Result in the failure of the operating SGTS filter bank, and

b. Possibly cause equipment failures in the reactor enclosure due to duct impact, impingement, and/or the resulting environmental conditions.

Failure of the operating SGTS filter bank is of little significance due to the limited benefit derived from SGTS for accident sequences related to plant risk and the possibility that the backup filter bank would be available. The results of the Reactor Safety Study (WASH-1400, table 5-3) indicate that the failure of SGTS during a LOCA does not contribute to any significant releases in a BWR for the following reasons:

a. LOCA sequences contribute little to radioactive releases relative to transient sequences.

b. Consideration of SGTS failure is only relevant for small containment leaks (ie., compared with a containment overpressure rupture).

Because of the potential significance of equipment failures, calculations and detailed equipment location surveys have been performed for LGS to verify that:

a. The environmental qualifications for the LGS equipment are sufficient to ensure operability under the predicted environmental conditions, and

b. The potential does not exist for impact or impingement-related damage to essential equipment.

The above described conclusions also apply but with significant conservatism to the situation when either a medium or small LOCA is postulated to occur during purging. For a small LOCA, the duct-work is not expected to rupture, and the SGTS heaters can be expected to reduce the relative humidity of the incoming gases. For a medium LOCA if the duct-work should rupture, the amount of steam released into the reactor enclosure and the energy available for impact or impingement will be considerably less than that associated with a DBA LOCA.

The four high volume purge lines are each provided with two normally closed butterfly valves for containment isolation. The inboard isolation valve is pneumatic-cylinder-operated, and the outboard valve is motor-operated. These valves can be operated by hand switches in the control room and are automatically closed upon receipt of a containment isolation signal. Containment isolation is discussed further in Section 6.2.4.

The high volume purge lines are 18 inches, 20 inches and 24 inches in diameter. Seismic Category I debris screens, capable of withstanding LOCA differential pressures, will be provided on the purge line penetrations.

9.4.5.1.2.3 Low Volume Purge

Low volume purging is occasionally performed during reactor operation to maintain the pressure and oxygen concentration of the primary containment atmosphere within specified ranges. During reactor operation, the primary containment pressure is normally maintained in the range of 0.1 psig to 0.7 psig and the oxygen concentration is restricted to 4% (by volume) or less. Low volume purging involves occasionally introducing nitrogen into the primary containment and/or releasing gases from the primary containment and is used on an as-needed basis, rather than continuously. Gaseous nitrogen is supplied from the liquid nitrogen facility and is introduced into the containment through a 1 inch low volume purge line that connects to the discharge lines of both containment combustible gas analyzer packages, between the containment isolation valves on the latter lines. The flow rate of nitrogen into the containment is controlled by a MOV.

Gases are released from the primary containment through 2 inch low volume purge lines that connect to the high volume purge exhaust lines from the drywell and suppression chamber, inboard of the containment isolation valves on the latter lines. The exhaust flow rate is controlled by a MOV in each of the 2 inch lines. The exhausted gases are processed by the reactor enclosure equipment compartment exhaust filters (Section 9.4.2) prior to release to the environment.

Each low volume purge line is provided with two normally closed globe valves for containment isolation. The inboard isolation valve is motor-operated and the outboard valve is air-operated.

These valves may be opened from the control room during normal plant operation and are automatically closed upon receipt of a containment isolation signal. Containment isolation is discussed further in Section 6.2.4.

The need for containment purging during normal operation is minimized by providing a PCIG system (Section 9.3.1.3). Purging for pressure control is required periodically during reactor system heatup and cooldown, if the PCIG system is out of service and the instrument air system is being used as a backup, or when other system leakage causes pressurization.

9.4.5.1.2.4 Combustible Gas Analyzers

Redundant hydrogen and oxygen analyzers are provided to monitor the primary containment atmosphere during normal operation and following a LOCA. The sampling system and analyzer packages are described in Section 6.2.5.

Each gas sample line is provided with two solenoid valves in series, for containment isolation. The isolation signals to these valves may be overridden by using key-locked bypass switches.

9.4.5.1.2.5 Containment Hydrogen Recombiner Packages

In the event of a LOCA, hydrogen and oxygen may be generated inside the primary containment. To control the buildup of oxygen and prevent a combustible concentration from occurring, redundant containment hydrogen recombiners are provided, as described in Section 6.2.5. The process gas supply and return lines for the recombiner packages connect to the high volume purge lines, inboard of the latter's containment isolation valves. The supply and return lines are each provided with two normally closed, MOVs for containment isolation. These valves may be operated from the control room during normal plant operation, and they automatically close upon receipt of a containment isolation signal. For operation of the recombiners after a LOCA, the isolation signals to these valves are overridden by using key-locked bypass switches. The portions of the recombiner system that would be exposed to the post-LOCA containment atmosphere have been designed to the same pressures and temperatures as the containment. Containment isolation is discussed further in Section 6.2.4.

9.4.5.1.2.6 Post-LOCA Purge

As a backup to the redundant hydrogen recombiners, post-LOCA oxygen concentration can be controlled by purging the containment atmosphere. The post-LOCA purge is accomplished by the same method described above for the low volume purge. Under post-LOCA conditions, however, the gases exhausted from the containment are processed through the RERS and the SGTS (Section 6.5.1) prior to release to the environment. The isolation signals to the containment isolation valves on the low volume purge lines may be overridden by using key-locked bypass switches. Containment isolation is discussed further in Section 6.2.4.

9.4.5.1.2.7 Primary Containment Vacuum Relief Valve Assemblies

In order to limit the degree to which suppression chamber pressure can exceed drywell pressure, four primary containment vacuum relief valve assemblies are provided. The assemblies are located in the suppression chamber, each assembly being mounted on the side of a downcomer. Each assembly consists of two 24 inch (nominal diameter) vacuum relief valves mounted in series. When the suppression chamber pressure exceeds the drywell pressure by a specified amount, the vacuum relief valves open automatically, allowing gases from the suppression chamber to enter

the downcomer and flow upward into the drywell, thereby equalizing pressure above and below the diaphragm slab.

A single vacuum relief valve (upstream-type) is shown schematically in Figure 9.4-6. The downstream valves are the same, except for a shorter body length. The valve consists of a swinging disk that closes an orifice in the body of the valve. The valve disk is keyed to a body-penetrating shaft that rotates as the disk opens or closes. By way of lever arms also keyed to this shaft, a compression spring holds the valve disk against the seat. When the differential pressure across the disk (in the opening direction) results in a force greater than the force exerted by the spring, the valve begins to open. The opening set pressure of the valve is 0.5 psid. However, because each assembly consists of two valves in series, actual tests performed on the valves indicate that measurable flow starts when the differential pressure across the valve assembly reaches about 1 psid, and both valves reach fully open position when the differential pressure is 2.9 psid.

The flow loss coefficient for the vacuum relief valves was calculated based on actual flow measurements conducted in the manufacturer's shop. The valve was mounted in a test rig, a differential pressure established across the valve, and the resulting flow rate was measured. Using this measurement, the loss coefficient for 24 inch pipe size was calculated to be 2.65 for a single valve and 5.3 for two valves mounted in series.

A valve operator is provided so that the valve can be opened to check the operation of the valve and the disk position indication system. Associated hand switches are located on a test panel in the reactor enclosure so that the valve may be tested remotely. When the switches are actuated, air pressure is applied to the actuating cylinder. This pressure overcomes the closing force applied by the spring and thus opens the valve.

9.4.5.1.3 Safety Evaluation

The safety-related functions of the CAC system include primary containment isolation, suppression chamber to drywell vacuum relief, suppression chamber pressure monitoring, and post-LOCA combustible gas monitoring and control.

All safety-related portions (including supporting structures) of the CAC system are designed to seismic Category I requirements as defined in Section 3.7. That piping which is safety-related is designed, fabricated, inspected, and tested in accordance with the requirements of the ASME Section III, Class 2, as discussed in Section 3.2. All safety-related portions of the CAC system are located within the reactor enclosure, which is designed to seismic Category I requirements as discussed in Section 3.8.4. Evaluation of the CAC system with respect to the following areas is discussed in the following sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6

e. Environmental design Section 3.11

Each line penetrating the primary containment (other than the hydrogen recombiner supply and return lines) is provided with redundant isolation valves powered from different divisions of Class 1E power. Therefore, in the event of failure of one division of Class 1E power, no more than one containment isolation valve in each pair is disabled, and the isolation function is assured. Each supply and return line for the hydrogen recombiners is provided with two containment isolation valves powered from the same division of Class 1E power. The purpose of powering all of a hydrogen recombiner's supply and return line isolation valves from the same division of Class 1E power is to maintain the operational capability of at least one hydrogen recombiner in the event of the loss of one of the Class 1E power divisions. In the event of a loss of one division of Class 1E power all of the isolation valves for the other recombiner will still be receiving power, and can be opened so that the recombiner can be put in service. The bypass of an isolation signal to any valve is annunciated in the control room.

The recombiner outlet lines are each provided with pressure relief valves to protect the outlet piping from overpressurization in the event of recombiner cooling water line isolation valve leakage from the RHR system during recombiner isolation.

The simplicity of design of the primary containment vacuum relief valve assemblies assures their ability to operate, when necessary, to limit the differential pressure across the diaphragm slab. The valves are of the swing-check configuration and require no motive power other than the differential pressure across the valve. The use of two valves in series within each assembly prevents a failure of any single valve in the stuck open position from compromising the pressure-suppression capability of the primary containment.

Post-LOCA combustible gas monitoring and control is discussed in detail in Section 6.2.5.

This essential area has been provided with redundant HVAC equipment to maintain the required air flows and temperatures under normal and accident conditions. A failure modes and effects analysis for the primary containment ventilation system is presented in Table 9.4-11 for both normal and accident conditions.

9.4.5.1.4 Tests and Inspections

The CAC system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of the Technical Specifications (except for the hydrogen recombiners and combustible gas monitors). Inservice inspection of the safety-related portions of the system is in accordance with the ASME Section XI, for Section III, Class 2 components.

The primary containment vacuum relief valve assemblies are preoperationally tested by the manufacturer to verify the opening set pressure. The set pressure is determined by applying a slowly increasing pressure to the inlet side of the valve and observing the point at which the inlet pressure suddenly stops increasing. This point indicates the start of leakage across the valve disk, which is the definition of the beginning of valve opening.

9.4.5.1.5 Instrumentation Applications

The CAC system is designed to be operated remotely from the control room. Power-operated valves are provided with hand switches and position indicating lights in the control room. All operations other than containment isolation are performed manually.

The liquid nitrogen facility is provided with controls and instrumentation necessary to maintain the pressure and temperature of the gaseous nitrogen supplied by the facility within appropriate ranges. The steam inlet piping to the water bath vaporizer is provided with a control valve which modulates to control the rate of steam admission to the steam coil inside the vaporizer. A temperature sensor immersed in the water bath provides a signal to this control valve so that the water bath temperature can be automatically controlled within a preset range. The pressure of the gaseous nitrogen leaving the liquid nitrogen facility is maintained at a nominal 50 psig by pressure control valves located in the nitrogen supply piping downstream of the vaporizer. A dual setpoint temperature switch installed in the nitrogen supply piping near the pressure control valves is wired into the control circuits of those valves. The presence of nitrogen in the piping at a temperature outside the range defined by the setpoints of the temperature switch will cause the switch to trip and the pressure control valves to close, thereby terminating the flow of nitrogen gas from the liquid nitrogen facility. Temperature elements in the nitrogen supply line are also connected to temperature switches with the same setpoints. These switches will trip when nitrogen at a temperature outside the range defined by the setpoints of the temperature switch is sensed, causing valves to close in the supply line and isolate the containment from the nitrogen supply.

During inerting of the primary containment through the high volume purge penetrations, the desired flow rate of nitrogen into the high volume purge piping is set by the operator on a flow controller in the control room. The measured flow rate in the nitrogen supply piping is displayed on the flow controller and is automatically compared to the value set on the flow controller; a signal corresponding to the difference between these two values is used to automatically modulate a flow control valve in the nitrogen supply piping so as to maintain the desired flow rate. When nitrogen is introduced into the primary containment in the low volume purge mode, the nitrogen flow rate in the low volume purge piping is recorded in the control room and the operator controls the flow rate by remotely actuating a MOV in that piping.

Gas pressure in the nitrogen supply lines is indicated in the control room. Temperature in the nitrogen supply lines is indicated locally and in the control room. An alarm is annunciated in the control room when the nitrogen temperature is too hot or too cold and when the nitrogen supply line is isolated, as discussed above.

Position indication for each vacuum relief valve is provided by a set of position switches that are actuated directly by the valve disk. The redundant position switches and their associated indicating lights on a test panel in the reactor enclosure provide visual indication when the valve is NOT FULLY CLOSED or NOT FULLY OPEN. When the valve is in an intermediate position, both the NOT FULLY CLOSED and NOT FULLY OPEN sets of lights are on. The position indicating switches are calibrated to indicate inboard valve disk displacement greater than or equal to 0.120 inch off the valve seat, and outboard valve disk displacement of greater than or equal to 0.050 inch off the valve seat. These setpoints ensure that the steam bypass leakage path will be maintained below $A/(k)^{1/2} = 0.046\ ft^2$ for the vacuum relief system, even with one of the outboard valves in the fully open position. A valve position other than fully closed is annunciated in the control room.

Atmosphere temperature in the drywell and suppression chamber is monitored by two temperature elements in each volume. The temperatures at all four points are recorded simultaneously in the control room. Drywell temperature is also indicated at the remote shutdown panel.

Pressures in the drywell and suppression chamber are monitored by pressure transmitters mounted outside the containment and are indicated in the control room. Drywell and suppression chamber pressures are also recorded in the control room.

9.4.5.2 Drywell Air Cooling System

The drywell air cooling system serves to remove heat from the drywell during normal plant operations and to maintain air circulation in the drywell under accident conditions. This latter function is safety-related.

9.4.5.2.1 Design Bases

a. The drywell air cooling system is designed to limit the temperature inside the drywell, during normal reactor operation, to an average of 135°F ①, with the maximum not to exceed 150°F in areas containing equipment which requires environmental qualification under 10CFR50.49 and not to exceed 160°F in other areas.

b. The drywell air cooling system is designed to limit the temperature inside the drywell, in the event of loss of offsite power and reactor scram, to 186°F in general drywell areas and 210°F in the area below the reactor vessel (inside the reactor pedestal).

c. The drywell air cooling system is designed to prevent concrete structures within the primary containment from exceeding their maximum design temperature during normal operation.

d. The drywell air cooling system is designed to maintain the drywell atmosphere in a thoroughly mixed condition following a LOCA to prevent stratification of hydrogen and oxygen that may be generated as a result of the accident.

e. Safety-related portions of the drywell air cooling system are designed to remain functional after an SSE.

f. The drywell air cooling system is designed so that a single failure of an active component, concurrent with a LOOP, cannot result in loss of a safety function.

① This was used for original HVAC system design basis conditions. Further evaluation has validated the HVAC for a drywell average air temperature of 150°F.

9.4.5.2.2 System Description

The drywell air cooling system is shown schematically in drawing M-77. The system includes eight drywell unit coolers, each of which contains two redundant cooling coils and two redundant fans. The design parameters of the unit coolers are listed in Table 9.4-10.

One fan in each drywell unit cooler is normally operating, with the second fan on standby. The standby fan starts automatically upon loss of the lead fan, sensed by a low air flow switch in the

discharge duct from the unit cooler. During normal reactor operation, chilled water is supplied to the unit coolers by the DCWS (Section 9.2.10). Chilled water is normally supplied to only one of the two redundant cooling coils in each unit cooler. In the event of a LOOP, the DCWS is not available, but cooling water flow to the unit coolers can be restored by remotely opening the valves in the cross-connection between the DCWS and the RECW system. The latter system is described in Section 9.2.8. RECW can be supplied simultaneously to both cooling coils in each unit cooler if the additional capacity is needed.

The drywell unit coolers are located in the lower section of the drywell between el 243' and el 265' and are arranged around the circumference of the drywell. Two of the unit coolers are provided with duct-work on both the suction and discharge sides, while the remaining six unit coolers have discharge duct-work only. Return air enters the latter unit coolers directly from the surrounding air space. The unit coolers (drawing M-77) serve specific areas of the drywell as follows:

a. Unit coolers 1AV-212 and 1BV-212 serve the MSRV area and the CRD area inside the reactor pedestal. Cooling air enters the CRD area through two penetrations in the reactor pedestal, 180° apart. Air exfiltrates from the CRD area through the four CRD piping penetrations in the pedestal.

b. Unit coolers 1CV-212 and 1DV-212 supply air to the area immediately below the refueling bellows and also to the drywell head area above the containment seal plate. Return air from the drywell head area is ducted to the suction side of the two unit coolers.

c. Unit coolers 1EV-212 and 1FV-212 serve the refueling bellows area, the area above the top of the reactor shield wall, and the annular area between the reactor vessel and the reactor shield wall. Cooling air is supplied to the reactor shield annulus through a ring header around the outside of the shield wall, which discharges into the annulus through 12 evenly spaced penetrations through the wall. From the discharge points near the bottom of the annulus, cooling air is forced upward between the shield wall and the reactor vessel insulation and is exhausted to the drywell general area at the top of the shield wall.

d. Unit coolers 1GV-212 and 1HV-212 supply air to the refueling bellows area, the area above the top of the reactor shield wall, and the drywell head area.

e. Unit coolers 1AV-212, 1BV-212, 1GV-212, and 1HV-212 are operated, as necessary, prior to and during the Type A test to maintain stable containment atmospheric conditions as discussed in section 6.2.6.1.b.

f. Air ducts that penetrate through the containment seal plate to the drywell head area will be removed and covered by water seal blind flanges during refueling operations.

g. Unit coolers 1AV-212 or 1BV-212, and 1GV-212 or 1HV-212 are in operation after a LOCA to maintain containment atmosphere in a thoroughly mixed condition.

The layout of the drywell air cooling system is shown in Figure 9.4-8.

9.4.5.2.3 Safety Evaluation

The safety-related portions of the drywell air cooling system (Unit coolers 1AV-212, 1BV-212, 1GV-212, and 1HV-212) are designed to seismic Category I requirements as defined in Section 3.7. The system is located within the primary containment, which is designed to seismic Category I requirements as discussed in Section 3.8.1. Evaluation of the drywell air cooling system with respect to the following areas is discussed in the following sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11

The safety-related function of the drywell air cooling system is to maintain the drywell atmosphere in a thoroughly mixed condition after a LOCA to prevent stratification of hydrogen and oxygen that may be generated as a result of the accident. Cooling water supply to the unit coolers is not needed for this function. The cooling coils are seismically designed and are not postulated to fail in a manner that would block air flow to the unit cooler fans. The unit cooler cooling coil piping is protected from overpressurization due to thermal expansion of residual water in the pipe by a pressure relief valve. In the event of a postaccident cooling coil tube failure the flow of water will be temporary because the isolation valves, HV-122 and HV-128, will stop the flow of water to the drywell unit coolers. The flow rate of water resulting from a shear fracture of a 5/8 inch (outside diameter) coil tube can be removed from the unit cooler cabinet by the existing 2 inch drain line.

The drywell air cooling system uses duct relief valves to prevent transient differential pressures that would occur early in the blowdown phase of a LOCA from exceeding the drywell unit cooler housing and duct-work design pressure rating. The duct relief valves are shown on drawing M-77.

To ensure continued availability during a LOOP, all drywell unit cooler fans and controls are powered from Class 1E buses. Loss of one division of Class 1E power may cut off power to one fan in each of two safety-related unit coolers, however, one fan in each of at least two safety-related unit coolers remains operable.

A failure mode and effects analysis for the drywell air cooling and primary containment purge systems is presented in Table 9.4-11.

9.4.5.2.4 Tests and Inspections

The drywell air cooling system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16.

9.4.5.2.5 Instrumentation Applications

The drywell air cooling system is designed to be operated remotely from the control room. All operations are performed manually, with the exception of automatic startup of a standby fan. Each unit cooler fan is provided with a separate hand switch in the control room.

Two flow elements are provided in the discharge duct from each unit cooler, one element being associated with each fan in the unit cooler. Upon detection of low flow from the unit cooler, failure of the operating fan is annunciated in the control room through the plant computer, and the standby fan is automatically started.

Air temperature is monitored both upstream and downstream of the cooling coils in each unit cooler. Temperature indication for both locations is provided in the control room, and high downstream temperature is annunciated in the control room through the plant computer.

9.4.6 DIESEL GENERATOR ENCLOSURE VENTILATION SYSTEM

The diesel generator enclosure ventilation system maintains suitable ambient air temperatures for the diesel generators and their accessories during all modes of operation. The ventilation systems are safety-related. The heating system, including the plant heating system condensate pump-room ventilation system, is not safety-related.

9.4.6.1 Design Bases

To ensure a proper environment for diesel generator operation, each of the four (per unit) emergency diesel generator cells is individually ventilated and heated. The failure of any cell ventilation system affects only one diesel. The maximum cell design temperature is 115°F, with the diesels operating, and the minimum design temperature is 65°F. The ventilation system normally operates automatically by thermostat, but each fan can be manually started or stopped from its local panel. The design basis and equipment for Unit 2 diesel generator enclosure ventilation system is similar to Unit 1.

The design basis for the outdoor air temperature used in designing the HVAC systems for the diesel generator enclosure is in accordance with the 1977 ASHRAE Fundamentals, Volume 1, Chapter 23. The use of ASHRAE is consistent with the practices used by other plants in the nuclear industry. Table 1 of Chapter 23 of the 1977 ASHRAE Fundamentals shows that the highest 1% design dry-bulb temperature for the areas around LGS is 94°F. A design outside air temperature of 95°F was conservatively used for LGS. Due to internal heat loads in the diesel generator enclosures with the diesels operating and the design ventilation air flows, the diesel enclosure ambient temperature will be 20°F higher than the outdoor air temperature. This results in a maximum internal room temperature of 115°F. The diesel generators were qualified to operate at this design room temperature throughout their normal operating lives and any accident conditions.

The 1% design dry-bulb temperatures provided in ASHRAE represent values that have been equalled or exceeded for 1% of the total hours during the summer months of June through September. Therefore, this would imply that in a normal summer there would be less than 30 hours at or above the 94°F outside air temperature at the LGS site.

Hourly weather data from LGS Weather Station No. 1 was reviewed for the 10 year period from 1972 through 1981. For this 10 year period, it was found that there were only 5 hours for which the outdoor air temperature exceeded 95°F. These temperatures were: 96.2 (1 hour), 95.4 (1 hour), 95.3 (2 hours), and 95.2 (1 hour). The use of 106°F, the maximum temperature recorded in Philadelphia over the last century, does not represent a realistic design basis.

However, the few hours a year in which the room temperature might exceed 115°F due to an outside air temperature between 95°F and an assumed maximum of 106°F would not adversely

affect the operation of the safety-related equipment in the diesel compartments. The higher room temperatures would not cause a prompt failure of any safety-related equipment in these compartments. Rather, room temperatures above 115°F would tend to shorten the long-term life of the equipment. Because the room temperatures will be below 115°F more than 99% of the time, thermal aging would be insignificant.

Each Diesel generator ventilation system can be considered operable in the event that only one of the 50% capacity fans is available provided that the outside air temperature is 75°F or below.

9.4.6.2 System Description

The diesel generator enclosure ventilation system is shown in drawing M-81. Equipment design parameters are listed in Table 9.4-12. Each diesel generator cell is provided with a separate, full load ventilation system. The following description for one cell is applicable to all other cells.

Air is exhausted from the north end of the diesel generator cell by two 50% capacity, variable-pitch blade, vaneaxial fans, discharging vertically through a concrete exhaust house. Makeup outdoor air is drawn in at the south end of each cell through a concrete plenum and is directed by baffles to floor level. The mode of fan operation is set by a hand switch in the diesel generator cell. In automatic mode, a fan is started and its discharge damper is opened by a cell thermostat when its associated diesel generator is operating. A temperature controller varies the fan air flow rate by varying the pitch of the fan blades to maintain the cell temperature at 102°F. If the cell temperature exceeds 105°F with the diesel generator running, another thermostat starts the standby fan; its blade pitch is also controlled by a temperature controller to maintain the cell temperature at 102°F. When the diesel generator stops, and the cell temperature falls below 95°F, the fans stop and their respective dampers close. If the cell temperature exceeds the thermostat setpoint (110°F) whether the diesel generator is running or not, both exhaust fans are cycled on to prevent the cell from overheating.

Heating for each cell is provided by thermostatically controlled steam unit heaters that operate when the cell temperature falls below 65°F. The heating systems are not safety-related.

Dust intake in the diesel generator enclosure is minimized through the use of a labyrinthine intake path for outside air. The air enters the intake plenum through a horizontally mounted removable screen located under the roof overhang, at about 18 feet above grade elevation. Air is then drawn vertically another 6 feet into the plenum before it moves horizontally through an opening in the enclosure wall. Once inside the diesel generator enclosure, the air is directed downwards towards the floor by a ceiling-mounted baffle (drawing M-146). This air path affords ample opportunities for airborne particulates to settle out before they disperse throughout the enclosure.

Further dust protection is provided by covering the ground around the enclosure with grass, gravel, and asphalt. During the period of Unit 1 operation and Unit 2 construction, all yard work around the diesel generator enclosure will be completed. Concrete dust generation will be minimized by painting the floors with a masonry-type paint.

The electrical relays and switches associated with engine start are housed in enclosures with gasketed doors. The contacts for the relays and switches have internal contact surfaces, and many are also enclosed with dust tight covers.

In addition to the design features that minimize the impact of dust on the diesel generator operation, the preventive maintenance program for the control cabinets includes requirements for cleaning out dust accumulation.

Periodic testing of the diesel generators ensures their availability on demand.

Provisions made to protect combustion air from dust are discussed in Section 9.5.8.2.

The plant heating steam condensate pump-room ventilation is provided by a thermostatically controlled power roof ventilator that operates when the pump-room temperature is above 80°F.

9.4.6.3 Safety Evaluation

Each of the diesel generator cells is provided with a separate ventilation system that is located within the seismic Category I tornado and missile-protected enclosure. These ventilation systems are safety-related and designed to seismic Category I requirements, except for the control room annunciator and steam unit heaters. Each ventilation system is powered from the offsite sources under normal conditions and by its associated diesel generator on LOOP. Each ventilation system is designed to maintain the cell temperature below the continuous-duty ambient rating of the safeguard equipment located in the cell.

Evaluation of the diesel generator ventilation system with respect to the following areas is discussed in the following sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood protection	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

Table 9.4-13 provides a failure modes and effects analysis. An FMEA during normal operation for the diesel generator enclosure is not provided because system operation is identical during both normal and accident conditions.

9.4.6.4 Tests and Inspections

The diesel generator ventilation system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16.

9.4.6.5 Instrumentation Requirements

Each diesel generator ventilation fan can be started or stopped and changed from lead to lag fan operation in automatic mode from the local panels. When in the automatic mode, the fans start and stop, and their dampers open and close in response to the cell thermostats (with staged setpoints). Temperature sensing controllers automatically adjust the fan blade pitch to increase air flow rate with increased cell temperature. A low and a high temperature switch in each cell initiates an alarm in the control room if cell temperature is abnormal. Loss of power to an operating fan motor or failure of a damper to fully open also initiate alarms in the control room. Each fan has its own separate set of controls.

9.4.7 SPRAY POND PUMP STRUCTURE VENTILATION SYSTEM

9.4.7.1 Design Bases

The spray pond pump structure ventilation system is safety-related. The function of the ventilation system is to maintain suitable ambient air temperatures for the ESW and RHRSW pumps and their associated accessories. To ensure a proper environment for pump operation, the redundant loop A and loop B pump areas are divided and individually ventilated and heated to maintain temperature between a maximum design value of 115°F and a minimum design value of 62°F. The ventilation system normally operates with the lead fan in the run mode. The standby fan will automatically start if required. Either fan may be placed in standby. Temperature is controlled automatically by modulating the inlet and return dampers or energizing structure heaters. The ventilation system is designed with sufficient redundancy so that the failure of any single active component does not prevent the system from performing its safety function.

The design basis for the outdoor air temperature used in designing the HVAC systems for the spray pond pumphouse is in accordance with the 1977 ASHRAE Fundamentals, Volume 1, Chapter 23. The use of ASHRAE is consistent with the practices used by other plants in the nuclear industry. Table 1 of Chapter 23 of the 1977 ASHRAE Fundamentals shows that the highest 1% design dry-bulb temperature for the areas around LGS is 94°F. A design outside air temperature of 95°F was conservatively used for LGS. Due to internal heat loads in the pump-room enclosures with the pumps operating and the design ventilation air flows, the enclosure ambient temperature will be 20°F higher than the outdoor air temperature. This results in a maximum internal room temperature of 115°F. The ESW and RHRSW pumps were qualified to operate at this design room temperature throughout their normal operating lives and any accident conditions.

The 1% design dry-bulb temperatures provided in ASHRAE represent values that have been equalled or exceeded for 1% of the total hours during the summer months of June through September. Therefore, this would imply that in a normal summer there would be less than 30 hours at or above the 94°F outside air temperature at the LGS site.

Hourly weather data from LGS Weather Station No. 1 was reviewed for the 10 year period from 1972 through 1981. For this 10 year period, it was found that there were only 5 hours for which the outdoor air temperature exceeded 95°F. These temperatures were: 96.2 (1 hour), 95.4 (1 hour), 95.3 (2 hours), and 95.2 (1 hour). The use of 106°F, the maximum temperature recorded in Philadelphia over the last century, does not represent a realistic design basis.

However, the few hours a year in which the room temperature might exceed 115°F due to an outside air temperature between 95°F and an assumed maximum of 106°F would not adversely affect the operation of the safety-related equipment in the spray pond pumphouse. The higher

room temperatures would not cause a prompt failure of any safety-related equipment in these compartments. Rather, room temperatures above 115°F would tend to shorten the long-term life of the equipment. Because the room temperatures will be below 115°F more than 99% of the time, thermal aging would be insignificant.

9.4.7.2 System Description

The spray pond pump structure ventilation system is shown schematically in drawing M-81. The equipment design data are listed in Table 9.4-14. The two redundant spray pond pump compartments are provided with separate and identical dual ventilation systems. Each individual ventilation system is rated for 100% of the compartment heat load. The following description of ventilation equipment for one pump compartment also applies to the equipment for the other compartment. Each pump compartment has an outdoor air louver, a missile-protected concrete air plenum, and two separate steel mixing boxes, each containing an outdoor damper and a return air damper. Each mixing box feeds a separate fan cabinet containing an electric heating coil and vaneaxial fan. Outside and return air is mixed, tempered (as required) by electric heat, and supplied to the structure by the operating fan(s). Exhaust air from the structure is discharged through two wall louvers, which have manual dampers.

The outdoor air intake dampers are designed to fail closed to prevent freezing.

9.4.7.3 Safety Evaluation

Each pump compartment is ventilated and heated by two separate, completely independent, full capacity systems. The fans and thermostats are located in the seismic Category I spray pond pump structure, which is tornado-protected, missile-protected, and flood-protected. Each ventilation system is powered from the offsite power sources under normal conditions and by separate diesel generators on loss of offsite sources. The electric heaters are not required to operate after a LOCA due to the heat load from the ESW and RHRSW pump motors.

The ventilation system is safety-related and is designed to seismic Category I requirements. The ventilation system is designed to maintain the compartment temperature below the continuous-duty ambient rating of the safeguard electrical equipment located in the compartment and above freezing.

Evaluation of the spray pond pump structure ventilation system with respect to the following areas is discussed in the following sections:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood protection	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11

f. Fire protection Section 9.5.1

For a failure modes and effects analysis, see Table 9.4-15. An FMEA during normal operation for the spray pond pumphouse is not provided because system operation is identical during both normal and accident conditions.

9.4.7.4 Tests and Inspections

The spray pond pump structure ventilation system is preoperationally tested in accordance with the requirements of Chapter 14 and periodically tested in accordance with the requirements of Chapter 16.

9.4.7.5 Instrumentation Requirements

Each supply fan in the spray pond pump structure can be individually controlled by a hand switch in the control room. The fans are started by placing the hand switch in the run position.

In run mode, the lead fan is started and runs continuous. The outside air and return air dampers are energized when the compartment temperature is greater than 70°F and are modulated to maintain controller setpoint. The lag fan is started by its thermostat if the compartment temperature exceeds 105°F or decreases below 62°F.

The following control description applies to each operating fan. An electric controller sensing compartment temperature modulates the outside air damper and return air damper in the inlet plenum to the fan cabinet. When the temperature of the mixed air entering the fan drops below 64°F, a low temperature switch energizes the electric heater.

A low temperature safety switch, with its sensor in the inlet plenum, shuts down the fan and heater if the mixed air temperature falls below 35°F. A common temperature trouble is alarmed in the control room if the compartment temperature falls below 50°F or exceeds 115°F. A common fan/coil unit trouble is also alarmed in the control room. For a failure modes and effects analysis, see Table 9.4-15.

9.4.8 HOT MAINTENANCE SHOP VENTILATION SYSTEM

The hot maintenance shop ventilation system maintains air temperature, quality, and pressure in the hot maintenance shop. The hot maintenance shop ventilation system is not safety-related.

9.4.8.1 Design Bases

The hot maintenance shop ventilation system is designed to operate during normal conditions and to accomplish the following objectives:

a. Maintain the hot shop cells between 70°F and 76°F during working hours

b. Provide, to each cell, a supply of mixed return and outside air that has been filtered, washed, and tempered

c. Maintain cell average air velocity at 25 fpm to 50 fpm to move dust particles to exhaust grilles

d. Maintain the hot shop and equipment room at a negative pressure relative to other shops and the outdoors

e. Maintain airflow from areas of lesser to areas of greater potential contamination

f. Provide local fume and particle hoods at each cutting and cleaning machine to capture potentially contaminated particles at the source

g. Provide high velocity ducts and dust collectors with pocket filters to capture machined particles before they enter the HEPA filtration system

h. Provide HEPA filtration for exhaust air from the hot shop

j. Monitor and exhaust the air from the hot shop to the reactor enclosure east vent stack

9.4.8.2 System Description

The schematic diagram for the hot maintenance shop is shown on drawing M-82. Equipment design parameters are listed in Table 9.4-16. The air handlers, fans, compressor, condenser, unit heaters, control panel, and two dust collectors are located in the HVAC equipment compartment above the hot shop repair cells, at el 230'

The heat exchanger and pump supplying hot water for the hot shop air heating coils are located in the administration building penthouse, at el 282'.

The supply and exhaust fans are controlled to maintain a negative hot shop pressure. Filtered air is supplied to "clean" spaces and exhausted from potentially contaminated spaces. Dust particles from machining or cleaning operations are exhausted at the source. Exhausted air is filtered and sampled by radiation monitors before it is discharged to the east vent stack. All ducts are isolated by dampers from the outdoors during system shutdown.

9.4.8.2.1 Hot Shop Supply and Return System

The air handler for the repair cells and HVAC equipment compartment is shown in drawing M-82 as V-5001. The air handler for the lay-down area, cleanup cell, shower, and tool room is shown in drawing M-82 as V-5002. Each air handler consists of a 100% capacity fan connected to a housing containing a mixing plenum, prefilter, medium efficiency filter, air washer, direct-expansion cooling coil, and hot water coil.

With air flow established by the exhaust fans, either (or both) supply fan(s) may be started manually by local hand switches; this also opens the respective outside air damper and control air supply valve, and starts the water spray pump. Return and outdoor air is mixed, filtered, washed, tempered, and distributed by duct-work to the aforementioned areas. Air to the repair and cleanup cells is discharged through perforated ceilings to minimize induction of room particles. Air flows at an average velocity of 25 fpm to 50 fpm across the lay-down area and each cell to return grilles at the opposite end. Air also infiltrates from the machine shop to the hot shop lay-down area, and from the lay-down area to the repair and cleanup cells.

Seventy-eight percent of the supplied and infiltrated air is returned to the air handlers by grilles and duct-work for conditioning and recirculation as described above.

9.4.8.2.2 Fume and Particle Removal System

The dust collectors for the grinders and band saw are shown in drawing M-82 as V-5006 and V-5007. Each dust collection system consists of a hood, high velocity duct, pocket filter, fan, and exhaust duct.

Fume collectors for the erection plates, lathes, and electrostatic cleaners are also provided. Exhaust air from the dust collectors and from the fume hoods is conveyed by fan V-5004 to exhaust unit V-5003, as indicated in drawing M-82.

The dust collectors and fume exhaust fan are started manually by local hand switches. Particles from the grinders and saw are conveyed from the source and removed by pocket filters in each dust collector. Fumes discharged from the dust collectors, and dust and fumes removed by the fume hoods, are conveyed by sealed duct-work and exhaust fan V-5004 to the filter/ exhaust unit. Failure of fan V-5004 stops air handlers V-5011 and V-5002.

9.4.8.2.3 Exhaust System

The exhaust unit for the hot shop, shown in drawing M-82, consists of a 100% capacity fan (V-5003) with constant flow control connected to a housing containing a prefilter bank and a HEPA filter bank. An isolation damper is provided in the duct-work between the fan discharge and the vent stack.

The exhaust unit is started manually by a local hand switch, which also opens the supply damper and the control air supply valve.

Twenty-three percent of the air supplied to the hot shop is exhausted to the reactor enclosure east vent stack. The exhaust air is taken from the dust and fume collection system described in Section 9.4.8.2.2. The quantity of exhaust air is held constant by a fan blade controller on V-5003 to maintain a negative shop pressure (exhaust air quantity is designed to exceed outside air quantity, with clean or dirty filters). After filtration, the exhaust air is sampled and monitored for radioactivity and discharged into the reactor enclosure east vent stack. Failure of fan V-5003 stops air handler V-5001 and V-5002.

9.4.8.2.4 Refrigeration System

The refrigeration system serving the cooling coils in the two air handlers is shown in drawing M-82. The system consists of a refrigerant-22 compressor, an evaporative condenser with accessories, and the direct-expansion cooling coils in the air handlers. Outdoor air is used to remove the heat from the evaporative condenser.

9.4.8.3 Safety Evaluation

The hot maintenance shop ventilation system has no safety-related functions. Failure of the system does not compromise any safety-related system or component or prevent a safe shutdown of the plant.

9.4.8.4 Tests and Inspections

All HVAC equipment is inspected and tested during manufacture, installation, and startup. Air and water flows are measured and adjusted to design requirements using calibrated instruments. System operability is demonstrated by use during normal plant operation.

9.4.8.5 Instrumentation Requirements

All hand control switches for the hot maintenance shop ventilation system are on a local control panel in the shop HVAC equipment compartment. Hand switches for dust collectors are located outside the shop near the dust collectors.

The local panel transmits any HVAC alarm signal to the control room panel. The following abnormal conditions are alarmed:

a. Air flow failure (all ducted fans)

b. High pressure differential across a filter bank

There are various sensors, controllers, time delays, switches, and indicators to start and stop the fans, pumps, compressor, and condenser; to open and close dampers; to modulate hot water valves; to open and close refrigerant solenoid valves; to adjust fan blade; to cycle unit heaters; and to indicate temperatures and filter pressure differentials.

9.4.9 MISCELLANEOUS STRUCTURES VENTILATION SYSTEMS

Miscellaneous structures include the circulating water pump structure, water treatment enclosure, Schuylkill River pump structure, Perkiomen Creek pump structure, sewage treatment enclosure, auxiliary boiler enclosure, boiler fuel transfer enclosure, lube oil structure, chlorine and acid feed enclosure, and the administration building, and the technical support center. The ventilation systems for these structures are not safety-related.

9.4.9.1 Design Bases

The miscellaneous structures ventilation systems are designed to function during normal plant operations to maintain a suitable environment for equipment operation and/or personnel comfort.

a. Provide a supply of outside air to all enclosures

b. Provide a supply of filtered and conditioned air to the administration building offices and the water treatment enclosure laboratory

c. Exhaust gases and fumes from the chlorine and acid feed enclosure, shop welding areas, and battery rooms

d. Provide emergency cooling for the guard station, CAS, SAS, and telephone equipment room

9.4.9.2 System Description

Ventilation systems for miscellaneous structures other than the administration building are shown schematically in drawing M-81. The administration building ventilation system is shown in drawing M-80. Major equipment design parameters are listed in Table 9.4-17.

9.4.9.2.1 Circulating Water Pump Structure

The circulating water pump compartment is ventilated by 24 roof-mounted exhaust fans that are controlled by four staged room thermostats. Outside air is drawn through 10 wall louvers (with manual dampers) near ground level and is exhausted through the roof. The area is heated by 12 steam unit heaters; each heater is controlled by an individual area thermostat and 3 flash steam unit heaters, each controlled by an individual flash steam tank thermostat.

The compartment for the diesel-driven fire pump is ventilated by a roof-mounted exhaust fan controlled by a room thermostat. Outside air is drawn in through a wall louver (with manual damper) near ground level. The compartment is heated by a steam unit heater, which is controlled by a thermostat.

The chlorine equipment and equipment control compartments are ventilated by two roof-mounted exhaust fans controlled by individual compartment thermostats. Outside air is drawn in through wall louvers (with manual dampers) near ground level. The compartments are heated by individual steam unit heaters, each controlled by thermostat.

9.4.9.2.2 Water Treatment Enclosure

The water treatment area is ventilated by roof-mounted exhaust fans that are controlled by individual, staged, compartment thermostats. Outside air is drawn in through four wall louvers (with manual dampers) near ground level. The compartment is heated by six steam unit heaters, which are controlled by individual area thermostats.

The utility area is ventilated by a thermostatically controlled roof exhaust fan and heated by a thermostatically controlled steam unit heater.

The water treatment laboratory is cooled by a rooftop packaged air conditioner and heated by a steam coil in the supply duct-work. Compartment thermostats control the air conditioner and the steam coil control valve.

9.4.9.2.3 Sewage Treatment Enclosure

The sewage treatment equipment compartment is ventilated by two roof-mounted exhaust fans, each controlled by a thermostat. Outside air is drawn in through a wall louver (with manual damper) near ground level. The equipment compartment is heated by two electric unit heaters, which are controlled by individual area thermostats.

9.4.9.2.4 Schuylkill River Pump Structure

The Schuylkill River pump structure is ventilated by four roof-mounted exhaust fans, each controlled by a thermostat. Outside air is drawn in through wall louvers. The intake structure is heated by six electric unit heaters, which are controlled by individual area thermostats.

The Schuylkill River debris facility is ventilated by a wall exhaust fan, which is controlled by a hand switch. Outside air is drawn in through a wall louver (with manual damper). The debris facility is heated by two electric unit heaters, which are controlled by individual area thermostats.

9.4.9.2.5 Perkiomen Creek Pump Structure

The Perkiomen Creek pump structure is ventilated by three roof-mounted exhaust fans, each controlled by a compartment thermostat. Outside air is drawn in through wall louvers with motor-operated dampers. Heating is provided by five electric unit heaters, each controlled by an individual area thermostat.

The battery room has its own roof-mounted exhaust fan, which runs continuously. Battery room makeup air is drawn from the pump compartment.

9.4.9.2.6 Boiler Fuel Oil Transfer Enclosure

The fuel oil transfer enclosure is ventilated by two roof-mounted exhaust fans, each controlled by a thermostat. Outside air is drawn in through two wall louvers (with manual damper) near ground level. The equipment compartment is heated by two electric unit heaters that are controlled by individual area thermostats.

9.4.9.2.7 Auxiliary Boiler Enclosure

The auxiliary boiler enclosure is ventilated by six roof-mounted exhaust fans, each controlled by a compartment thermostat. Outside air is drawn in through wall louvers that have manual dampers. Combustion air for each boiler is ducted from separate outside air louvers to the boiler combustion air fans located on the boiler wind boxes.

9.4.9.2.8 Lube Oil Structure

The lube oil structure is ventilated by a roof-mounted exhaust fan that is thermostat controlled. Outside air is drawn in through a wall louver that has a manual damper. The compartment is heated by two steam unit heaters, each having its own area thermostat.

The calibration equipment storage compartment in the lube oil structure is ventilated by a roof-mounted exhaust fan and heated by a thermostatically controlled steam unit heater.

9.4.9.2.9 Chlorine and Acid Feed Enclosure

The chlorine and acid feed enclosure is ventilated by four roof exhaust fans ducted to floor level. The roof exhaust fans cycle on room thermostats. A wall exhaust fan is mounted near the acid tank to provide supplemental ventilation during chemical deliveries and system maintenance. The wall fan is controlled from a handswitch on the building exterior.

Outside air is drawn in through wall louvers. The enclosure is heated by five electric unit heaters controlled by individual area thermostats.

The chlorine and acid feed electrical equipment compartment is ventilated by a thermostatically controlled wall exhaust fan. Outside air is drawn in through a wall louver. Heating is provided by an electric unit heater which is controlled by a thermostat.

The circulating water chlorine and acid feed pipe trench is heated by 5 electric heaters, each controlled by an individual area thermostat.

9.4.9.2.10 Administration Building

The administration building office areas are air conditioned by a low velocity, variable volume system. Major components include a centrifugal water chiller, steam heat exchanger, hot and chilled water pumps, supply air handling unit, return air fan, and modulating room air terminals. Outside air and return air is mixed, filtered, heated or cooled, humidified, and supplied to the room terminal units. Room temperature is controlled by room thermostats modulating the ceiling terminal dampers and hot water coils.

During air handler breakdown, the telephone equipment room is ventilated by an exhaust fan.
The locker rooms and rest rooms are ventilated and heated by a supply air handling unit and exhaust air fan located in the penthouse.

The eastern extension is air conditioned by a separate built-up system located in an equipment compartment above the lobby.

The security areas are air conditioned by two redundant, packaged, air conditioning units located on the roof. The supply and return air paths are either ducted through security bars or otherwise limited to prevent unauthorized entry to the security areas. Fresh air intakes to each of the redundant systems are not located directly adjacent to any of the security areas. The primary packaged air conditioning unit is powered from a safeguard power supply which is tripped upon a LOCA signal. The stand-by packaged air conditioning unit is not powered from a safeguard power supply.

The warehouse, machine shop, and off-loading facility are all ventilated by roof-mounted exhaust fans, each controlled by its own room thermostat. Outside air is drawn in through automatically adjusted wall louvers. The machine shop is heated by an air handling unit with thermostatically controlled hot water coils; the other facilities are heated by thermostatically controlled hot water unit heaters.

9.4.9.2.11 Technical Support Center

The security areas are air conditioned by two redundant, packaged, air conditioning units located on the first floor. The supply and return air paths are either ducted through security bars or otherwise limited to prevent unauthorized entry to the security areas. Fresh air intakes to each of the redundant systems are not located directly adjacent to any of the security areas.

9.4.9.3 Safety Evaluation

The ventilation systems for the miscellaneous structures are not safety-related. Failure of the systems does not compromise any safety-related system or component or prevent a safe shutdown of the plant. There are multiple fans and unit heaters in the larger compartments. The air conditioning units for the security area in the administration building and the technical support center are redundant, located within the protected area, and powered from redundant power supply systems.

9.4.9.4 Tests and Inspections

Equipment is tested and balanced after installation to verify its operation and capacity. System operability is demonstrated by use during normal plant operation.

9.4.9.5 Instrumentation Requirements

The ventilation systems in the miscellaneous structures are controlled by local thermostats or local hand switches that can override the thermostat. The ventilation systems in the administration

building are controlled by local thermostats and by hand and automatic controls mounted in control panels located in the administration building, eastern extension, and the machine shop. Alarm signals from the administration building, eastern extension, and shop control panels annunciate in the control room on equipment failure.

Table 9.4-1

CONTROL ROOM AND CONTROL STRUCTURE VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

SYSTEM	CONTROL ROOM SUPPLY	AUXILIARY EQUIPMENT ROOM SUPPLY	EMERGENCY SWITCHGEAR & BATTERY ROOMS SUPPLY	SGTS ROOM UNIT COOLERS
Identification no.	OAV-116, OBV-116	OAV-114, OBV-114	OAV-118, OBV-118	OAV-140, OBV-140
No. of units	2	2	2	2
Type	Air handling unit	Air handling unit	Air handling unit	Fan/coil unit
Flow rate, each (cfm)	26,200	33,600	15,535	1,000
Fan:				
Type	Vaneaxial	Vaneaxial	Vaneaxial	Vaneaxial
Drive	Direct (adj pitch)	Direct (adj pitch)	Direct (adj pitch)	Direct (adj pitch)
No. running	1	1	1	1
Static pressure	3.91	2.34	2.45	0.17
Total pressure (in wg)	4.61	3.09	2.9	0.29
Motor horsepower (each)	40	30	15	1
Cooling coils:				
Quantity, per unit	1	1	1	1
Rows	8	4	2	4
Cooling capacity (Btu/hr)	1,032,000	1,050,000	550,080	43,000
Electric duct heaters:				
Quantity, per unit	1	1	None	None
Hea ing capacity (kW)	50	65	-	-
Filters:				
Type	Roll	Roll	Roll	None
Pressure drop (in wg)	0.25 clean 0.5 dirty	0.25 clean 0.5 dirty	0.25 clean 0.5 dirty	-

Table 9.4-1 (Cont'd)

SYSTEM	BATTERY ROOMS EXHAUST	TOILET ROOM EXHAUST	SGTS COMPARTMENT ACCESS AREA UNIT COOLERS	CONTROL ROOM EMERGENCY FRESH AIR SUPPLY
Identification no.	OAV-124, OBV-124	OOV-126	OAV-141, OBV-141	OAV-127, OBV-127
No. of units	2	1	2	2
Type	Fan only	Fan only	Fan/coil unit	Fan and filter plenum
Flow rate, each (cfm)	8,000	775	2,500	3,000
Fan:				
Type	Vaneaxial	Centrifugal	Vaneaxial	Centrifugal
Drive	Direct (adj pitch)	Direct	Direct (adj pitch)	Direct
No. running	1	1	1	1
Static pressure (in wg)	-	1.5	0.69	11.0
Total pressure (in wg)	3.5	-	0.82	-
Motor horsepower (each)	7.5	1	7.5	10
Cooling coils:				
Quantity, per unit	None	None	1	None
Rows	-	-	3	-
Cooling capacity (Btu/hr)	-	-	110,000	-
Electric duct heaters:				
Quantity, per unit	None	None	None	1
Hea ing capacity (kW)	-	-	-	40
Filters:				
Type	None	None	None	Plenum w/prefilter, HEPA, charcoal, HEPA
Pressure drop (in wg)	-	-	-	Cartridge: 0.55 clean HEPA: 1.0 clean Charcoal: 1.1 ±0.15
Charcoal adsorber[1]				
Type	None	None	None	Rechargeable vertical bed
Depth (in)	-	-	-	2
Adsorber medium	-	-	-	Impregnated activated carbon
Assigned efficiency[2]	-	-	-	1.1 ±,0.15
Removing elemental iodine	-	-		95%
Removing organic iodine	-	-	-	95%
Residence time	-	-		0.25 sec

Table 9.4-1 (Cont'd)

SYSTEM	CONTROL ROOM RETURN AIR	AUXILIARY EQUIPMENT ROOM RETURN AIR	SGTS ROOM EXHAUST
Identification no.	OAV-121, OBV-121	OAV-120, OBV-120	OAV-131, OBV-131
No. of units	2	2	2
Type	Fan only	Fan only	Fan and filter plenum
Flow rate, each (cfm)	26,200	33,600	2,000
Fan:			
Type	Vaneaxial	Vaneaxial	Centrifugal
Drive	Direct (adj pitch)	Direct (adj pitch)	Direct
No. running	1	1	1
Static pressure (in wg)	1 3	1.95	12.6
Total pressure (in wg)	2 2	2.5	12.6
Motor horsepower (each)	15	20	10
Cooling coils:			
Quantity, per unit	None	None	None
Rows	-	-	-
Cooling capacity (Btu/hr)	-	-	-
Electric duct heaters:			
Quantity, per unit	None	None	None
Hea ing capacity (kW)	-	-	-
Filters:			
Type	None	None	Plenum w/prefilters, HEPA, charcoal, HEPA
Pressure drop (in wg)	-	-	Cartridge: 0.55 clean HEPA: 1.0 clean
Charcoal adsorber[(1)]			
Type	None	None	Vertical tray
Dep h (in)	-	-	2
Filter medium	-	-	Impregnated activated carbon
Pressure drop (in wg)	-	-	1.1 ±0.15
Assigned efficiency[(2)]			
Removing elemental iodine	-	-	70%
Removing organic iodine	-	-	70%
Residence time	-	-	0.25 sec

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[(1)] Physical property specifications of new activated carbon are given in Table 9.4-4.
[(2)] Efficiency designated by Regulatory Guide 1.52 for use in release analyses.

Table 9.4-2

CONTROL ROOM HVAC SYSTEM ISOLATION VALVE DESIGN PARAMETERS

ISOLATION VALVES	LOCATION	FUNCTION	OPERATOR TYPE	VALVE OPENING OR CLOSING TIME (SEC)	SPECIFIED LEAKAGE	FAIL POSITION
HV-78-021A HV-78-021B	Fresh air inlet duct to OAV-116 and OBV-116	Isolation of unfiltered fresh air to control room	Pneumatic	3-5	Zero leakage (bubble-tight)	Closed
HV-78-052A HV-78-052B	Normal control room exhaust air duct	Isolation of control room exhaust air duct from outside environment	Pneumatic	3-5	Zero leakage (bubble-tight)	Closed
HV-78-020A HV-78-020B HV-78-020C HV-78-020D	Fresh air inlet ducts to emergency fresh air filter for control room	Provide path for filtered fresh air for pressurization on high radiation. Isolate on chlorine release	Electrohydraulic	8-12 (adj)	Zero leakage (bubble-tight)	Closed
HV-78-010A HV-78-010B	Recirculation duct from control room return air duct to emergency fresh air filter inlet duct	Provide path for recirculation cleanup of control room air during radia ion isolation, chlorine or offsite toxic chemical release isolation	Electrohydraulic	8-12 (adj)	Zero leakage (bubble-tight)	Closed
HV-78-057A HV-78-057B	Toilet exhaust duct – control Room	Isolate duct from outside environment	Pneumatic	3-5	Zero leakage (bubble-tight)	Closed
HV-78-071A HV-78-071B	Toilet exhaust branch duct from Unit 2 turbine enclosure	Isolate control room from Unit 2 turbine enclosure environment	Pneumatic	3-5	Zero leakage (bubble-tight)	Closed

Table 9.4-3

CONTROL ROOM AND CONTROL STRUCTURE VENTILATION SYSTEMS
FAILURE MODE AND EFFECT ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency	Power supply	LOOP	None - all safety-related equipment and controls are redundant and are powered from separate standby diesel generators.	Alarm in the control room.	No loss of safety function
Emergency (LOCA, LOCA & LOOP, high radiation, offsite toxic gas, or chlorine release) and normal operation.	Control room and auxiliary equipment room HVAC system supply air handling units	Failure of fan motor	None - the standby fan automatically starts. Note 1	Alarm in the control room.	No loss of safety function
		Reduced air flow	None - the standby fan automatically starts. Note 1	Alarm in the control room.	No loss of safety function
		Loss of chilled water to cooling coil	None - For Auxiliary equipment room air handling unit, temperature switch high stops the running fan and the standby fan starts automa ically. For control room supply air handling unit, temperature switch high causes C101 trouble alarm in control room. Then manual action can be taken to restore cooling to opera ing air handling unit or to place redundant fan/train in service. Note 1	High temperature switch on local panel C101, which causes C101 trouble alarm in the control room to activate. For the auxiliary equipment room HVAC system, the high temperature switch stops the running fan.	No loss of safety function
		Loss of heating	None - Air heating is not required during emergency operation.	Low temperature switch on local panel C101, which causes C101 trouble alarm in the control room to activate.	No loss of safety function

Table 9.4-3 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency (LOCA, LOCA & LOOP, high radiation, chlorine or offsite gas release) and normal operation.	Control room and auxiliary equipment room HVAC system return air fans	Failure of fan motor	None - The standby Fan automatically starts. Note 1	Alarm in he control room.	No loss of safety function
		Reduced air flow	None - The standby fan automatically starts. Note 1	Alarm in he control room.	No loss of safety function
Emergency (LOCA, LOCA & LOOP, high radiation, chlorine, or offsite toxic gas release)	Control room emergency fresh air fans	Failure of fan motor	None - The standby fan automatically starts.	Alarm in he control room.	No loss of safety function
		Reduced air flow	None - The standby fan automatically starts.	Alarm in he control room.	No loss of safety function
Emergency (LOCA, LOCA & LOOP, high radiation, chlorine or offsite toxic gas release) and normal operation	Emergency switch gear and battery compartment air handling units	Failure of fan motor	None - The standby fan automatically starts.	Alarm in he control room.	No loss of safety function
		Reduced air flow	None - The standby fan automatically starts.	Alarm in he control room.	No loss of safety function
		Loss of chilled water to cooling coil	None – Temperature switch high stops the running fan. The standby fan fan starts automa ically.	High temperature switch on local panel C101, which causes C101 trouble alarm in the control room to activate and stops the running fan.	No loss of safety function

Note 1: For control room HVAC system supply air and return fans, the standby fan can also be manually started.

Table 9.4-3 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency control room high radiation, chlorine or toxic gas release Isola ion	Control room normal fresh air inlet duct isolation valves, normal exhaust duct isolation valves, toilet exhaust duct isolation valves	Loss of signal; valve stuck in open position	None - Valves are redundant in series. Second valve closes. Valves have fail closed action on loss of signal.	Radiation isola ion signal trouble alarms in control rooms. High chlorine signal alarms in control room. Isolation valve position indicated on local panel C101.	No loss of safety function
	Control room emergency fresh air inlet valves	Loss of signal; valve stuck in closed position (radiation accident)	Parallel paths are provided to assure inlet to emergency fresh air filters on high radiation.	Radiation isola ion signal trouble alarms in control room. Isolation valve position indicated on local panel C101.	No loss of safety function
		Valve stuck in open position (chlorine release accident)	Valves are in series on each parallel duct to assure isolation.	High chlorine signal alarms in control room. Isolation valve position indicated on panel seal C101.	No loss of safety function

Table 9.4-4

VENTILATION SYSTEMS TESTS AND INSPECTIONS

GENERAL

a. Safety-related components are designed, fabricated, installed, and tested under quality assurance requirements in accordance with 10CFR50, Appendix B.

b. For systems that must perform a safety-related function, periodic inservice testing of fans, valves, controls, and instrumentation in the systems is performed. MOVs and dampers are tested by opening and closing the valve or damper.

c. Equipment in seismic Category I systems is required by specification to meet LGS seismic requirements. Before each equipment item is shipped, the supplier of that item is required to submit an adequate analysis or applicable test data as evidence of compliance.

d. Systems designed to seismic Category I requirements are subjected to a program of vendor shop and field testing.

e. Standby units are tested at periodic intervals to verify the operation of essential features. Periodic tests of the activation circuitry and the system components are conducted during normal plant operation.

FANS

Centrifugal, propeller, and vaneaxial fans are tested in accordance with the AMCA Standard Test Code for Air Moving Devices, Bulletin 210. Vaneaxial fan blade setting adjustments are made to correct flow rates where necessary.

MOTORS

Motors are built, designed, rated, and tested in accordance with NEMA MG-1. Seismic Category I motors have certification for the NEMA tests required in Publication No. MG-1. Motors used within the containment comply with IEEE 334.

COOLING COILS

Cooling coils are furnished in accordance with ARI 410. Chilled water, service water, and emergency service water coils are hydrostatically and pneumatically tested. Seismic Category I coils are seismically qualified by analysis or testing on a shaker table.

Table 9.4-4 (Cont'd)

PARTICULATE FILTERS (SUPPLY AIR ROLL FILTERS)

Particulate filters are UL Class II. The filter media, when tested in accordance with ASHRAE 52-76 (replaced NBS Type Dynamic Test) will have a minimum average efficiency of 83% arrestance.

PREFILTERS (USED IN SERIES WITH HEPA FILTERS)

The prefilters are certified to meet standards for UL Class 1 filters. Airflow resistance of the prefilters at rated flow is less than 0.55 inch wg (clean). Prefilters have an efficiency rating of 80% minimum by the NBS dust spot test.

HEPA FILTERS

a. Qualification Tests Before Installation

HEPA filters are constructed in accordance with MIL-F-51068C or ASME AG-1, "Filter Medium, Fire Resistant, High Efficiency" and MIL-F-51068C or ASME AG-1, "Filter, Particulate High Efficiency, Fire Resistant." The minimum tensile strength of the filter media is at least 2.5 lb/in of width, in accordance with requirements of MIL-F-51068C or ASME AG-1.

The filter medium is securely fastened to the sides and ends of the filter frame and sealed. Patching of holes or tears in the medium is not permitted.

The assembled filters are type-tested in accordance with UL 586, "High Efficiency Air Filter Units" requirements to minimize fire hazards. The filters are approved UL Class 1.

Each filter is tested for flow resistance at rated flow. The filter resistance is not to exceed the rated pressure drop of 1 inch wg under this condition.

The filters are rough-handled with the Q110 Vibrating Machine, DLA 26-18-67, and examined for damage, and the DOP penetration is determined in accordance with Section 4.3.4.1.

Filters are subjected to acceptance tests made by an NRC quality assurance station. The filter efficiency exceeds 99.97% when tested with monodispersed, thermally generated DOP aerosol having a mean particle size of 0.3 micron.

Table 9.4-4 (Cont'd)

Filters selected at random from the manufacturer's production line are subjected to moisture, overpressure resistance, and filter dust loading tests in order to initially qualify the filters. The moisture and overpressure resistance tests are performed in accordance with MIL-F-51068.

Each filter is individually tested by the appropriate NRC quality assurance station at 100% and 20% of the rated capacity.

b. Preoperational Tests for Acceptance (Performed in Filter Train Housing)

Visual and dimensional checks of the housing and mounting frames are made in the field to check for conformance with design specifications. Nonconforming items are rejected and replaced with acceptable equipment.

After installation, inplace testing of HEPA filter efficiency is conducted in accordance with section 10 of ANSI/ASME N510 (1980) (formerly ANSI N510 (1975)). The tests are conducted at the rated airflow, using the DOP aerosol test equipment, test procedures, and test reports specified in ANSI/ASME N510 (1980). The overall filtration efficiency is not less than 99.95%. When leaks exist that would result in inability to meet the specified system parameters, they are located and after repair or filter replacement, the system is tested again to ensure conformance with acceptance criteria.

<u>CARBON ADSORBERS</u>

Carbon adsorbers are tested as follows:

a. Qualification Tests Before Installation

1. Representative samples, taken from each original or replacement batch of activated carbon used for filling the adsorbers, are tested to meet the qualification and batch test results summarized in ANSI N509 (1980), table 5.1, except that laboratory analysis of carbon samples is performed in accordance with ASTM D3803-1989, for ESF systems, and Regulatory Guide 1.140 (Rev 1), table 1 for normal ventilation exhaust systems (as an alternative, the test requirements specified in ANSI N509 (1980), table 5-1 and ASTM D3803-1989 can be used for normal ventilation exhaust systems). The assigned removal efficiencies and minimum air residence times are as follows for relative humidities up to 70%:

Table 9.4-4 (Cont'd)

	Removal Efficiency	
Adsorber Depth	Safety-Related	Nonsafety-Related
2 inches (0.25 sec res time)	95.0 elemental 95.0 organic	70.0% elemental 70.0% organic
8 inches (1.0 sec res time)	99.0 elemental 99.0 organic	99.0% elemental 99.0% organic

Tests or calculations demonstrate that the residence times shown above are met.

2. Each charcoal adsorber cell is tested for leakage using the test method presented in ANSI N510 (1980) (formerly AEC Report DP1082). The tracer gas used in the test is either R-112 or R-11 (tetrachloro-difluorothane or trichlorofluoromethane). Tracer gas is mixed into the rated air flow in accordance with the above procedure. Leakage paths are identified and blocked by welding, as necessary, to meet the limiting requirements on leakage. Pressure drop across the cell is measured during the tracer gas test.

b. Inplace Testing of Adsorber

1. Refrigerant (R-11 or R-112) is introduced into the upstream side of the adsorber at a concentration of approximately 20 ppm at rated airflow. The downstream concentration is less than 0.05% of the upstream 20 ppm. No more than four tests are conducted on any given carbon filter cell. No radioactive isotopes are used in the efficiency tests performed on the carbon adsorbers.

2. The installed carbon adsorber filter bank is visually and dimensionally checked for conformance to the design specifications.

Table 9.4-4 (Cont'd)

FILTER HOUSINGS

In addition to the housing manufacturer's shop tests, a field performance test is conducted for each housing. The leakage rate is to be less than 0.05% of the rated air flow in cubic feet per minute for RERS filter and control room emergency fresh air filter housings and 0.1% for all other filter housings at 125% of the negative design pressure.

FILTER INSERVICE TESTS AND INSPECTIONS

a. The air filtering systems are subject to inplace testing at intervals specified in Regulatory Guide 1.52 (Rev 2) (ESF) or Regulatory Guide 1.140 (Rev 1) (non-ESF). Except HEPA filters and charcoal adsorbers are in-place tested as specified in Regulatory Guide 1.52 at least once per 24 months or tested as specified in Regulatory Guide 1.140 at intervals of approximately 24 months.

b. Periodic testing of the filter banks ensures that the filter bank performance is not degraded through normal use, or during standby, to a level below that assumed in the accident analyses. Test methods and sensitivities are the same as or equal to those for initial acceptance of the system components. Should the test results indicate that performance of a component has fallen to the level assumed in the accident analyses, the component is replaced.

c. Results of all tests are made available upon completion of performance and acceptance by PECo.

d. The following filter inservice tests and inspections are performed at regular intervals during plant life to determine that the filtration systems are functioning correctly:

   1. With the fan running, observe and record readings on the differential pressure gauges, which are mounted on the filter plenum.

   2. Prefilters are replaced when the pressure drop across them reaches 1.0 inch water column.

   3. HEPA filters are replaced when the pressure drop across them reaches 3.0 inches water column. Where there are two HEPA filter banks, the second one is changed at 4 inches wg.

Table 9.4-4 (Cont'd)

4. Field leak tests are conducted after each change of HEPA filters in a system.

5. Field leak tests of HEPA filter banks are made with cold generated dioctylphthalate, and a light scattering aerosol photometer is used for measuring percentage penetration. A penetration greater than the value specified in the test procedures requires corrective action, as stated previously.

6. Corrective action after a leak test may consist of increasing the contact pressure on a seal or replacement of a cell or cells. After corrective action is taken, an additional leak test is made.

7. Laboratory tests in compliance with ASTM D3803-1989 (with the exception that ANSI N509 (1980) test procedures can be used) and Regulatory Guide 1.140 (Rev 1), table 2 (with the exception that ANSI N509 (1980) and ANSI N510 (1980) test procedures and ASTM D3803-1989 can be used) of representative samples are performed (1) initially, (2) at least once per 24 months thereafter for systems maintained in standby status or after 720 hours of system operation, and (3) following painting, fire, or chemical release in any ventilation zone communicating with the system. The activated carbon adsorber section is replaced with new activated carbon meeting the physical property specifications of ANSI N509 (1980), table 5.1 and ASTM D3803-1989 or Regulatory Guide 1.140 (Rev 1), table 1, as appropriate. The adsorber is replaced if a representative sample fails to pass the applicable test in Regulatory Guide 1.52 (Rev 2) table 2 and ASTM D3803-1989 and Regulatory Guide 1.140 (Rev 1), table 2 or no representative samples are available for testing.

DUCT-WORK

a. For Unit 1, leakage tests on all duct-work are conducted during construction. This also applies to Unit 2 duct-work with the exception of duct-work in the primary containment (drywell).

b. All air distribution systems are tested and balanced to provide design air quantities at each outlet, within a tolerance of ±10%.

Table 9.4-4 (Cont'd)

c. Category I duct-work is supported by seismically designed duct hangers.

d. All Category I duct-work is seismically designed and based on the analysis and test results conducted by Bechtel Power Corporation in April, 1976.

CONTROLS

a. All controls and instrumentation are tested prior to plant operation.

b. Inservice tests and inspection procedures are incorporated in the plant operations manual and are performed at regular intervals during the life of the plant to show that the instruments are functioning properly. Recalibration, when necessary, is made at that time.

Table 9.4-5

REACTOR ENCLOSURE AND REFUELING AREA VENTILATION SYSTEMS DESIGN PARAMETERS

	ZONE I REACTOR ENCLOSURE			ZONE III REFUELING AREA	
ITEM	SUPPLY UNIT SYS NO. V-202	EXHAUST FAN SYS NO. V-205	EQUIP. COMP EXH SYSTEM SYS NO. V-206	UNIT I SIDE SUPPLY UNIT SYS NO. V-201	UNIT I SIDE EXHAUST FAN SYS NO. V-204
Type	Built-up unit	Fan on built-up exhaust plenum	Built-up unit	Built-up unit	Fans on built-up exhaust plenum
Number of units	1	1	2	1	1
Unit flow rate (cfm)	180,000	140,000	40,000	43,000(6)	43,000(6)
Fan:					
Type	Vaneaxial	Vaneaxial	Centrifugal	Vaneaxial	Vaneaxial
Drive	Direct	Direct	Direct	Direct	Direct
No. of fans per unit	3	3	1	3	3
No. of running fans	2	2	1	2	2
Motor horsepower, (each)	200	125	150	40	40
Cooling coils:					
No. of coils per unit	1	None	None	1	None
Capacity, each (Btu/hr)	5,200,000	-	-	1,570,000	-
Heating coils:					
No. of coils per unit	2	None	None	2	None
Capacity, each (Btu/hr)	10,700,000	-	-	3,200,000	-
Prefilters:					
Quantity	1 roll	None	35	1 roll	None
Size, each	35'x12'	24x24x12	16'x12'		
Pressure drop, (in wg)					
Clean	0.45 avg	-	0.55	0.45 avg	-
Dirty	0.45 avg	-	1.0	0.45 avg	-
Efficiency(1)	85%	-	80% (min)	85%	-
HEPA filter, upstream:					
Quantity	None	None	35/24x24x12	None	None
Size, each					
Pressure drop (in wg)	-	-	-	-	-
Clean	-	-	1.0	-	-
Dirty	-	-	3.0	-	-
Efficiency(2)			99.97%		

Table 9.4-5 (Cont'd)

ITEM	ZONE I **REACTOR ENCLOSURE** SUPPLY UNIT SYS NO. V-202	EXHAUST FAN SYS NO. V-205	EQUIP. COMP EXH SYSTEM SYS NO. V-206	ZONE III **REFUELING AREA** UNIT I SIDE SUPPLY UNIT SYS NO. V-201	UNIT I SIDE EXHAUST FAN SYS NO. V-204
Charcoal absorber[4] :	None	None	Rechargeable	None	None
Type			vertical bed	-	-
Depth (in)			2	-	-
Filter medium			Impregnated activated carbon activated carbon	-	-
Pressure drop (in wg)			1.1 ±0.15		
Assigned efficiency[5]				-	-
Removing elemental iodine			70%	-	-
Removing organic iodine			70%	-	-
Residence time	-	-	0.25 sec	-	-
HEPA Filter, downstream:	None	None	[3]	None	None

[1] Dust spot test on atmospheric dust
[2] By MIL Standard 282 DOP test me hod on 0.3 micron par icles
[3] All design parameters same as HEPA, upstream
[4] Physical property specifications of new activated carbon are given in Table 9.4-4.
[5] Efficiency designated by Regulatory Guide 1.52 for use in release analyses.

Table 9.4-6

REACTOR ENCLOSURE SAFETY-RELATED AIR COOLING SYSTEM DESIGN PARAMETERS

			RHR PUMP ROOMS UNIT COOLERS		**CORE SPRAY PUMP ROOMS UNIT COOLERS**	
ITEM	RCIC PUMP ROOM UNIT COOLERS V-208 A&B	HPCI PUMP ROOM UNIT COOLERS V-209 A&B	RHR EAST V-210 **B&F, D&H**	RHR WEST V-210 **A&E, C&G**	EAST V-211 **B&F, D&H**	WEST V-211 **A&F, C&G**
Type	Fan cabinet	Fan cabinet	Fan cabinet	Fan cabinet	Fan cabinet	Fan cabinet
Number of units	2	2	4	4	4	4
Flow rate, each (cfm)	9,000	19,100	21,800	21,800	12,000	12,000
Fan:						
Type	Vaneaxial	Vaneaxial	Vaneaxial	Vaneaxial	Vaneaxial	Vaneaxial
Drive	Direct	Direct	Direct	Direct	Direct	Direct
No. of running fans	1	1	1	1	1	1
Total pressure (in wg)	2.5	2.9	4.17	4.17	3.4	3.4
Motor horsepower (each)	5	15	20	20	10	10
Cooling coil:						
No. of coils per unit	1	1	1	1	1	1
Cooling capacity, each (Btu/hr)	125,000	258,000	352,000	352,000	157,000	157,000

Table 9.4-7

REACTOR ENCLOSURE VENTILATION SYSTEM FAILURE MODES AND EFFECTS ANALYSIS(1)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency	Power supply	Total LOOP	None. All safety-related equipment and controls are redundant and are powered from separate standby diesel generators.	Alarm in the control room	No loss of safety func ion.
Emergency (LOCA or LOCA + LOOP)	Cooling fans RHR room - east (V-210)	Loss of one fan	None, the standby fan is 100% capacity. When the standby fan is not in service, none, provided the other pump's standby fan is In service.	Local temperature element & switch Trouble alarm from local panel to control room	When either standby fan is in service, no loss of safety func ion. When either standby fan is not in service, eventual loss of both pumps may occur. The RHR pumps in separate room are redundant after ten minutes.
Emergency (LOCA or LOCA + LOOP)	Cooling fans RHR room - east (V-210)	Loss of both fans for one of the two pumps (safeguard LC bkr failure)	One LPCI Injection Valve does not open. One RHR pump runs on minimum flow until secured by operator or until it eventually fails.	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety function. The other pump's two coolers will adequately cool the room. Redundant ECCS satisfy the core cooling requirements. When the other pump's standby cooler is out of service, eventual loss of both pumps occurs.
Emergency (LOCA or LOCA + LOOP)	Cooling fans RHR room – west (V-210)	Loss of one fan	None, the standby fan is 100% capacity, When the standby fan is not in service, none, provided the other pump's standby fan is in service.	Local temperature element & switch Trouble alarm from local panel to control room	When either standby fan is in service, no loss of safety function. When either standby fan is not in service, eventual loss of both pumps may occur. The RHR pumps in separate room are redundant after ten minutes.
Emergency (LOCA or LOCA + LOOP)	Cooling fans RHR room - west (V-210)	Loss of both fans for one of the two pumps (safeguard LC bkr failure)	One LPCI Injection valve does not open. One RHR pump runs on minimum flow until secured by operator or until it eventually fails.	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety function. The other pump's two coolers will adequately cool the room. Redundant ECCS satisfy the core cooling requirements. When the other pump's standby cooler is out of service, eventual loss of both pumps occurs.
Emergency (LOCA or LOCA + LOOP)	Power Supply	LOOP + failure of one Diesel Generator	Loss of power for a LPCI pump, a pair or RHR room coolers, a Core Spray pump and its coolers	Alarm in the control room	No loss of safety function because he other RHR pump's cooler(s) will adequately cool the room. Core Spray pumps in redundant loop are in separate compartments.

Table 9.4-7 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency (LOCA or LOCA + LOOP)	Cooling fans RCIC room (V-208)	Loss of one fan	None. The standby fan automatically starts.	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety func ion
Emergency (LOCA or LOCA + LOOP)	Cooling fans RCIC room (V-208)	Loss of both fans	None. RCIC operation without compartment unit coolers has been evaluated and determined acceptable	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety func ion
Emergency (LOCA or LOCA + LOOP)	Cooling fans HPCI room (V-209)	Loss of one fan	None. The standby fan automatically starts.	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety func ion
Emergency (LOCA or LOCA + LOOP)	Cooling fans HPCI room (V-209)	Loss of both fans	None. HPCI operation without compartment unit coolers has been evaluated and determined acceptable	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety func ion
Emergency (LOCA or LOCA + LOOP)	Cooling fans core spray pumps room (V-211)	Loss of one fan	When the standby fan is in service, none. The standby fan starts. When When the standby fan is not in service, eventual loss of the associated pump.	Alarm in the control room	When he standby fan is in service, no loss of safety function. When he standby fan is not in service, no loss of safety function. The core spray pumps in separate rooms are redundant.
Emergency (LOCA or LOCA + LOOP)	Cooling fans core spray pumps room (V-211)	Loss of both fans	Eventual loss of the associated pump.	Alarm in the control room	No loss of safety func ion. The core spray pumps in separate rooms are redundant.
Emergency (LOCA or LOCA + LOOP)	Emergency service water, cooling coils	Loss of ESW in one loop or loss of water due to pipe break between header and individual unit coil	Eventual loss of the associated pump.	Local temperature element & switch Trouble alarm from local panel to control room	No loss of safety func ion. The ECCS pumps are redundant.

Table 9.4-7 (Cont'd)

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency (Zone 3 isolation with or wi hout LOOP)	Zone 3 isolating valves	Failure of one valve to close	None. The valves are redundant and are in series. The dampers are designed to fail-safe in the closed position.	Valve position indica ion on local panel C101 and ISOLATION INCOMPLETE alarm in control room	No loss of safety func ion.
Emergency (pipe break in rooms containing high energy piping)	Steam flooding isolation dampers	Failure of one damper to close	None. The dampers are redundant and are in series. Only one damper is needed to close and isolate.	Damper position indica ion on local panel	No loss of safety func ion.
Emergency (LOCA or LOCA + LOOP)	Zone 1 isolation valves	Failure of one valve to close	None. The valves are redundant and are in series. Only one valve is needed to close and isolate. In addi ion, the valves are designed to fail-safe in closed position.	Valve position indica ion on local panel C101 and ISOLATION INCOMPLETE alarm in control room	No loss of safety func ion.

(1) For recircula ion system filter, fan, damper and valve FMEA see Section 6.5 and Table 6.5-6.

Table 9.4-8

RADWASTE ENCLOSURE VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS(1)

ITEM	GENERAL AREA AIR SUPPLY OA/BV 301	SERVICE & CONTROL AREA AIR SUPPLY OA/BV 302	GENERAL AREA EXHAUST OA/BV 304
Type	Built-up unit	Built-up unit	In-line fans
Number of units	1	1	2
Flow rate, each (cfm)	63,150	9,300	16,490
Fan:			
Type	Vaneaxial	Vaneaxial	Vaneaxial
Drive	Direct	Direct	Direct
No. of fans per unit	2	2	1
No. of running fans	1	1	1
Static pressure (in wg)	5.7	2.6	5.7
Motor horsepower, (each)	75	15	25
Heating coils:			
No. of coils per unit	2	2	None
Capacity, each (Btu/hr)	3,700,000	443,000	
Cooling coils:			
No. of coils per unit	1	2	None
Capacity, each (Btu/hr)	2,020,000 (5)	867,200	
Prefilters:			
Type, Size (ft)	Glass, roll	Glass, roll	None
Capacity (cfm)	63,150	10,350	
NBS efficiency	85%	85%	
HEPA filters:	None	None	None
Charcoal adsorber:	None	None	None

Table 9.4-8 (Cont'd)

ITEM	CHEMISTRY LABORATORY AIR EXHAUST SYSTEM OA/BV 306	EQUIPMENT COMPARTMENT EXHAUST OA/BV 305	TANK AND SUMP EXHAUST OOV 318
Type	Built-up unit	Built-up unit	Built-up unit
Number of units	2	2	1
Flow rate, each (cfm)	2850	53,000	385
Fan:			
Type	Centrifugal	Vaneaxial	Centrifugal
Drive	Direct	Direct	Direct
No. of fans per unit	1	1	1
No. of running fans	1	1	1
Static pressure (in wg)	7.9	17.5	4.1
Motor horsepower, (each)	7-1/2	200	1/2
Heating coils:	None	None	None
Cooling coils:	None	None	None
Prefilters:			
Type, Size (ft)	2x2x1 cells	2x2x1 cells	2x2x1 cells
Capacity (cfm)	2850	53,000	
NBS efficiency	80%	80%	
HEPA filters:			
Type, Size (ft)	2x2x1 cells	2x2x1 cells	2x2x1 cells
Capacity (cfm)	2850	53,000	330
DOP efficiency	99.97%	99.97%	99.97%
Charcoal adsorber[2]	None	None	Charcoal tray,
Type, Size		2 inches	
		330	
Capacity (cfm)		70%	
Elemental iodine eff[3]		0%	
Methyl iodide efficiency[3]		0.25 sec	
Residence time			

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[1] Offgas treatment charcoal tank vaults air conditioning equipment will be described later.
[2] Physical property specifications of new activated carbon are given in Table 9.4-4.
[3] Efficiency designated by Regulatory Guide 1.52 for use in release analyses.
[4] OA/BV321 - Abondoned in place by Mod.# 6126
[5] The 00-E366 Cooling Coil has 1 of its 3 individual cooling coil banks permanently blanked off.

TABLE 9.4.8A

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Fume Hood Aux. Air Supply HV-1	Fume Hood Aux. Air Supply HV-2	Data Acquisition Cooling Unit 00V386	Data Acquisition Cooling Unit 00V387	Storage Room Cooling Unit 00V389
Type	Central Station	Central Station	Wall Mounted	Wall Mounted	Ceiling Mounted
Number of Units	One	One	One	One	One
Flow rate, each (cfm)	5510	5510	800	480	1050
Fan:					
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Drive	Belt	Belt	Direct	Direct	Direct
No. of fans per unit	One	One	One	One	One
No. of running Fans	One	One	One	One	One
Static Pressure (in wg)	5 1/4	5 1/4	N/A	N/A	N/A
Motor Horsepower, (each)	15	15	0.9 FLA	0.5 FLA	2.1 FLA
Heating Coils:			None	None	None
No. of coils per unit	N/A	N/A	-	-	-
Capacity, each (Kw)	142	142	-	-	-
Cooling Coils:	None	None			
No. of coils per unit	-	-	N/A	N/A	N/A
Capacity each (BTU/hr)	-	-	24000	12600	36400
Prefilters					-
Type, Size (ft)	Glass, N/A	Glass, N/A	N/A	N/A	-
Capacity (cfm)	7425	7425	N/A	N/A	-
NBS efficiency	30%, 65%	30%, 65%	N/A	N/A	N/A
Final Filters:			-	-	-
Type, Size (FT)	Cartridge, N/A	Cartridge, N/A	-	-	-
Capacity (cfm)	5510	5510	-	-	-

TABLE 9.4.8A (Cont'd)

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Fume Hood Aux. Air Supply HV-1	Fume Hood Aux. Air Supply HV-2	Storage Room (Existing Room #410) Cooling Unit 00V386	Data Acquisition (Existing Room #411) Cooling Unit 00V389
Type	Central Station	Central Station	Wall Mounted	Ceiling Mounted
Compressors:				
Number	None	None	None	None
Motor Horsepower	None	None	54 LRA	74 LRA
Number of Steps	None	None	One	One
Condensor Fans:				
Number	None	None	One	One
Motor Horsepower	None	None	54 LRA	1.6 LRA
HEPA Filters	None	None	None	None
Charcoal Absorber:(each)	None	None	None	None

Note: ACUs 00V-387 & 00V-388 are abandoned in the place (Mod 6148-0, Phase 3). Future use of these units is required if needed for supplementary cooling Rooms 418 & 412, respectively. The primary cooling for these rooms is provided from Air Supply System V-302.

TABLE 9.4.8A (Cont'd)

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Fume Hood Aux. Exhaust EF-1	Fume Hood Aux. Exhaust EF-2	Fume Hood Aux. Exhaust EF-3	Fume Hood Aux. Exhaust EF-4	Conf/Lunch Exhaust EF-5	Toilet/Locker Exhaust EF-6
Type	Utility	Utility	Utility	Utility	Roof	Roof
Number of Units	One	One	One	One	One	One
Flow rate, each (cfm)	1120	1120	1200	750	200	400
Fan:						
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Drive	Belt	Belt	Belt	Belt	Belt	Belt
No. of fans per unit	One	One	One	One	One	One
No. of running Fans	One	One	One	One	One	One
Static Pressure (in wg)	11 1/2	11 1/2	0.6	0.5	3/8	3/8
Motor Horsepower, (each)	40	40	5	5	1/4	1/4
Heating Coils:						
No. of coils per unit	None	None	None	None	None	None
Capacity, each (BTU/hr)						
Cooling Coils:						
No. of coils per unit	None	None	None	None	None	None
Capacity each (BTU/hr)						
Prefilters						
Type, Size (ft)	Glass, N/A	Glass, N/A	None	None	None	None
Capacity (cfm)	11200	11200				
NBS efficiency	30%, 65%	30%, 65%				
HEPA Filters:	Yes	Yes	None	None	None	None
Charcoal Absorber:	None	None	None	None	None	None

TABLE 9.4.8A (Cont'd)

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Penthouse Exhaust EF-7	Penthouse Exhaust EF-8				
Type	Roof	Roof				
Number of Units	One	One				
Flow rate, each (cfm)	3500	3500				
Fan:						
Type	Centrifugal	Centrifugal				
Drive	Belt	Belt				
No. of fans per unit	One	One				
No. of running Fans	One	One				
Static Pressure (in wg)	3/8	3/8				
Motor Horsepower, (each)	3/4	3/4				
Heating Coils:						
No. of coils per unit	None	None				
Capacity, each (BTU/hr)						
Cooling Coils:						
No. of coils per unit	None	None				
Capacity each (BTU/hr)						
Prefilters						
Type, Size (ft)	None	None				
Capacity (cfm)						
NBS efficiency						
HEPA Filters:	None	None				
Charcoal Absorber:	None	None				

TABLE 9.4.8A (Cont'd)

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Chem Lab Area Air Air Supply AC-1	Chem Lab Area Air Supply AC-2	Environmental Control Unit AC-3	Environmental Control Unit AC-3	Conference/Lunch & Office Area AC-5
Type	Central Station	Central Station	N/A	N/A	Roof Top
Number of Units	One	One	One	One	One
Flow rate, each (cfm)	8500	8500	3600	2600	4200
Fan:					
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Drive	Belt	Belt	Belt	Belt	Belt
No. of fans per unit	One	One	One	One	One
No. of running Fans	One	One	One	One	One
Static Pressure (in wg)	6 1/2	6 1/2	5	5	1.3
Motor Horsepower, (each)	20	20	1 1/2	1 1/2	3
Heating Coils:			None	None	None
No. of coils per unit	N/A	N/A	N/A	N/A	N/A
Capacity, each (Kw)	150	150	30	24	20
Cooling Coils:					
No. of coils per unit	4	4	N/A	N/A	N/A
Capacity each (BTU/hr)	590000	590000	58500	42000	150000
Prefilters					
Type, Size (ft)	Glass, N/A	Glass, N/A	N/A	N/A	Glass N/A
Capacity (cfm)	8500	8500	N/A	N/A	N/A
NBS efficiency	30%, 65%	30%, 65%	N/A	N/A	N/A
Final Filters:					
Type, Size (FT)	Cartridge, N/A	Cartridge, N/A	N/A	N/A	N/A
Capacity (cfm)	8500	8500	N/A	N/A	N/A
NBS Efficiency	95%	95%	N/A	N/A	N/A

TABLE 9.4.8A (Cont'd)

CHEMISTRY LABORATORY VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

Item	Chem Lab Area Air Air Supply AC-1	Chem Lab Area Air Supply AC-2	Environmental Conttol Unit AC-3	Environmental Control Unit AC-3	Conference/Lunch & Office Area AC-5
Compressors:					
Number	4	4	2	2	2
Motor Horsepower	2(10), 2(15)	2(10), 2(15)	2 1/2	2 1/4	2 (5 1/4)
Number of Steps	4	4	N/A	N/A	N/A
Condensor Fans:					
Number	6	6	N/A	N/A	N/A
Motor Horsepower	1	1	1	1	N/A
HEPA Filters	None	None	None	None	None
Charcoal Absorber:	None	None	None	None	None

Note: N/A - Not Applicable

Table 9.4-9

TURBINE ENCLOSURE VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

ITEM	TURBINE ENCLOSURE AIR SUPPLY V101	CLEAN AREA AIR EXHAUST V105	EQUIPMENT COMPARTMENT AIR EXHAUST V106	BATTERY COMPARTMENT EXHAUST V108
Type	Built-up unit	Built-up unit	Built-up unit	Fan
Number of units	1	1	1	1
Flow rate (cfm)	250,000	200,000	63,000	1170
Fan:				
Type	Vaneaxial	Vaneaxial	Centrifugal	Centrifugal
Drive	Direct	Direct	Direct	Direct
No. of fans per unit	3	3	2	1
No. of running fans	2	2	1	1
Static pressure (in wg)	5.75	5.55	17.75	2.5
Motor horsepower (each)	150	125	250	1
Heating coils:		None	None	None
No. of banks per unit	1	-	-	-
Capacity, each (Btu/hr)	15,700,000	-	-	-
Cooling coils:		None		None
No. of banks per unit	8	-	2 (in duct-work)	-
Capacity, each (Btu/hr)	1,500,000/420,000	-	464,000	-
Prefilters		None		None
Type, size (ft)	Glass, roll	-	2x2x1 cells	-
Capacity (cfm)	250,000	-	31,500/housing	-
NBS efficiency	85%	-	80%	-
HEPA filters:	None	None		None
Type, size (ft)	-	-	2x2x1 cells	-
Capacity (cfm)	-	-	31,500/housing	-
DOP efficiency	-	-	99.97%	-
Type	Built-up unit	Built-up unit	Built-up unit	Fan
Charcoal adsorbers[(1)]:	None	None		None
Type, size	-	-	8-in deep rechargeable bed	-
Capacity (cfm)	-	-	31,500/housing	-
Elemental iodine eff[(2)]	-	-	99.0%	-
Methyl iodide efficiency[(2)]	-	-	99.0%	-
Residence time	-	-	1 sec	-

Table 9.4-9 (Cont'd)

ITEM	FEEDWATER HEATER COMPARTMENT COOLING V133 el 269'	FEEDWATER HEATER COMPARTMENT COOLING V124 el 239'	RFPT COMPARTMENT ACCESS COOLING V135	CT&RP COMPARTMENT ACCESS COOLING V136
Type	Unit cooler	Unit cooler	Unit cooler	Unit cooler
Number of units	2 per compartment	3 per compartment	4	2
Flow rate, each (cfm)	2800	5200	3400	1,850
Fan:				
Type	Vaneaxial	Propeller	Propeller	Propeller
Drive	Direct	Direct	Direct	Direct
No. of fans per unit	1	1	1	1
No. of running units	1 per compartment	2 per compartment	2	1
Total pressure (in wg)	1.55	0.65	0.59	0.48
Motor horsepower, (each)	2	3	1-1/2	3/4
Heating coils:	None	None	None	None
Cooling coils:				
No. of coil banks per Unit	1	1	1	1
Capacity, each (Btu/hr)	106,000	199,000	100,000	55,000
Filters	None	None	None	None

Table 9.4-9 (Cont'd)

ITEM	VACUUM PUMP COMPARTMENT COOLING V137	FEEDWATER HEATER ACCESS COOLING V138	CONDENSATE PUMP COMPARTMENT COOLING V112	MAIN CONDENSER COMPARTMENT COOLING V113
Type	Unit cooler	Unit cooler	Unit cooler	Unit cooler
Number of units	2	9	6	12
Flow rate, each (cfm)	1,170	7,650	34,500	32,000
Fan:				
Type	Propeller	Propeller	Vaneaxial	Vaneaxial
Drive	Direct	Direct	Direct	Direct
No. of fans per unit	1	1	1	1
No. of running units	1	6	4	8
Total pressure (in wg)	0.22	1.2	4.7	4.2
Motor horsepower, (each)	½	3	40 / 60	30
Heating coils:	None	None	None	None
Cooling coils:				
No. of coil banks per Unit	1	1	1	1
Capacity, each (Btu/hr)	42,000	293,000	500,000	658,000
Filters	None	None	None	None

(1) Physical property specifications of new activated carbon are given in Table 9.4-4.
(2) Efficiency designated by Regulatory Guide 1.52 for use in release analyses.

Table 9.4-10

DRYWELL UNIT COOLER DESIGN PARAMETERS

Type	Built-up
Number of unit coolers	8
Flow rate, each	7000 cfm
Fans:	
Type	Vaneaxial
Drive	Direct
No. of fans per unit cooler	2
External static pressure, each	3.5 in wg
Fan speed	3600 rpm
Motor power rating	30 hp
Cooling coils:	
No. of coils per unit cooler	2
Cooling capacity, each	575,000 Btu/hr
Heating coils	None
Filters	None[1]

(1) "Throw-away" type roughing filters 2 inches thick are used during plant construction only. No filters are used during plant operation.

Table 9.4-11

PRIMARY CONTAINMENT VENTILATION SYSTEM FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON THE SYSTEM	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLAN OPERATION
Normal	Power supply	LOOP	Loss of fans in drywell unit coolers and loss of cooling water supply to unit coolers	Alarm in he control room and rise in drywell temperature indication in the control room	None. Fans in dry well unit coolers are powered from Class 1E buses and restart automatically when emergency power is available. Cooling water supply can be re-established by switching to the RECW system, which is powered from the diesel generators.
Emergency (LOOP)	Fans	Loss of one fan	Loss of air flow through one unit cooler	Alarm in he control room on computer	None. Standby fan starts automatically.
Emergency (LOCA or LOCA + LOOP)	Fans	Loss of one fan	Loss of air flow through one unit Cooler	Alarm in he control room on computer	None. Redundant unit coolers continue to operate.
Emergency (LOCA or LOCA + LOOP)	Containment isolation valve	Failure of one valve to close	Reduction in containment isolation barriers from two valves to one in the affected purge line	Indicating lights in the control room	None
Emergency (LOCA or LOCA + LOOP)	Power supply	Failure of one division of Class 1E power	Loss of power to one fan in two of the four safety-related unit coolers. Possible reduction in containment isolation barriers from two valves to one in the affected purge lines	Indicating lights in the control room	None. A minimum of one fan in each of two unit coolers continues to operate.

Table 9.4-12

DIESEL GENERATOR ENCLOSURE VENTILATION SYSTEM
EQUIPMENT DESIGN PARAMETERS

ITEM	EXHAUST FANS	UNIT HEATERS	PLANT HEATING STEAM CONDENSATE STEAM PUMP ROOM POWER ROOF VENTILATOR
Quantity, per cell	2	2	1
Flow rate, each (cfm)	35,000	2,680	380
Seismic category	I	II	II
Fan:			
Type	Vaneaxial	Propeller	Centrifugal
Drive	Direct	Direct	Direct
Static pressure (in wg)	1.6	0	0.25
Motor power rating, each (hp)	20	1/5	1/12
Cooling coil	None	None	None
Heating coil (BTU/hr)	None	291,000	None
Filters	None	None	None

Table 9.4-13

DIESEL GENERATOR ENCLOSURE VENTILATION SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SAFEGUARD EQUIPMENT	FAILURE MODE DETECTION	EFFECT OF FAILURE ON PLANT OPERATION
Emergency	Ventilation System	Total LOOP	None. Ventilation systems are powered from their associated diesel generators.	Alarm in control room	No loss of safety function
Emergency (LOCA or LOCA + LOOP)	Fan, damper, and instruments	Failure of fan, damper, or an instrument	Possible overheating of cell in summer and eventual loss of one diesel generator.	Alarm in control room on loss of power or high or low temperature	No loss of safety function. The remaining three diesel generators are sufficient for a safe shutdown
Emergency (LOCA or LOCA + LOOP)	Steam unit heaters	Loss of power or failure	None. Equipment is not affected by low temperature	Alarm in control room on low temperature	No loss of safety function
Emergency (LOCA or LOCA + LOOP)	Power roof ventilator	Loss of power or failure of fan	There is no safeguard equipment in the plant heating condensate pump-room.	None	No loss of safety function

Table 9.4-14

SPRAY POND PUMP STRUCTURE
VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS

ITEM	FAN CABINET
Quantity	4
Flow rate, each (cfm)	30,000
Seismic Category	I
Fan:	
Type	Vaneaxial
Drive	Direct
External static pressure (in wg)	0.97
Motor power rating, each (hp)	10
Heating coil type	Electric
Capacity, each (Btu/hr)	410,000

Table 9.4-15

SPRAY POND PUMP STRUCTURE VENTILATION SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

PLANT OPERATING MODE	SYSTEM COMPONENT	COMPONENT FAILURE MODE	EFFECT OF FAILURE ON SAFEGUARD EQUIPMENT	FAILURE MODE DETECTION	EFFECT OF FAILURE PLANT OPERATION
Emergency	Entire system	Total LOOP	None. All H&V systems are powered from onsite Class 1E power (diesel generators).	Alarm in control room	No loss of safety function
Emergency (LOCA or LOCA + LOOP)	Ventilation fans	Loss of one fan	None. Standby fan cabinet designed for 100% of cooling load. Automatic start on thermostat signal.	Alarm in control room	No loss of safety function
Emergency (LOCA or LOCA + LOOP)	Intake, exhaust, and return dampers	Loss of dampers in one system	None. Standby fan cabinet with separate dampers available. Automatic or manual start.	High or low temperature alarm in control room	No loss of safety function
Emergency (LOCA or LOCA + LOOP)	Instruments	Failure of instrument(s) in one system	None. Standby fan cabinet with separate dampers available. Automatic or manual start.	High or low temperature alarm in control room by standby instruments	No loss of safety function

Table 9.4-16

HOT MAINTENANCE SHOP VENTILATION SYSTEM
EQUIPMENT DESIGN PARAMETERS

ITEM	REPAIR AREA SUPPLY V-5001	CLEANUP AREA SUPPLY V-5002
Type	Air handler	Air handler
Flow rate (cfm)	20,000	10,000
Fan:		
Type	Vaneaxial	Vaneaxial
Drive	Direct	Direct
Total pressure (in wg)	4.3	4.4
Motor power rating (hp)	25	15
Cooling coils:		
Capacity (Btu/hr)	530,000	320,000
Heating coils:		
Capacity (Btu/hr)	500,000	239,000
Prefilters:		
Type	Glass pad	Glass pad
Efficiency by weight	70% AFI	70% AFI
Medium efficiency filters:		
Size, type	12 inch deep cell	12 inch deep cell
Efficiency by dust spot	90%-95% NBS	90%-95% NBS

Table 9.4-16 (Cont'd)

ITEM	EXHAUST UNIT V-5003	EXHAUST FAN V-5004
Type	Fan cabinet	In-line
Flow rate (cfm)	7000	7000
Fan:		
Type	Vaneaxial	Vaneaxial
Drive	Direct	Direct
Total pressure (in wg)	6.0	4.0
Motor power rating (hp)	20	10
Cooling coils:	None	None
Capacity (Btu/hr)		
Heating coils:	None	None
Capacity (Btu/hr)		
Prefilters:		
Size, type	12 inch deep cell	None
NBS efficiency	85%	
High efficiency filters:		
Type	HEPA cell	None
Efficiency	99.97% DOP	

Table 9.4-16 (Cont'd)

TEM	DUST COLLECTOR V-5006	DUST COLLECTOR V-5007
Type	Cabinet	Cabinet
Flow rate (cfm)	940	440
Fan:		
Type	Centrifugal	Centrifugal
Drive	Direct	Direct
Static pressure (in wg)	4.3	3.8
Motor power rating (hp)	1½	¾
Cooling coils:	None	None
Capacity (Btu/hr)		
Heating coils:	None	None
Capacity (Btu/hr)		
Prefilters:	None	None
Medium efficiency filters:		
Type	Pocket (bag)	Pocket
Efficiency by weight	99.9%	99.9%

Table 9.4-17

MISCELLANEOUS STRUCTURES VENTILATION SYSTEM EQUIPMENT DESIGN PARAMETERS [(1)]

Item	Circulating Water Pump Structure Exhaust	Circulating Water Pump Structure Heating	Diesel Fire Pump Compartment Exhaust	Diesel Fire Pump Compartment Heating	Chlorine Equipment Compartment Exhaust
Type	Roof ventilators	Unit heaters	Roof ventilator	Unit heater	Roof ventilators
Number of units	24	12/3 Flash steam	1	1	2
Flow rate, each (cfm)	22,980-32,068	999/508	32,068	886	2,345
Location	Roof	Compartment	Roof	Compartment	Roof
Fan:					
Type	Tubeaxial	Propeller	Tubeaxial	Propeller	Centrifugal
Drive	Direct	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	2/8-3/8	0	3/8	0	3/4
Motor power, each (hp)	5 - 6	1/20 / 1/70	5	1/20	3/4
Cooling coil (Btu/hr)	None	None	None	None	None
Heating coil	None	Steam	None	Steam	None
Capacity, each (Btu/hr)		72,900 / 38,800		53,800	
Filters	None	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Chlorine Equipment Compartment Heating	Water Treatment Eqpt Comp Exhaust	Water Treatment Eqpt Comp Heating	Water Treatment Utility Comp Exhaust	Water Treatment Utility Comp Heating
Type	Unit heaters	Roof ventilators	Unit heaters	Roof ventilator	Unit heater
Number of units	2	6	6	1	1
Flow rate, each (cfm)	508/550	3635 or 3527	1100	1150	508
Location	Compartment	Roof	Compartment	Roof	Compartment
Fan:					
Type	Propeller	Tubeaxial	Propeller	Centrifugal	Propeller
Drive	Direct	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	0	1/4	0	3/4	0
Motor power, each (hp)	1/70, 1/20	3/8 or 1/2	1/20	3/8	1/70
Cooling coil (Btu/hr)	None	None	None	None	None
Heating coil	Steam	None	Steam	None	Steam
Capacity, each (Btu/hr)	38,800 / 58,000		83,800		38,800
Filters	None	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Water Treatment Laboratory Air Cond	Sewage Treatment Equipment Comp Exhaust	Sewage Treatment Equipment Comp Heating	Schuy kill River Intake Structure Exhaust	Schuylkill River Intake Structure Heating
Type	Package air conditioner	Roof ventilators	Unit heaters	Roof ventilators	Unit heaters
Number of units	1	2	2	4	6
Flow rate, each (cfm)	1200	1022	670	13,700	850
Location	Roof	Roof	Compartment	Roof	Compartment
Fan:					
Type	Centrifugal	Centrifugal	Propeller	Tubeaxial	Propeller
Drive	Belt	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	0.7	3/8	0	1/4	0
Motor power, each (hp)	1/2	1/8,1/6	1/10	3	1/12
Cooling coil (Btu/hr)	49,000 Btu/hr	None	None	None	None
Heating coil	Steam	None	Electric	None	Electric
Capacity, each (Btu/hr)	26,000		25,600		41,000
Filters	Glass pad	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Schuylkill River Debris Facility Exhaust	Schuy kill River Debris Facility Heating	Perkiomen Pump Structure Exhaust	Perkiomen Pump Structure Heating	Perkiomen Pump Station Battery Room Exhaust
Type	Wall fan	Unit heater	Roof ventilator	Unit heater	Roof ventilator
Number of units	1	2	3	5	1
Flow rate, each (cfm)	1500	260	45,876	1530	380
Location	Wall	Equipment room	Roof	Compartment	Roof
Fan:					
Type	Propeller	Propeller	Tubeaxial	Propeller	Centrifugal
Drive	Direct	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	1/4	0	1/4	0	1/4
Motor power, each (hp)	1/4	1/50	15	1/4	1/20
Cooling coil (Btu/hr)	None	None	None	None	None
Heating coil	None	Electric	None	Electric	None
Capacity, each (Btu/hr)		13,700		71,700	
Filters	None	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Boiler Fuel Oil Transfer Enclosure Exhaust	Auxiliary Boiler Boiler Structure Exhaust	Boiler Fuel Oil Transfer Enclosure Heating	Chlorine & Acid Feed Electrical Equipment Compartment Exhaust	Chlorine & Acid Feed Electrical Equipment Compartment Heating	Chlorine & Acid Feed Pipe Trench Heating
Type	Roof ventilators	Roof ventilators	Unit heaters	Wall	Unit heater	Unit heater
Number of units	2	6	2	1	1	5
Flow rate, each (cfm)	2600	3635 or 3527	712	386 (un.1) 386 (un.2)	405	405
Location	Roof	Roof	Compartment	Wall	Compartment	Compartment
Fan:						
Type	Centrifugal	Tubeaxial	Propeller	Centrifugal	Propeller	Propeller
Drive	Direct	Direct	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	1/8	1/4	0	1/4	0	0
Motor power, each (hp)	1/2	3/8 or 1/2	1/25	1/6 (un.1) 1/6 (un.2)	1/40	1/40
Cooling coil (Btu/hr)	None	None	None	None	None	None
Heating coil	None	None	Electric	None	Electric	Electric
Capacity, each (Btu/hr)			34,000		10,200	6800
Filters	None	None	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Technical Support Center Security Areas Air Conditioning	Lube Oil Storage Exhaust	Lube Oil Storage Heating	Calibration Equipment Storage Comp Exhaust	Calibration Equipment Storage Comp Heating	Chlorine & Acid Feed Enclosure Ventilator	Chlorine & Acid Feed Enclosure Heating
Type	Air Handler	Roof ventilator	Unit heater	Roof ventilator	Unit heater	Roof/Wall ventilator	Unit heaters
Number of units	1 ; 1	1	2	1	1	4/1	4/1
Flow rate, each (cfm)		747	508	590	508	1190/2958	590/712
Location	First floor Mechanical Room	Roof	Compartment	Roof	Compartment	Roof / Wall	Compartment
Fan:							
Type	Centrifugal	Centrifugal	Propeller	Centrifugal	Propeller	Centrifugal	Propeller
Drive	Belt	Direct	Direct	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	1	0.25	0	1/4	0	1/2;0	0
Motor power, each (hp)	5 ; 7½	1/6	1/70	1/12	1/70	1/4;1/3	1/40, 1/25
Cooling coil (Btu/hr)	360,000 ; 420,000	None	None	None	None	None	None
Heating coil	Electric	None	Steam	None	Steam	None	Electric
Capacity, each (Btu/hr)	102,000 ; 136,000		38,800		38,800		25,600 / 34,000
Filters	40% Pleated	None	None	None	None	None	None

Table 9.4-17 (Cont'd)

Item	Administration Building Air Conditioning Supply OOV 501	Administration Building Air Conditioning Return OOV 503	Administration Building H & V Supply OOV 505	Administration Building Exhaust OOV 509
Type	Air handler	In-line fan	Air handler	In-line fan
Number of units	1	1	1	1
Flow rate, each (cfm)	30,000	22,600	13,000	22,600
Location	Penthouse	Penthouse	Penthouse	Penthouse
Fan:				
Type	Vaneaxial	Vaneaxial	Vaneaxial	Vaneaxial
Drive	Direct	Direct	Direct	Direct
External Static Pressure (in wg)	3.8	1.3	2.5	1.2
Motor power, each (hp)	25	10	7-1/2	5
Cooling coil (Btu/hr)	1,440,000 Btu/hr	None	None	None
Heating coil	Hot water	None	Hot water	None
Capacity, each (Btu/hr)	1,200,000		890,000	
Filters	Glass roll	None	Glass pad	None

Table 9.4-17 (Cont'd)

Item	Administrative Building Telephone Equipment Room Exhaust OO/V	Security Areas Air Conditioning OA/B V565	Machine Shop Heating & Ventilating OOV 550	Administration Building Eastern Extension Air Conditioning OO V551
Type	In-line fan	Package air cond	Air handler	Air handler
Number of units	1	2	1	1
Flow rate, each (cfm)	1000	4000	8600	12,500
Location	Admin Bldg Bsmt	Guard station roof	Machine shop	Second floor
Fan:				
Type	Vaneaxial	Centrifugal	Vaneaxial	Guard station Vaneaxial
Drive	Direct	Belt	Direct	Direct
External Static Pressure (in wg)	0.75	1	2.3	3.6
Motor power, each (hp)	1/3	1/2	5	15
Cooling coil (Btu/hr)	None	111,000	None	810,000
Heating coil	None	None	Hot water	Hot water
Capacity, each (Btu/hr)			568,000	465,000
Filters	None	Glass pad	Glass pad	Glass pad

(1) Design data listed in Table 9.4-17 does not constitute performance requirements. There is no licensing basis requirement for these particular design parameter values. This information should be treated as historical information and does not require updating.

Table 9.4-18

CONFORMANCE WITH REGULATORY GUIDE 1.140[1]

REGULATORY GUIDE POSITION	TURBINE[2]	SGTS ROOM EXHAUST[2]	REACTOR[2]	RADWASTE[2]
Para C.1 - Environmental Design	Conform	Conform	Conform	Conform
Para. C.2 – System Design Criteria				
C.2.a	Conform	Conform	Conform	Conform
C.2.b	System is rated at 35,000 cfm. Space restrictions prohibit multiple train. HEPA filters are arranged 5 wide by 6 high. Platforms are provided in the plenum to service the filters	Conform	System is rated at 40,000 cfm. Space restrictions proh bit multiple train. HEPA filters are arranged 5 wide by 7 high. Platforms are provided in the plenum to service the filters	(A) Conform (B) System is rated at 53,000 cfm. Space restrictions proh bit multiple train. HEPA filters are arranged 8 wide by 6 high. Platforms are provided in the plenum to service the filters.
C.2.c	Conform	Conform	Conform	Conform
C.2.d	Conform	Conform	Conform	Conform
C.2.e	Conform	Conform	Conform	Conform
C.2.f	Allowable leak rate: (1) filter house, 0.1% of rated flow in cfm at 125% negative pressure; (2) duct work, 4.0% of scheduled air flow multiplied by ratio of the volume of duct being tested to the total volume of the duct run. The system is not in a high radiation zone	Same as Turbine	Same as Turbine	Same as Turbine except (A) filter plenum is located in a high radiation zone.

Table 9.4-18 (Cont'd)

REGULATORY GUIDE POSITION	TURBINE(2)	SGTS ROOM EXHAUST(2)	REACTOR(2)	RADWASTE(2)
Para C.3 – Component Design Criteria and Qualification Testing				
C.3.a	Conform	Conform	Conform	Conform
C.3.b	Conform	Conform	Conform	Conform
C.3.c	Conform	Conform	Conform	Conform
C.3.d	Due to space restrictions, system is rated at 35,000 cfm. HEPA filters are arranged 5 wide by 6 high.	Conform	Due to space restrictions, the system is rated 40,000 cfm. HEPA filters are arranged 5 wide by 7 high.	(A) Conform (B) Due to space restrictions, the system rated at 53,000 cfm. HEPA filters are arranged 8 wide by 6 high. Does not contain charcoal filter
C.3.e	Housing design generally meets guideline except that no view ports are provided	Same as Turbine	Same as Turbine	(A) Access doors are smaller than recommended due to lower cfm rating of system. (B) Same as Turbine
C.3.f	Conform except allowable duct leak rate of 4.0%	Same as Turbine	Same as Turbine	Same as Turbine
C.3.g	Conform(4)	Conform(4)	Conform(4)	(A) Does not contain charcoal filters. (B) Does not contain charcoal filter.
C.3.h through C.3.l	Conform	Conform	Conform	Conform

Table 9.4-18 (Cont'd)

REGULATORY GUIDE POSITION	TURBINE[(2)]	SGTS ROOM EXHAUST[(2)]	REACTOR[(2)]	RADWASTE[(2)]
Para C.4 – Maintenance				
C.4.a	Conform	Conform	Conform	Conform
C.4.b	Conform	Conform	Due to space restrictions, distance between filter banks is less than recommended	(A) The system is rated at 330 cfm and the physically small housing design provides easy access to filters for servicing (B) Same as Reactor
C.4.c	Conform	Conform	Conform	Conform
C.4.d	Conform	Conform	Conform	Conform
Part C.5 – In-Place Testing Criteria	Conform except tested at intervals of approximately 24 months[(3)]	Same as Turbine[(3)]	Same as Turbine[(3)]	(A) Same as Turbine[(3)] (B) Same as Turbine[(3)], Does not contain charcoal filter
Part C.6 – Laboratory Testing Criteria for Activated Carbon	Conform except tested at intervals of approximately 24 months[(5)]	Same as Turbine[(5)]	Same as Turbine[(5)]	(A) Same as Turbine[(5)] (B) Does not contain charcoal filter

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(1) The LGS design was completed prior to the issuance of this guide, and therefore the guide was not specifically considered in the design

(2) Turbine - Turbine enclosure equipment compartment exhaust air filter plenum
SGTS - Standby gas treatment room exhaust air filter plenum
Reactor - Reactor enclosure equipment compartment exhaust air filter plenum
Radwaste - (A) Radwaste enclosure common tanks vent filter assembly
(B) Radwaste Enclosure Equipment Compartment Exhaust Filter Assembly.

(3) To ANSI/ASME N510 (1980) testing criteria.

(4) As an alternative, the criteria specified in the ANSI N509 (1980), table 5-1 can be used.

(5) As an alternative, the test procedures specified in the ANSI N509 (1980) and ANSI N510 (1980) can be used.

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 FIRE PROTECTION PROGRAM

The term "fire protection system" refers to the integrated complex of components and equipment provided for detection and suppression of fires. In addition to this system, the "fire protection program" includes the concepts of design and layout implemented to prevent or mitigate fires, administrative controls and procedures, and the training of personnel to combat fires.

An evaluation of potential fire hazards has been performed and is summarized in the Fire Protection Evaluation Report (Appendix 9A). Included in the report are details of the locations of fire barriers that divide the plant into fire areas, the type and quantity of combustible material contained in each fire area, the fire detection and suppression systems provided in each fire area, and the effects of postulated fires on safety-related systems required for reactor shutdown. Also included is a comparison of the plant's fire protection provisions with the guidelines of BTP CMEB 9.5-1.

Fire protection operational conditions and remedial actions and test requirements are located in the Technical Requirements Manual and are incorporated herein by reference (reference 9.5-1). These requirements have been relocated from the Technical Specifications by Amendments 104 and 68 to the Unit 1 and Unit 2 Facility requirements was in accordance with NRC Generic Letter (GL) 86-10, "Implementation of Fire Protection Requirements", and GL-88-12, "Removal of Fire Protection Requirements for Technical Specifications".

These requirements are mandated by FOL Condition 2.C.(3).

9.5.1.1 Design Basis

The fire protection system is designed to perform the following functions:

a. To maintain safe shutdown ability by providing the capability to control the postulated fires encountered in all plant areas by the use of fixed and/or portable fire fighting equipment

b. To provide automatic fire detection and annunciation for selected areas of the plant for personnel safety and fire brigade notification

c. To supply rated flow of fire protection water, with one pump out-of-service, to points throughout the plant area where fire fighting may be required

d. To supply simultaneously the maximum flow for any automatic sprinkler or water spray system and 500 gpm for fire hoses for a minimum of 2 hours.

e. To preclude loss of function of plant safety-related structures, systems, or components due to seismic loading of the fire protection system

f. To prevent failure or inadvertent operation of the fire suppression system from jeopardizing the capability to achieve safe shutdown of the plant

g. To minimize the probability of the spread of fire by the use of fire barriers between hazards

The codes, standards, or guidelines considered and used in the design of the fire protection systems include the following:

a. "Basic Fire Protection for Nuclear Power Plants," American Nuclear Insurers - Mutual Atomic Energy Reinsurance Pool

b. "Building Regulations for Protection from Fire and Panic," Commonwealth of Pennsylvania, Department of Labor and Industry

c. Occupational Safety and Health Administration, Rules and Regulations for Fire Protection Systems (29CFR1910)

d. National Fire Protection Association (NFPA) Standards (listed in Table 9.5-1 and Appendix 9A)

e. Branch Technical Position CMEB 9.5-1, Revision 2 (part of NUREG-0800).

9.5.1.2 System Description

The fire protection system P&ID is shown in drawing M-22.

9.5.1.2.1 Facility Features for Fire Prevention

Consistent with other safety requirements, structures, systems, and components (including those required for safe shutdown) are designed and located to minimize the probability and effect of fires. Noncombustible and fire resistant materials are used to the maximum extent practicable throughout the plant to minimize fire potential by lessening the duration, severity, and intensity of combustion.

The structural features of all enclosures are constructed of noncombustible materials. Reinforced concrete, masonry block, and structural steel are the primary constituents of the various enclosures. Stairwells in the power block are enclosed in concrete or masonry block towers with walls rated as 2 hour fire barriers at a minimum. The doors of the stair towers have fire ratings of at least 1½ hours. The tower doors, being self-closing, minimize any smoke infiltration during a fire. The reactor enclosures, turbine enclosures, and radwaste enclosure are each provided with at least two separated stairwells; the control structure is provided with its own stairwell.

The use of plastic materials has been minimized to the greatest extent practicable. However, alternatives to plastic or elastomeric materials for electrical cable insulating systems, with an optimum balance of electrical, physical, and environmental characteristics, are not available. Cable insulation and jacketing materials are chosen for their fire retardant and self-extinguishing properties, such that fuel contribution to a cable fire is minimized and propagation of a fire along cables is self-limiting in the absence of an exposure fire. The types of electrical cable insulation and jacketing used in the plant are listed in Table 9.5-2.

Outside of the administration building and maintenance facilities, the use of plastic materials for interior architectural features is limited to vinyl asbestos floor tile or a resilient terrazzo-type tile in a small number of compartments. The flame spread and smoke generation rating of vinyl asbestos floor tile is 25 or less. The resilient terrazzo-type tile used to replace vinyl asbestos floor tiles,

which can no longer be used as a replacement tile, has a flame spreading rate of 25 and a smoke generation rating of 780.

Thermal insulation materials are noncombustible, with the following exceptions:

a. Insulation for domestic cold water piping (in the administration building only) is a closed-cell foamed elastomer with an ASTM E-84 flame spread rating of 25 or less.

b. Insulation for the offgas refrigeration equipment (located only in the offgas enclosure) has an ASTM E-84 flame spread rating of 25 or less.

c. Insulation for duct-work and plenums of the ventilation systems has an ASTM E-84 flame spread rating of 25 or less and a smoke generation rating of 50 or less.

Foamed plastics are not used for construction or as insulation other than the thermal insulation noted above and that used in the construction of seismic separation gaps between the walls of adjacent seismically independent structures in the power block.

Suspended ceiling panels have UL ratings of 25 or less for fuel contribution, flame spread, and smoke contribution. Supports for suspended ceilings are noncombustible.

High voltage transformers are installed outdoors. The main, auxiliary, and safeguard transformers, which are located near the north side of the turbine enclosure, are provided with individual deluge systems and are separated from each other by 3 hour rated fire walls. The wall extensions between the Main Power Transformers are based on maintaining integrity for 3 hours. The turbine enclosure exterior walls are not fire rated. The main and plant services transformers are located more than 50 feet from any buildings, but the safeguard and auxiliary transformers are located within 14 feet of the turbine enclosure wall. The turbine enclosure contains some safety related and fire safe shutdown equipment, however, none of this equipment is credited for safe shutdown for a fire in the turbine building. The transformers are protected by an automatic water deluge system. Thus, operators will be alerted to a transformer fire and it will not impair the ability to safely shut down the plant.

9.5.1.2.2 Fire Protection Water Supply Systems

9.5.1.2.2.1 Water Source

The source of water for the fire protection system is two cooling tower basins that have a capacity of 7,200,000 gallons each, for a total capacity of 14,400,000 gallons. For a system pumping capacity of 5000 gpm, this allows continuous operation of both fire pumps for 48 hours. If one cooling tower basin or supply line is not available, the remaining water source provides both fire pumps with a 24 hour supply of water. Water for the fire pumps is taken from either Unit 1 or Unit 2 cooling tower water basins through connections to the circulating water lines. Check valves are installed at the pump discharges to prevent water from one source from being pumped into the other source.

9.5.1.2.2.2 Pumps

There are two (2) horizontal centrifugal-type fire pumps, each capable of 2500 gpm at a system head of 125 psig. The lead pump is electric motor-driven and the 100% capacity lag pump is diesel engine-driven. The pumps and their controllers are UL-listed.

The fire water system is capable of delivering 100 gpm per hose station at no less than 65 psig to any hose station, considering the operation of two hose stations simultaneously with the largest water demand flowing from any automatic suppression system in the vicinity of the hose station. In addition to the 100 gpm per hose station, 300 gpm is assumed at the nearest outside fire hydrant to support manual fire fighting activities. This meets BTP section C.6.b.(11) requirement of 500 gpm for manual hose streams in addition to the largest suppression system design. When the fire pumps are not running, the standpipes are maintained full of water by a 2 inch connection to the service water system, which is capable of replenishing 50 gpm for leakage. When a portion of the fire water system is activated, a low pressure switch set at 100 psig provides a signal to start the motor-driven pump automatically. If the motor-driven pump fails to start, the diesel-driven pump receives a start signal at a lower pressure signal setpoint of 95 psig to start the diesel-driven pump automatically. Both pumps are stopped manually.

A third fire pump is provided as a backup to the two primary pumps. This pump is diesel engine driven and is placed in service as stated in the technical requirements manual bases 3/4 7.6 to satisfy the requirement of providing an alternate pump.

The electric power for the motor-driven fire pump is taken from a load center that is supplied from the non-Class 1E 13 kV switchgear. The primary power source for the switchgear is the unit auxiliary transformer, and the secondary power source is the offsite power supplies. If the primary power source fails, the switchgear is automatically transferred to one of the two offsite power supplies. Switching from one offsite power supply to the other can be performed manually from the control room.

The diesel oil supply tank for the diesel engine has a capacity of 550 gallons. This volume is sufficient to allow operation of the diesel engine for approximately 40 hours at full pump capacity.

The fire pumps are located at one end of the circulating water pump structure north of the power block. The motor-driven fire pump and its controls are in an area common with the circulating water pumps and are protected by hose reels and portable fire extinguishers. Each pump and it’s driver and controls are located in a room separated from the remaining fire pumps by a fire wall with a minimum rating of three hours. The diesel oil day tank is located in a curbed area within the diesel-driven fire pump compartment. This compartment is provided with an automatic sprinkler system.

9.5.1.2.2.3 Yard Piping

Fire protection water is distributed to the various areas of the plant from a yard fire main loop which completely encircles the power block. The connections to the yard fire main loop from the two fire pumps located in the circulating water pump structure are spaced about 6 feet apart and are provided with valving so that either connection can be isolated while retaining 100% water supply capacity to the yard fire main.

The yard fire main loop consists of 12 inch cement-lined cast iron piping which is buried below the frost line. The west and east ends of the loop are cross-connected by piping that traverses the Unit 1 and Unit 2 turbine enclosures. Locked open postindicator valves provide sectionalized control and isolation of portions of the fire main loop. There are 12 yard hydrants spaced at intervals of 250-300 feet along the fire main loop. Each hydrant is provided with a key operated 6” gate valve with curb box or 6” post indicating gate valve for hydrant isolation. Five hose cart houses are located in the yard area in the vicinity of the hydrants, each enclosing a hose cart that can be

manually moved to any hydrant where it is needed. The system of hydrants connected to the fire main loop is designed in accordance with NFPA 24.

9.5.1.2.2.4 Automatic Sprinkler System Water Supply

Water main headers are provided to supply water to the different areas protected by sprinkler systems. The deluge systems for the transformers located outside are connected to an 8 inch header.

Outside screw and yoke gate valves controlling each automatic sprinkler system are either electrically supervised, providing trouble annunciation to the control room, or are administratively locked open/throttled. The postindicator valves controlling the branches feeding the deluge and sprinkler systems and standpipe systems are locked open by locks having a frangible design.

9.5.1.2.3 Automatic Sprinkler Systems

9.5.1.2.3.1 Wet Pipe Sprinkler Systems

Wet pipe sprinkler systems are provided to protect the following areas and equipment:

a. Turbine enclosure - feedwater pump lube oil reservoir compartments

b. Turbine enclosure - lube oil storage tanks and electrohydraulic control power unit

c. Turbine enclosure - main turbine lube oil reservoir and lube oil centrifuge area

d. Turbine enclosure - main turbine condenser area

e. Turbine enclosure - main turbine moisture separator area

f. Reactor enclosure - electric cable penetration areas at el 253' and el 283'

g. Lube oil storage enclosure

h. Auxiliary boiler enclosure

i. Radwaste enclosure compactor area

j. Circulating water pump structure - diesel fire pump compartment

k. Deleted

l. Deleted

m. Deleted

n. Deleted

o. Control structure - cable spreading rooms and corridor (el 239’)

p. Turbine Enclosure - Facility/laydown area, Plant Operators Break Facility (Rm 468A,B,C) and Plant Operators Building (Rm 468)

q. Deleted

Wet pipe sprinkler system operation is initiated in the event of a rise in ambient temperature to the melting point of fusible links on sealed sprinkler heads, thus causing the spray heads to open. The flow of water through alarm check valves energizes a flow switch that transmits the alarm condition to the fire protection panels in the control room. The wet pipe sprinkler system for the cable spreading rooms and corridor does not have an alarm check valve, but is provided with a flow switch that transmits an alarm signal to the fire protection panels in the control room.

The wet pipe sprinkler system operation is terminated manually by shutting the outside screw and yoke gate valves. The OS&Y gate valve for the corridor (el. 239) wet pipe sprinkler system (WP-124) is locked in the throttled position to limit flow in the event of a postulated sprinkler system pipe break as identified by the PRA internal flooding analysis. Throttling the valve gives plant personnel adequate time to diagnose if fire or flood conditions have occurred and take the required action prior to a flood induced equipment failure to risk significant components.

9.5.1.2.3.2 Preaction Sprinkler Systems

Preaction sprinkler systems are provided to protect the following areas and equipment:

a. Reactor enclosure - HPCI pump compartment (el 177')

b. Reactor enclosure - RCIC pump compartment (el 177')

c. Reactor enclosure - RECW equipment area (el 201')

d. Reactor enclosure - Safeguard system access area (el 201')

e. Reactor enclosure - partial coverage at el 217', el 253', and el 283'

f. Standby diesel generator compartments

g. Turbine enclosure - railroad access area

h. Turbine enclosure - generator equipment area

i. Turbine enclosure - under the turbine's appearance lagging and turbine bearing housings 1 through 9 and under the generator's appearance lagging and bearing 10.

j. Deleted

k. Control structure - fan room at el 304' (sprinkler heads are located at the underside of the platform at el 313')and localized coverage in the 13.2 kV switchgear room (el 217’).

l. Radwaste Building - Storage Room, Data Acquisition Room, Storage Room, Source Storage/Standard Preparation Room and Technician's Area.

m. Chemistry Laboratory Building - Count Room, Instrument Lab. and Penthouse.

Each preaction sprinkler system is automatically actuated by area fire detectors that release a tripping device to open the deluge valve, thus supplying water under pressure to the closed sprinkler heads. A rise in ambient temperature to the melting point of the fusible links on the sealed sprinkler heads causes the spray heads to open.

The actuation of a heat detector actuates a local release control panel which in turn sends a signal to a fire alarm code transmitter. The fire alarm code transmitter sends a coded signal to the main control room fire alarm panel which sounds the horns throughout the plant.

The preaction system for the 13.2 kV switchgear room is similar to the other systems, except both fire detection and loss of air pressure must be received before the system will actuate. The area fire detection system alarms, as well as low air pressure alarm, is provided at a local panel with remote indication also provided in the control room. A separate deluge valve actuation alarm is provided both locally and in the control room.

9.5.1.2.3.3 Deluge Systems

Deluge systems are provided to protect the following areas and equipment:

a. Main transformers, auxiliary transformers, and safeguard transformers (all located outdoors)

b. Isophase bus ducts and bus duct supporting steel for main and auxiliary transformers (outside areas only)

c. Generator hydrogen seal oil unit

d. Main turbine lube oil reservoir and lube oil centrifuge.

Operation of a deluge sprinkler system is initiated by heat detection. The actuation of any heat detector alarms a local release control panel which then trips the deluge valve and sends a signal to a fire alarm code transmitter. The fire alarm code transmitter sends a coded signal to the main control room fire alarm panel which sounds the horns throughout the plant. Manual release of the deluge valve tripping device also initiates remote alarms.

9.5.1.2.3.4 Water Deluge Application for Charcoal Filters

Charcoal filters in the ventilation systems of the plant are provided with water deluge application systems for fire protection. The water is supplied to the filters by means of a fixed piping system.

An indicating gate valve is manually opened when a thermal sensor actuates a local alarm system and registers an alarm condition on the fire protection panels in the control room. The operation is terminated manually by shutting the gate valves.

9.5.1.2.3.5 Water Curtain Systems

Two types of water curtain suppression systems are provided in the plant: (a) systems that subdivide certain fire areas into two zones, and (b) systems that protect floor slab openings associated with equipment hatchways in the reactor enclosures.

Water curtain systems that serve to subdivide fire areas are provided at el 217', el 253', and el 313' in the reactor enclosures. Each water curtain system consists of an OS&Y gate valve, a deluge valve, a local pull station, piping, and open sprinkler heads. Each water curtain system is actuated manually, using the local pull station to open the deluge valve. The pull station is located inside a

stairwell near the location of the water curtain. Actuation of a water curtain system is sounded throughout the plant by a coded alarm. Operation of the system is terminated manually by shutting the OS&Y gate valve, which is located near the stairwell in which the pull station is located.

Each of the water curtain systems is designed to achieve a discharge density of 0.3 gpm/ft^2 at floor level. This is accomplished through the use of open sprinkler heads arranged in a linear array across the top of the water curtain location. In addition, sprinkler heads discharging horizontally inward from the sides of the water curtain are provided where necessary to achieve the design discharge density.

Water curtain systems that protect the equipment hatchways in the reactor enclosures are designed similarly to the water curtain systems described above. The equipment hatchways are located in the southeast corner of the Unit 1 reactor enclosure and the southwest corner of the Unit 2 reactor enclosure. Each hatchway consists of openings in the concrete floor slabs at el 253', el 283', and el 313', with the openings arranged above one another. The opening in each slab is protected by an individual water

curtain system having its distribution piping located at the underside of the slab and arranged around the perimeter of the opening. Each water curtain system is actuated manually, using a local pull station to open the deluge valve. The pull station is located inside the stairwell near the location of the water curtain. In addition to the pull station, each water curtain system is provided with an emergency trip valve located near the local control panel.

9.5.1.2.4 Wet Standpipes

Wet standpipes are designed for Class II service in accordance with NFPA 14. All areas in the power block are within reach of at least one effective hose stream. Each hose station has 100 feet of woven, jacket-lined fire hose. Hose stations are located outside entrances to normally unoccupied areas, and outside both entrances of the control room. Most areas of the plant have adjustable fog nozzles that can be adjusted down to a straight stream. In areas with electrical hazards, there are adjustable fog nozzles (intrinsically safe) that will not go down below a 30 degree fog pattern.

9.5.1.2.5 Foam Extinguishing System

A foam system is provided for the protection of the fuel oil transfer structure and one outdoor fuel oil storage tank, and is designed in accordance with NFPA 11. The foam is educed from a foam solution tank by water from the main fire water header. Contacts are provided to annunciate operation of the system in the control room.

The one storage tank is provided with a fixed foam maker at the tank. Foam making is initiated manually from a local station after a high temperature condition at the tank has been alarmed locally and annunciated on the fire protection panels in the control room. Fire protection inside the fuel oil transfer structure is provided by a foam play-pipe with hose rack. When the play-pipe is removed from its holder, an electric switch located in the holder actuates a control valve to allow foam solution to enter the hose. A squeeze-type play-pipe valve enables the operator to control the flow of foam.

9.5.1.2.6 Deleted

9.5.1.2.7 Halon Extinguishing Systems

Three independent Halon extinguishing systems are provided for the raised flooring at el 289' in the control structure. Two of the systems serve the auxiliary equipment room; one system is designed to discharge simultaneously into all floor sections on the Unit 1 side of the room, and the other system is designed to discharge simultaneously into all floor sections on the Unit 2 side of the room. The third Halon system serves the remote shutdown room.

The flooring in the auxiliary equipment room and the remote shut-down room consists of 1 foot high floor sections resting on the concrete slab at el 289'. The floor sections are of all steel construction (except for aluminum honeycomb in the floor plates) and are used for the routing of cabling to and from the electrical equipment located in the two rooms. In the auxiliary equipment room, this equipment includes the PGCC equipment, the plant computers, the Samac panels, the river evacuation and PA panel, a tone cabinet, and fault detection equipment. The PGCC for each unit consists of floor sections that are 8 feet wide and 20 feet long, each of which has vertical panels mounted near the center of the floor section. A termination cabinet is located at one end of each PGCC floor section. Smoke detectors are located in the floor sections and termination cabinets. The equipment located in the remote shutdown room consists of the remote shutdown panels for Unit 1 and Unit 2. Smoke detectors are located within the floor sections in the remote shutdown room.

The Halon extinguishing systems are designed in accordance with NFPA 12A. Each Halon system is designed to achieve a concentration of 20% by volume with the raised flooring that it serves fully installed and secured. Each system includes two banks of Halon cylinders, each of which has sufficient capacity to maintain a 20% concentration for 20 minutes. In addition to having two banks of Halon cylinders, each system consists of distribution piping and nozzles, heat detectors, and a manual selector switch. The heat detectors serve to actuate the Halon system; a predischarge alarm is sounded first, followed by a time-delayed discharge of Halon. The manual selector switch is used to designate which of the two banks of Halon cylinders in each system will discharge automatically. Halon cylinders can be discharged manually at the hand switch location or at the cylinder locations. The unused bank of cylinders can be used to provide a supplemental discharge of Halon by manually actuating the release.

9.5.1.2.8 Portable Fire Extinguishers

Portable fire extinguishers, using extinguishing agents compatible with the combustible material in the area in which they are located, are provided throughout the plant.

9.5.1.2.9 Fire and Smoke Detection System

The fire and smoke detection system is in compliance with NFPA 72A (1979). The system also complies with the requirements of NFPA 72D (1975), with the following exceptions and clarifications:

a. No device is provided for permanently recording incoming signals with the date and time of receipt. (The logging of fire events by a device for permanently recording incoming signals is not needed, because plant operating procedures will require the operator on duty in the control room to update the plant log book with the date and time of alarms from the fire detection system as well as the date and time of initiation of any fire suppression system.)

b. Operation and supervision of the system is not the primary function of the operators. (The control room operators are responsible for monitoring and supervision of all plant systems, including the fire detection and fire suppression systems.)

c. The locations of early warning fire and smoke detectors were established under the direction of a registered fire protection engineer. (The locations of fire and smoke detectors are in compliance with the guidance of NFPA 72E, with the clarification that ionization-type detectors in certain areas of the plant are located in accordance with subsections 4-3.1 and 4-3.1.1 of NFPA 72E. These subsections allow detector location to be determined based on engineering judgment considering ceiling shape, ceiling surfaces, ceiling height, configuration of contents, combustible characteristics, and ventilation. In areas where concrete floor slabs are supported by structural steel beams, the diffusion of ionized particles throughout the compartment volume during the incipient stage of the fire will negate the effect of beam depth and result in an appropriate level of detection capability.)

d. NFPA 72D (1979) references NFPA 72E (1978) for testing of smoke detectors. NFPA 72E (1978) requires functional testing of smoke detectors semiannually. Functional testing of smoke detectors at Limerick will be done annually which is in accordance with NFPA 72E (1990).

e. In fire area 2, the smoke detection system is upgraded to NFPA 72, 1996, Chapter 5 for detector location and spacing.

f. In fire area 98, the smoke detection system above the ASD System is upgraded to NFPA 72, 2010, Chapter 17 for detector location and spacing.

g. In fire area 111, the smoke detection system above the ASD System is upgraded to NFPA 72, 2010, Chapter 17 for detector location and spacing.

Fire and smoke monitoring, detection, and alarm are accomplished by installing smoke detectors and/or heat-responsive detectors in areas where fire potential exists. Fire and smoke detection systems for annunciation are separate from fire detection systems for actuation of fire extinguishing systems, except for the 13kV Switchgear Area (Fire Area 02). The smoke detection system in the 13kV Switchgear Area (Fire Area 02) provides early warning notification while also providing an input signal to the double interlock preaction system that provides localized protection.

The fire and smoke detection system is electrically supervised to detect circuit breaks, ground faults, and power failure. All fire or trouble alarms register on the audible/visual annunciator on the fire protection panels in the control room. Functional testing of the supervised circuits is done annually in accordance with NFPA Standard 72 (1990).

9.5.1.2.10 Deleted

9.5.1.2.11 Deleted

9.5.1.2.12 Area Fire Protection Provisions

Primary Containment

There are no standpipes with hose stations or automatic sprinklers installed inside the primary containment. One hose station is located near the entrance to the containment personnel hatch. During refueling and maintenance operations, administrative procedures control ignition sources in the primary containment. Fire protection, including portable fire extinguishers and fire watches, is also controlled by administrative procedures. Self-contained breathing apparatus are provided near the open containment entrances for fire fighting and damage control personnel.

Control Room

The control room's location within the control structure provides 3 hour fire barrier separation from other major plant areas. The control room consists of the control room proper and support facilities such as offices, toilet, and utility rooms. The walls and doors of the support facilities are constructed of noncombustible materials.

Manual fire fighting capability provided for the control room consists of portable Halon extinguishers within the control room, and portable carbon dioxide extinguishers outside of the control room. Additionally, fire hose (water) stations with UL-approved fixed fog nozzles are installed outside both entrances to the control room. No hose stations are located within the control room.

The control room is provided with ionization-type smoke detectors that actuate an audible and visible alarm on the fire protection panels in the control room.

Self-contained breathing apparatus with a minimum operating life of 4 hours are available for use by control room personnel.

The control room ventilation intake is provided with smoke detection capability to automatically detect and annunciate the presence of smoke. Upon receipt of the alarm, the control room ventilation system can be manually placed in the recirculation mode in order to isolate the control room from the outside.

To clear the control room of smoke when there is no smoke in the outside air intake, the ventilation system can be placed in the purge mode, in which the recirculation path is closed off and 100% of the air flow through the control room is outside air.

The control room purge mode can be initiated from both inside and outside the control room. The control room ventilation system is discussed further in Section 9.4.1.

All penetrations in the control room are sealed airtight and comply with a 3 hour fire rating designed to satisfy ASTM E-119 requirements.

Cable Spreading Room

The cable spreading room is separated from other areas of the plant by 3 hour rated fire barriers. Automatic fire protection is provided by a wet pipe sprinkler system, with backup protection provided by a manually actuated, total flooding, CO_2 extinguishing system. To provide for manual fire fighting, hose stations and portable fire extinguishers are provided outside the cable spreading room near one entrance. Accessibility for manual fire fighting operations is provided by aisles between cable trays, the length and breadth of the room. Two separate entrances to each cable spreading room are provided.

A smoke detection system is provided in each cable spreading room to alarm locally and remotely in the control room on detection of an incipient fire.

Two floor drains are provided in each cable spreading room to drain water from manual fire fighting operations and/or sprinkler actuation.

Auxiliary Equipment Room

The auxiliary equipment room is separated from other areas of the plant by 3 hour barriers. Facilities provided for manual fire fighting include portable CO_2 fire extinguishers located within the room and a manual hose station at the entrance to the room.

The PGCC and the computer facilities, both of which are located in the auxiliary equipment room, utilize raised flooring approximately 1 foot high. The raised flooring is divided into sections typically 8 feet wide and approximately 20 feet long; PGCC panels or computer equipment are mounted near the center of each floor section. The floor sections are of all-steel construction (except for aluminum honeycomb in the floor plates) and are each divided into four longitudinal raceways and numerous lateral raceways, each of which is totally enclosed and therefore physically isolated from adjacent raceways. To minimize the possibility of occurrence of a fire, the cabling routed in these raceways is provided with flame retardant insulation, and no other combustible material exists in the floor sections. The highest voltages present within the floor sections are 125 V dc and 120 V ac. To prevent the spread of a postulated fire between different divisions of raceways within a floor section or between adjacent floor sections, fire stops are provided at the ends of the longitudinal raceways, at the ends of those lateral raceways that do not have end caps, in the lateral raceways where cables run from a longitudinal to a lateral raceway, and at the raceway openings at the bottom of the vertical panels. These fire stops consist of refractory material covered by silicone rubber.

The floor sections of the auxiliary equipment room are provided with an automatic, total flooding, Halon 1301 system. The system is actuated by heat detectors located in the floor sections. Smoke detectors are also located in the termination cabinets. Additional smoke detectors are located near the ceiling throughout the general area of the auxiliary equipment room. Detection of a fire by the smoke and fire detectors is annunciated on the fire protection panels in the control room.

Remote Shutdown Room

The remote shutdown room is separated from other areas of the plant by 3 hour rated fire barriers. The north and west walls of the room are constructed of reinforced concrete, whereas the south and east walls are a gypsum drywall assembly constructed in accordance with UL Design U435 and D744.

The remote shutdown panels are mounted on raised flooring approximately 1 foot high which consists of all-steel construction. To minimize the possibility of occurrence of a fire, the cabling routed through the raised flooring is provided with flame retardant insulation, and no other combustible material exists in the raised flooring. The raised flooring of the remote shutdown room is separated from the raised flooring of the adjoining auxiliary equipment room by the 3 hour rated gypsum drywall assembly, which extends down to the concrete slab at el 289'.

The raised flooring of the remote shutdown room is provided with an automatic, total flooding, Halon 1301 suppression system. The system is actuated by heat detectors located in the raised flooring. Early warning of a fire in the remote shutdown room is provided by smoke detectors

located within the raised flooring as well as at the ceiling of the room. The smoke detectors actuate an audible and visible alarm on the fire protection panels in the control room.

Provisions for manual fire fighting include a manual hose station and portable CO_2 fire extinguishers located near the entrance to the remote shutdown room.

Switchgear Compartments

The switchgear compartments in the control structure (4 kV switchgear at el 239' and 13.2 kV switchgear at el 217') are separated from other areas of the plant by 3 hour rated fire walls. The eight switchgear compartments at el 239' are separated by 3 hour rated fire walls. A localized preaction system is provided in the 13.2 kV switchgear room to protect redundant trains of cable trays which are provided with 1-hour rated fire barriers.

Manual fire fighting equipment provided for the switchgear compartments consists of portable CO_2 extinguishers at el 217' and el 239', plus portable CO_2 extinguishers adjacent to the compartment at el 217'. Additionally, fire hose stations are located near the entrances to the compartments at both elevations.

Station Battery Compartments

The four safety-related battery compartments in the control structure (at el 217' and el 239') are enclosed by 3 hour rated fire walls.

Uninterrupted ventilation capability is assured by two redundant 100% capacity seismic Category I fans, at a minimum rate of 12 air changes per hour, that preclude attainment of explosive hydrogen concentrations in the battery compartments.

The exhaust ducts from the Class 1E battery rooms are provided with safety-grade isolation dampers in both branches of duct-work leading to the battery room exhaust fans and to the emergency switchgear and battery room supply air fan cabinets. The dampers in the duct-work leading to the exhaust fans are provided with safety-related position switches which activate the dampers in the duct-work leading to the supply air fan cabinets. In the event of closure of any of the dampers leading to the exhaust fans, the dampers in the duct-work from the battery rooms of the affected reactor unit and leading to the air supply fan cabinets will automatically open, thereby establishing recirculation air flow through the affected battery rooms. This re-establishment prevents accumulation of hydrogen above safe limits.

Manual hose stations and portable extinguishers are provided in the battery compartment area. Heat and smoke detectors are installed in the battery compartments, with remote annunciation in the control room.

Turbine Enclosure

The turbine enclosure is separated from all other structures in the plant by 3 hour rated fire barriers with the exception of the radwaste enclosure which is a 2 hour rated fire barrier. Fire barriers internal to the enclosure are used to isolate areas with significant combustible loadings from each other. The types of fixed suppression systems provided for the various areas of the turbine enclosure include the following:

a. Feedwater pump lube oil reservoirs - wet pipe sprinkler

b. Main condenser and moisture separator area - wet pipe sprinkler

c. Lube oil storage tanks and electrohydraulic control power unit - wet pipe sprinkler

d. Main turbine lube oil reservoir and centrifuge - wet pipe sprinkler and deluge

e. Generator hydrogen seal oil unit - deluge

f. Generator equipment area - preaction sprinkler

g. Railroad access area - preaction sprinkler

h. Deleted

i. P.C. issue cage, Floor Operators Break Facility (Rm 468A,B,C) and Plant Operators Building (Rm 468) – wet pipe sprinkler

j. Deleted.

Diesel Generator Compartments

The four diesel generators for each reactor unit are separated from each other and other structures of the plant by fire barriers having 3 hour fire resistance ratings.

An automatic preaction sprinkler system protects each diesel generator cell and provides complete coverage of the cell. Flame and heat detectors are provided in each diesel generator cell. The flame and temperature detection systems annunciate in the control room.

Each diesel generator cell is provided with trapped and vented floor drains and an adequate drainage capacity to cope with the maximum sprinkler water flow in each room. The drainage system is arranged to prevent flow from one diesel generator cell from backflooding into another cell.

Each diesel generator cell is provided with a separate ventilation system which is controlled manually from a local control panel and is also started automatically by either high air temperature or a diesel engine start signal.

The diesel oil day tank for each diesel generator and the lube oil tank are installed within a 3 hour rated enclosure located inside the diesel generator cell. Each cell's preaction sprinkler system provides fire suppression for the 3 hour rated enclosure.

Diesel Oil Storage Area

There are eight 41,500 gallon capacity diesel oil storage tanks buried underground in the yard southwest of the diesel generator enclosures.

Safety-Related Pumps

The safety-related pumps located at the lowest elevation of the reactor enclosure are separated from each other by 3 hour rated fire walls. Access openings provided with watertight doors are nonrated.

Fire suppression provisions for the safety-related pump compartments in the reactor enclosure consist of preaction sprinklers for the HPCI and RCIC compartments, portable extinguishers at or near the compartment entrances, and hose stations close enough to the compartment entrances to provide complete coverage. In consideration of the low combustible loading in the spray pond pump structure, portable extinguishers only are deemed adequate to control and extinguish a single fire event at any pump in that structure.

Safety-related pump compartments are provided with smoke or temperature detectors that will annunciate in the control room.

Storage Area

A storage area is provided in a concrete vault with access from the top at the refueling floor level of the reactor enclosure. There is no combustible material inside the vault. A cover is provided for the vault and consists of steel plate welded to grating. The cover is normally kept on the vault except during periods of transfer in or out of the vault.

A portable extinguisher is available in the area immediately adjacent to the storage area, and a hose station is available within effective range. A floor drain in the refueling floor slab serves to collect any water in the vicinity of the storage vault cover. A floor drain is also provided at the bottom of the storage vault.

Spent Fuel Pool Area

A hose station and portable fire extinguisher are available at the spent fuel pool.

9.5.1.2.12 Area Fire Protection Provisions

Radwaste Enclosure

The radwaste enclosure is separated from other structures by 3 hour fire barrier, with the exception of the turbine enclosure which is a 2 hour fire barrier.

Automatic sprinkler protection is provided in the waste drum storage area at el 217' in the enclosure.

Automatic preaction sprinkler protection is provided in the renovated area: Storage Room, Data Acquisition Room, Storage Room, Source Storage/Standard Preparation Room and Technician's Area.

Hose stations and portable extinguishers are located on all levels of the radwaste enclosure and are within reach of the waste drum storage area.

Chemistry Laboratory Expansion

The Chemistry Laboratory Expansion is provided with automatic wet sprinkler system and automatic preaction sprinkle system protection.

Automatic wet sprinkler system protection is provided for the Hot Lab., Frisk/Corridor (RCA), Office Area, Air Lock, Corridor (Non RCA), Conference/Lunch, Cold Lab., Toilets, Locker and Vestibule.

Automatic preaction system protection is provided for the Count Room, Instrument Lab., and Penthouse.

Yard Transformers

High voltage, oil-filled transformers are installed outdoors and are protected by automatic deluge systems. Fixed temperature detectors annunciate in the control room.

Miscellaneous Areas

The cooling tower basins serve as a source of water for the fire protection system but not for any safety-related systems. The cooling towers are constructed entirely of noncombustable material except for the splash bars and drift eliminators, which are polyvinyl chloride, the splash bar support grids, which are fire retardant polyester and fiberglass, and the wind vane panels, which are polypropylene. The fill material is contained in a ring-shaped area around the periphery of each tower. The ring is separated into six cells by fire walls located at 60° intervals. A fire occurring in any one cell would have no effect on safety-related structures or systems, since such a fire would not affect the structural integrity of the cooling tower and the towers are located away from safety-related structures. This arrangement has been accepted by ANI for design of cooling towers with PVC and polyester fill material and without fire protection sprinklers.

The warehouse, machine shop, construction shop, and auxiliary boiler room are each provided with an automatic wet pipe sprinkler system. These areas are also provided with manual hose stations and smoke detector coverage.

The administration building is provided with automatic wet pipe sprinkler systems in the main office area and the laboratory. All elevations of the administration building are provided with manual hose stations and smoke detector coverage.

9.5.1.2.13 Miscellaneous Areas

The No. 2 fuel oil outdoor above ground tank for the auxiliary boiler is provided with foam a suppression system and full capacity dike surrounding the tank.

Storage areas for dry ion exchange materials are remote from essential safety-related systems. Local hose stations and portable extinguishers are provided in the vicinity of storage areas for dry resins.

The water treatment enclosure is protected by portable fire extinguishers and local hose stations.

9.5.1.3 Safety Evaluation

The safety evaluation for the fire protection program is included in Appendix 9A.

9.5.1.4 Inspection and Testing Requirements

9.5.1.4.1 Preoperational Testing

Pumps

Each fire pump is subjected to factory hydrostatic testing to twice the maximum pressure developed at pump shutoff head. Each fire pump is tested with a calibrated motor at the factory to develop pump performance curves showing head, delivery, efficiency, and brake horsepower. After installation, the pumps are tested in accordance with the requirements of NFPA 20.

Piping

The underground piping is hydrostatically tested at a pressure of 200 psi for 2 hours. The leakage is required to be less than two quarts per hour per 100 joints. All hydrants are opened and closed under water pressure. All postindicator valves are fully closed and opened under water pressure to ensure proper operation.

All wet standpipe, wet pipe sprinkler, preaction sprinkler, and deluge system piping is hydrostatically tested at a pressure of 200 psi with no visible leakage. The dry pipe portions of preaction sprinkler systems are pressurized with air to 40 psi, and allowed to stand 24 hours; leaks that allow a loss of pressure over 1½ pounds during the 24 hours are repaired.

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Halon 1301 System

After installation, the Halon system is inspected and tested to ensure that the system is in full operating condition and can achieve the design Halon concentration.

Smoke and Fire Detection System

The smoke and fire detection systems are tested for correct operation and function.

9.5.1.4.2 Operational Testing and Inspection

The fire pumps and associated equipment such as batteries, water supply, and fuel systems are periodically tested or inspected in accordance with the Technical Requirements Manual. The Technical Requirements Manual defines periodic test or inspection requirements to ensure operability of the fire suppression system.

9.5.1.5 Personnel Qualification and Training

The training program for plant personnel and the fire brigade in regard to fire fighting activities will be implemented in accordance with the Fire Protection Program, Section 13.2.1.5, 13.2.1.6. Qualifications of fire brigade members are described in Section 13.1.2.1.1.

9.5.2 COMMUNICATION SYSTEMS

The communication systems include internal (intraplant) and external (out-of-plant) systems and provide convenient, effective operational communications between various plant structures and locations and with points outside the station.

9.5.2.1 Design Bases

Various communication systems are provided in the plant to ensure reliable communication during plant startup, operation, shutdown, maintenance, and emergency conditions. The design bases of these systems are:

a. Voice communication between various plant structures and locations is provided with the following characteristics:

    1. Satisfactory voice communication in areas of extreme noise

2. Three separate communication systems with simultaneous conversation possible on each system without interference

b. Voice communication to points outside the station is provided by a dial telephone system and by a backup radio system.

c. An evacuation and alarm system is provided to warn personnel of emergency conditions.

d. The communication systems are designed to be operable during a LOOP.

e. All communication components are nonsafety-related seismic Category II components. These components, when located in safety-related areas, are supported on a selective basis to seismic Category IIA requirements as described in Section 3.2. The criteria for this selective basis and the design basis for seismic Category IIA supports are described in Section 3.2.

9.5.2.2 System Description

The plant communication systems consists of the intraplant public address system, the private automatic branch exchange telephone system, the intraplant maintenance telephone system, the evacuation alarm and river warning system, and the in-plant radio system. Descriptions of these systems are given in the following sections.

The public address and PABX telephone systems are illustrated in riser diagram form in drawings E-1366, E-1367, E-1368, E-1369, E-1370, and E-1371.

The PABX, PA, and in-plant radio systems are physically independent systems. They are ultimately powered by diverse Class 1E or battery backed-up/UPS sources. They serve as backup to one another in the event of system failures. These three independent voice communications systems have been designed and installed to provide assurance that any single event will not cause a complete loss of intraplant communication through the use of diverse technology, separate routing of cables, and separate diesel generator backed power supplies.

9.5.2.2.1 Intraplant Public Address System

The PA system is a 6 channel system permitting simultaneous usage of a page line and five party lines for intraplant use. Loudspeakers powered by individual amplifiers are located throughout the plant with muting facilities provided where required. The main control room is isolated (muted) from general plant paging announcements. However, each handset in the plant is equipped with an Emergency Control Room push button to activate (unmute) the control room speakers. The PA system is provided with a telephone line matching network for operation of the page channel by the PABX system described in Section 9.5.2.2.2.

The PA system has been equipped with an advanced page line control system for the enhancement of PAGE announcements throughout the site. This control system provides improved sound quality for emergency announcements made to and from the main control room. It is also capable of screening out page announcements that do not originate from designated page announcement control points such as the control room, TSC, OSC, security locations, etc. This screening feature has no effect on simultaneous usage of the 5 party lines along with the page

announcement function, nor does it prevent the use of the page for contacting the control room or conducting local emergency (fire brigade) announcements within a given plant area. The primary purpose of the screening function is to reduce the number of locations where site wide page announcements can originate.

The overuse of page announcements reduce the effectiveness of emergency and other priority control room announcements. The control of the type and number of general page announcements will improve the level of effectiveness of the remaining page announcements.

The page line control system reduces troubleshooting time for individual PA component problems, thereby improving the maintenance and effective usefulness of the entire system. The page line control system has been designed not to interfere with the plant's ability to conduct emergency announcements or evacuation alarm announcement coverage. The control system has no effect on the evacuation capabilities described in Section 9.5.2.2.4.

PA handsets and speakers are located in vital areas throughout the plant and remote buildings. Multiple handsets are provided at many plant elevations. Automatic volume control is provided to overcome high background noise levels in areas with high ambient noise levels.

Page controlled emergency evacuation equipment that works in conjunction with the PA system is provided where evacuation coverage is required during plant evacuation. This emergency evacuation equipment does not interfere with the PA system (See Section 9.5.2.2.4 for further information).

The public address system is powered from a Class 1E 440 V motor control center through a 480/120 V transformer and distribution panel. The transformer and distribution panel are seismic Category I. The panel remains connected to the Class 1E bus during all accident conditions. The Class 1E 440 V motor control center is powered by the Division 4 Class 1E ac power system.

The cables for the PA system are routed in independent and separate conduits dedicated to the PA system, the majority of which are embedded. The main amplifier panel for this system is located in a seismic Category I structure in a mild environment and is mounted seismic Category IIA. The individual hand stations are securely mounted to the walls using 4 inch anchored bolts. The PA system is designed to remain functional during normal and emergency conditions. In addition, there is assurance that it will remain functional following a seismic event.

9.5.2.2.2 Private Automatic Branch Exchange Telephone System

The PABX/PBX equipment and cabling is supplied and installed by a telecommunications vendor. The telephones associated with the PBX are located throughout the plant. The primary source of power for the telephone system will come from non-Class 1E Administration Building MCC 00B539. The secondary source of power will come from Class 1E Control Area MCC 00B131. MCC 00B131 is powered from a Division 3 safeguard bus. The MCC feeder breaker is automatically shed on a LOCA signal, but it can be manually reset at the MCC. If both sources of power are unavailable, an uninterruptible power supply with a minimum of two hours of emergency battery power will supply the telephone system. Dedicated circuits between the Limerick Generating Station and Peach Bottom Atomic Power Station emergency PBXs allow continuation of limited two way commercial telephone service in the event that the Limerick main commercial telephone switch (PBX) becomes inoperable or unavailable. The PABX is not designed to remain operational after a design basis seismic event.

9.5.2.2.3 Intraplant Maintenance Telephone System

The intraplant maintenance telephone system is part of the PABX system consisting of telephone jacks. Portable PABX (dial-type) telephones may be connected to the maintenance telephone jacks.

This system provides an additional station-to-station, intraplant communication system for use during startup, maintenance, and normal operation, and consists of telephone jack stations located at various selected areas throughout the plant. The use of maintenance telephones allows uninterrupted private communication between the control room and the following areas: CRD equipment area, refueling platform area, turbine-generator operating deck, areas containing switchgear, load centers, and motor control centers, and other high maintenance activity areas. Although intended for maintenance, the capability exists to utilize this system in areas covered by the PABX system.

9.5.2.2.4 Evacuation Alarm and River Warning System

The evacuation alarm and river warning system is provided to warn personnel of emergency conditions. This system supplements the radiation monitoring systems described in Section 12.3.4.

The evacuation alarm system consists of a siren tone generator, PA system speakers, page controlled emergency evacuation equipment and a roof siren.

The evacuation alarm is manually initiated by a selector switch in the control room. This selector switch also selects the evacuation alarm coverage in the drywell of Unit 1, the drywell of Unit 2, or the whole plant including the initiation of the roof siren and the river broadcast speakers.

Page controlled emergency evacuation equipment that works in conjunction with the PA system is provided for audible/visual indication during plant emergency evacuation. These units are connected to the PA system and initiated only when the roof siren is activated. A visual indication is used due to high noise environments within the plant.

The river warning system consists of a tape recorder, a microphone, river broadcast speakers and an output feedback monitoring system.

The tape recorder transmits recorded messages, and the microphone transmits warning instructions through the river broadcast speakers. An initiation signal from a selector switch in the control room starts the tape recorder or renders the microphone available for transmission.

The monitoring system monitors the output of the river broadcast speakers and transmits it back to the monitoring speaker when the tape recorder is initiated or to the VU meter when the microphone is activated. Monitoring speaker and VU meter are located in the control room.

Power for this system is supplied from a seismic Category I distribution panel that is fed from a Class 1E bus.

9.5.2.2.5 In-Plant Radio System

Emergency communications within the plant can be maintained after the loss of the PA and PABX systems through the in-plant radio system. This system consists of distributed antennas throughout the plant with centralized rebroadcast transmitters/base stations. Lower power walkie-talkies with approximately 1.8 watt output are used with this system. The low power of

the radios ensures that there will be no interference to low level control and instrument circuits. The system is designed to permit walkie-talkie to walkie-talkie and walkie-talkie to console communications from most locations within the plant and satellite buildings. Communication consoles are located at selected plant locations including the control room and remote shutdown room. Communication paths between consoles are hardwired, thus providing a means of communication between selected areas of the plant even with the failure of the radio base stations, PA system, and PABX system. The power for the base stations and consoles is from battery backed or UPS, non-Class 1E systems as further described in Section 9.5.2.3. In order to assure radio communications between the Main Control Room, Remote Shutdown Panel (RSP) Room, and Operational Support Center (OSC) in the event of a fire (in any one given area) and/or loss of power, the radio base station repeaters and their associated audio lines are designed to continue operating as further described. Communication lines are monitored for open or short circuits via the audio line monitoring system. This system consists of line monitors placed in the main audio trunk lines between fire zones/areas. The line monitors will continue to use the primary audio line path as long as the lines between monitors remain intact. In the event of a fault, the monitor will switch audio lines to enable alternate communication equipment.

9.5.2.2.6 Radio Communication

A backup offsite communications system consists of a radio system that provides communication between the control room and PECo Headquarters as well as other generating stations. Radio capability is also provided between the control room and local law enforcement authorities. Concurrently, the information is relayed to the Montgomery County Office of Emergency Preparedness. The radio transmitters are powered from a power source diverse from that which powers the PABX. The radio equipment is not designed to withstand the design basis seismic event.

The physical and electrical independence of the radios and the PABX provides assurance that a design basis seismic event would not cause the loss of offsite communications.

9.5.2.3 Safety Evaluation

The communications systems are not safety-related and are classified as non-Class 1E. When components of the communications systems are located within seismic Category I structures, these components are supported on a selective basis to seismic Category IIA requirements described in Section 3.2. The basis for providing Category IIA supports is to prevent the communications equipment from falling on safety-related equipment and impairing its ability to perform safe shutdown functions during a seismic event.

Following a design basis seismic event with coincident failure of all nonseismic equipment and components, LGS will attain a safe, cold plant shutdown from the main control room without the use of intraplant communication because all actions required under this scenario are taken in the control room. A Special Event procedure (SE-5, Earthquake) will instruct the plant operators to shut down the plant if a severe seismic event, including a DBE, takes place. This shutdown will be accomplished using the LGS Transient Response Implementation Plan Procedures (TRIPP). The TRIPP procedures will direct the plant operators on the actions to be taken to achieve a safe cold shutdown from the main control room when intraplant voice communications systems are not available. However, because the three intraplant communications systems use diverse technology and

Class 1E power sources, and because the critical active components of the PA system and the in-plant radio system are installed in seismic Category I structures, there is reasonable assurance that intraplant communications will be maintained following a design
basis seismic event.

The systems described above are conventional and have a history of successful operation at similar existing plants. System design considerations include diversity and operational reliability.

Physical and electrical separation is provided between primary and backup systems to minimize the possibility of a single occurrence affecting more than one system.

The communications systems have adequate flexibility to keep plant personnel informed of plant operational status at all times. If one handset station of the PA system is damaged or inaccessible or if extreme background noise prevents its use, multiple handset locations at each plant elevation provide easy access to an alternate handset of the PA system.

Failure of a single PABX telephone station does not affect the balance of the PABX telephone system. If failure of the central exchange or some other such failure makes the complete system inoperable, the public address system is used as backup in-plant communications.

The public address system is powered from a Class 1E 440 V motor control center through a 480 V - 120 V transformer and a 3-phase, 120 V distribution panel. The transformer and panel are seismic Category I and feed only the PA system and fire alarm system which are non-Class 1E. The cabling for these systems is routed in independent and separate conduits and no other systems' cables are routed in these conduits. For this reason and reasons of plant safety, this panel remains connected to the Class 1E bus during a LOCA. The Class 1E 440 V motor control center is powered by the Division 4 Class 1E 440 V load center. The Class 1E 440 V motor control center and load center are part of the Class 1E ac power system (Section 8.3.1.1.2). Failures of the fire alarm or PA systems will not affect the Class 1E bus because of the use of redundant overcurrent protection devices.

The primary source of power for the PABX/PBX telephone system will come from non-Class 1E Administration Building MCC 00B539. The secondary source of power will come from Class 1E Control Area MCC 00B131. MCC 00B131 is powered from Division 3 safeguard bus. The MCC feeder breaker is automatically shed on a LOCA signal, but it can be manually reset at the MCC. If both sources of power are unavailable, an uninterruptible power supply with a minimum of two hours of emergency battery power will supply the telephone system.

During the loss of both offsite power and the diesel generator associated with Division 4 bus, communication is maintained by the PABX telephone system and the in-plant radio system.

The in-plant radio system is powered by battery backed or UPS, non-Class 1E systems. Failure of any or all of its components will not affect any nuclear safety-related equipment. The audio line monitors are powered by a non-Class 1E power source (lighting panel). During the loss of power, the audio line monitoring equipment use their internal batteries (72-hr). The system is equipped with diagnostic lights on the audio line monitor equipment for surveillance testing.

9.5.2.4 Inspection and Testing Requirements

The communications systems will be tested by a preoperational test (1-P-99.3). Systems described above are conventional and have a history of successful operation at similar existing

plants. These systems will be in routine use and maintenance, and this will ensure their availability.

Also, these systems will be used extensively during the preoperational and startup phases. Any deficiencies will become readily apparent and will be corrected. The power sources, for the PABX and Class 1E bus for the PA system, are tested separately via the preoperational and startup test program.

Maximum dB levels have not been established for the remote shutdown locations. During the startup program when operating ambient noise levels are present, communications between each remote operating location and the control room or remote shutdown room will be tested. At least two communications systems of the PABX, PA or in-plant radio system described in Section 9.5.2 will be proven to be adequate for communicating with these remote areas with normal plant ambient noise levels. All remote shutdown locations that may be used to safely shut down the plant in the event of a control room evacuation are identified in Table 9.5-13. Any locations that may be subsequently identified will be added to this table.

9.5.3 LIGHTING SYSTEM

The plant lighting system provides illumination levels required for safe performance of plant operation, security, shutdown, and maintenance duties. Emergency dc lighting is provided in essential areas for the safety of personnel during an ac power failure.

9.5.3.1 Design Bases

a. The lighting system is designed to provide illumination intensities required for the performance of activities in the various areas, and is equal to or greater than those recommended by the IES (Illumination Engineering Society). Lighting fixtures have been selected with consideration for environmental conditions and ease of maintenance.

b. The emergency lighting system provides lighting intensities required for use during emergencies or shutdown and meets the requirements stated in the "Building Regulations for Protection from Fire and Panic," Commonwealth of Pennsylvania, Department of Labor and Industry.

c. The lighting system for safety-related areas, including the control room, portions of the auxiliary equipment room, diesel generator enclosures, emergency switchgear area, and other areas requiring lighting during emergencies, is comprised of the normal lighting and emergency lighting systems as described in Sections 9.5.3.2.1 and 9.5.3.2.2.

d. The control room lighting system is provided with lighted glare-free luminous ceiling with special attention given to the reduction of glare and shadows at the control panels.

e. Mercury gases are not used inside the primary containment or directly above the refueling area. Mercury switches are not used in the lighting system.

f. Outdoor area lighting uses high pressure sodium lamps that provide illumination for plant security and safe movement of plant personnel. Lighting of the protected outdoor area is sufficient to permit effective visual inspection to facilitate nighttime television surveillance and patrol of the perimeter fence. The average footcandle level inside and along the security fence is 0.2 ftc or greater.

g. All lighting system components are nonsafety-related and, except as described in Section 9.5.3.2.2.a, are seismic

Category II. These components, when located in safety-related areas, are supported on a selective basis to seismic Category IIA requirements as described in Section 3.2. The criteria for this selective basis and the design basis for seismic Category IIA supports are described in Section 3.2.

9.5.3.2 System Description

9.5.3.2.1 Normal Lighting

Power for normal lighting is supplied from the unit auxiliary or the startup buses which are described in Section 8.3.1. This system provides lighting for all indoor and outdoor areas. Outdoor security and roadway lighting is described in Section 9.5.3.2.3.

The high pressure sodium, mercury vapor, and some of the fluorescent and LED lighting fixtures rated at 480/277 V are fed from 480/277 V, 3-phase, 4-wire, grounded neutral system lighting panels, which are fed from the normal 440 V motor control centers. The incandescent, LED, and the fluorescent lighting fixtures rated at 208/120 V are fed from 208/120 V, 3-phase, 4-wire, grounded neutral system lighting panels. These lighting panels are also fed from the normal 440 V motor control centers through dry-type transformers.

9.5.3.2.2 Emergency Lighting

The emergency lighting installation consists of an emergency dc and an emergency ac lighting system as described below:

a. Emergency Ac Lighting

Emergency ac (480/277 V) lighting is supplied from the Class 1E buses that automatically transfer to the diesel generator upon loss of the normal source. However, the emergency ac lighting panels are shed from the Class 1E buses if a LOCA occurs. The panels are manually reconnected to the Class 1E buses following a LOCA through administrative controls. Emergency ac lighting is provided in the safety-related areas and the areas requiring lighting during emergencies.

The control room emergency lighting circuit (1L9) is installed to seismic Category I requirements. The raceways from the Class 1E sources to the control room emergency ac lighting fixtures are routed in a seismic Category I structure. These raceways and the lighting fixtures are seismically supported.

b. Emergency Dc Lighting

Emergency dc lighting consists of a combination of ac/dc lighting fixtures normally supplied from the Class 1E buses, and self-contained battery powered units. Upon loss of the Class 1E ac source, an automatic transfer switch transfers the ac/dc lighting fixture immediately to the 125 V dc non-Class 1E station battery source. The 125 V dc non-Class 1E lighting system will provide power to the emergency

ac/dc lighting system for one hour after a LOCA coincident with a LOOP. The battery chargers for this battery are fed from the Division IV diesel generator and can be manually reconnected to the diesel after the LOCA. On a LOOP without a LOCA, these chargers remain connected to the diesel generator, and dc lighting will remain available as long as the diesel is running. All emergency ac/dc lighting fixtures are incandescent-type.

Emergency lighting, energized from 8 hour battery-powered, self-contained units, is provided in areas where operator actions are required for operation of safe shutdown equipment needed to achieve shutdown during a fire. This emergency lighting is also provided for access and egress paths to these areas.

Emergency dc lighting fixtures and illuminated exit signs are located in the control room, stairways, and along exit routes from each floor throughout the plant.

Table 9.5-12 identifies the illumination intensities for the vital and hazardous areas where emergency lighting is provided for normal plant operation and the evacuation of personnel in the event of an accident. The table provides both the normal and emergency operating conditions for these areas. These illumination levels conform to the IES Lighting Handbook recommended levels. Column 4 of Table 9.5-12 shows the 125 V dc power-supplied lighting illumination intensity levels that are maintained in the control room and other areas of the plant between loss of offsite power and availability of onsite power.

Table 9.5-13 identifies the areas and lighting levels where remote actions are required to safely shutdown the plant in the event of a control room fire, auxiliary equipment room fire, or a failure of the remote shutdown system. The lighting levels provided at these locations are shown. In these areas, the loss of the diesel generator would leave the dc-supplied power system or the 8 hour battery-powered, self-contained units to provide lighting for the remote operations required in those areas as well as access to those areas.

The emergency ac/dc lighting system provides approximately 10% to 20% of the total lighting of the plant. The approximate percentage of emergency lighting fed from each division of Class 1E power is as follows:

a. Division 1 = 6%

b. Division 2 = 32%

c. Division 3 = 12%

d. Division 4 = 50%

The emergency lighting load is not divided equally among the four diesel generators due to plant utilization.

In the main control room, emergency ac lighting is supplied from Divisions 1 and 4 of Class 1E power. The emergency ac lighting supplied from each division of Class 1E power provides a uniform light level of approximately 20 footcandles in the main control room.

9.5.3.2.3 Outdoor Security and Roadway Lighting

Outdoor security and roadway lighting is provided by sodium vapor luminaries. The lighting illuminates the "security" area and the security fence to 0.2 ftc or greater.

The outdoor lighting poles do not exceed 130 feet in height. Any 130 foot pole is designed to withstand a sustained wind velocity of 90 mph and gusts of up to 117 mph. Shorter poles are designed to withstand winds of higher velocity. All exterior lighting poles are designed in accordance with 1975 AASHTO specifications for structural supports for highway luminaries.

The security area lighting is supplied from the non-Class 1E buses. The other outdoor area lighting is generally supplied from the normal 440 V buses. In the far areas, remote from the normal 440 V source, this lighting is supplied from the nearby Class 1E buses. The lighting supplied from the Class 1E buses is shed on a LOCA signal. This lighting, however, can be manually reconnected to the Class 1E buses following a LOCA through administrative controls.

9.5.3.3 Safety Evaluation

The lighting systems are not safety-related and are classified as non-Class 1E. When components of the lighting systems are located within seismic Category I structures, these components are supported on a selective basis to seismic Category IIA requirements described in Section 3.2. The basis for providing Category IIA supports is to prevent the lighting equipment from falling on safety-related equipment and impairing its ability to perform safe shutdown functions during a seismic event.

During a design basis seismic event coincident with a LOOP and failure of all nonseismic equipment/components, the control room lighting will be maintained at approximately 20 footcandles by the emergency ac lighting system. The fixtures in the control room are seismically mounted and the power is from a Class 1E source. The raceway from the source to the control room will be routed in a seismic Category I structure and will be seismically supported.

Lighting is provided to permit the operators to shut down the plant safely and maintain it in a safe shutdown condition at all times. The lighting system provides lighting at all times in areas used during reactor shutdown or emergency.

During normal plant operation, all plant lighting systems are energized from the respective unit auxiliary buses and startup buses. In the event of ac power loss from both unit auxiliary and startup buses, the normal lighting system is inoperable. The emergency lighting system, however, remains operable, being energized from the safeguard buses. The emergency lighting system is provided with the capability for full functional tests to ensure the operability of the automatic switches and other components of the system. In the event of ac power loss from both unit auxiliary and startup buses, the standby diesel generators start and energize the respective Class 1E buses within 10 seconds. During the 10 second delay (diesel startup time) the dc emergency lighting system remains energized from the station 125 V dc battery supplies. This system design ensures continuity of illumination in all indoor and essential operating areas including all emergency access and exit routes. All emergency ac lighting is automatically isolated from the Class 1E buses on receipt of a LOCA signal.

9.5.3.4 Inspection and Testing Requirements

The lighting systems are preoperationally tested. System operability is demonstrated by use during normal plant operation.

A routine test exists to simulate loss of offsite ac power to the emergency ac/dc lighting automatic transfer switches. Visual inspection of the lighting system will indicate whether the transfer switches have operated properly. This routine test will be performed twice a year consistent with available manpower and plant conditions.

9.5.4 DIESEL GENERATOR FUEL OIL SYSTEM

The diesel generator fuel oil system provides onsite storage and delivery of fuel oil for at least seven days of continuous operation to all diesel generators while supplying post-accident power requirements. The diesel generator fuel oil system is a safety-related system.

9.5.4.1 Design Bases

The diesel generator fuel oil system design bases are as follows:

a. To provide onsite storage of fuel oil for the diesel generators for at least seven days of continuous operation and to allow for subsequent refilling

b. To ensure that the single failure of any active component does not affect the operation of more than one diesel

c. To remain operable during and after a SSE

d. To withstand wind, tornadoes, floods, and missiles

e. To be capable of being tested during plant operation

f. To provide sufficient fuel oil to the diesel engines for all loading conditions

The diesel generator fuel oil system is designed to seismic Category I requirements. The quality group classification and corresponding codes and standards that apply to the design of the system are discussed in Section 3.2 and shown in drawing M-20. The quality assurance program is discussed in Chapter 17.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

9.5.4.2 System Description

The diesel generator fuel oil system P&IDs are shown in drawing M-20. Major component design parameters are listed in Table 9.5-3. Each diesel generator is provided with an independent fuel oil system. Each fuel oil system provides fuel oil to injectors and consists of a diesel oil storage tank, a diesel oil transfer pump, a day tank, an engine-driven fuel pump, a dirty fuel tank, a dc motor-driven auxiliary fuel pump, and associated piping, valves, strainers, and instrumentation. Details of the diesel oil storage tanks and their support structures are shown in Figure 3.8-64. The locations of the diesel oil storage tanks and the diesel generator enclosures are shown in Figure 3.8-58.

The description of the diesel generator fuel oil system components is as follows:

Diesel Oil Storage Tanks - One 41,500 gallon nominal capacity storage tank is provided for each diesel generator. The stored fuel oil is sufficient for seven days of continuous generator operation while supplying post-accident power requirements. The tanks are buried underground approximately 150 feet from the diesel generator enclosure as shown in Figure 3.8-58.

The diesel oil storage tanks are filled and replenished from trucks through the fill connection which branches to each of the reactor unit's four tanks. Each supply tank fill line has its own shutoff valve. A duplex-type basket strainer is provided in the fill line to prevent solid particles or debris from entering the storage tanks.

Connections for level instruments, manhole, day tank overflow return, vent, and pump support flange are provided on top of the tank. A concrete manhole for each tank, from grade to the tank connections, is furnished for access, maintenance, inspection, and repair, and can be used for emergency filling. Provisions have also been made for the collection of fuel oil that might leak from the diesel oil storage tanks into the surrounding concrete base. These provisions consist of two oil sumps, located at opposite ends of the row of eight tanks, plus associated collection piping. The sumps are of concrete manhole type and are buried completely underground. The underground collection piping consists of 6 inch diameter perforated corrugated metal pipe that is routed around the periphery of the group of eight tanks. Also, a waterproof membrane extends from ground level down to the concrete base and surrounds the eight tanks.

The locations of the sumps, the membrane, and the arrangement of the collection piping are shown in Figure 2.5-37 Sheet 8. In the unlikely event that a substantial amount of diesel oil was collected in the sumps, the temperature would be low enough to maintain the oil below its flash point of approximately 125°F. Because no flammable vapors would be formed, the possibility of an explosion is eliminated.

To preclude the potential for a fire, there are no ignition or heat sources within the sumps. When the sumps are drained, a portable pump will be placed on the surface and a suction hose dropped into the sump. Administrative procedures will ensure that no ignition sources are present in the vicinity of this operation. In addition, the sumps are completely separated from the tanks such that a potential fire in one sump would not propagate to the tanks. Any fire in these sumps would be extinguished once the available oxygen in the sumps has been consumed.

The tanks are vented through a flame arrestor above grade. The tank vent point and the fill pipe opening are higher than the probable maximum flood level. Each of the tanks is provided with a pressure/vacuum relief valve to protect against overpressure and vacuum.

The tank vent lines with a flame arrestor, the vacuum/air release valve, and the fill line for all fuel oil storage tanks are seismic Category IIA and are therefore not expected to crimp when subjected to seismic loads. Alternate vent and fill paths (e.g., manhole of the tank) are available for use in the unlikely event of damage by a seismic event. Cross connections are also provided in the fuel oil supply and return lines to each diesel to allow any diesel to be supplied from any fuel oil storage tank (drawing M-20). Credible fill or vent line damage due to a seismic event would not affect the safe shutdown of the plant.

Corrosion Protection - The exterior and interior surfaces of the diesel oil tanks are coated with protective paints according to the coating manufacturer's instructions. The exterior surfaces are commercial blast-cleaned (SSPC-SP-6) and painted with two coats of Koppers Bitumastic No. 50. Each coat has a dry film thickness of 15 to 18 mils. The entire interior surface of the tank is blast-cleaned to white metal (SSPC-SP-5) with a profile of 1.0 to 3.0 mils. The sump area and

bottom 1 foot vertical are coated with a minimum of three coats of an epoxy phenolic paint (Amercoat 90, manufactured by Ameron Protective Coatings) for a total dry film thickness of between 12.0 mils and 18.0 mils. This coating is proven for oil immersion service and has been certified by the manufacturer for compatibility with diesel fuel. In addition, the following measures have been taken to minimize the potential for internal corrosion and to mitigate its effects:

a. Corrosion Allowance: The tanks are provided with at least a 1/16 inch corrosion allowance in the shell and 1/8 inch in the sump.

b. Condensate Removal: The tanks are designed to permit easy removal of most condensation that may collect at the bottom of the tank. Each tank is equipped with a cylindrical sump affixed perpendicular to the bottom of the cylindrical tank such that the low point is directly beneath the manhole cover and dipstick nozzle. Figure 2.5-37 shows the details. Most of the condensate will flow down the tank walls and into the sump instead of being dispersed across the bottom of the tank.

   The accumulated condensate will be removed from the sump at the interval specified in the Technical Specifications by dropping one end of a flexible pipe through the dipstick nozzle and into the sump. A small pump will be attached to the other end of the pipe, which will draw the condensate from the sump and discharge it into a portable container for transportation to the plant oily waste processing facilities.

c. Fuel Oil Quality: The LGS tanks and the entire fuel oil transfer system are designed to maintain the highest level of fuel oil quality as practicable. The principal factors that have an effect on fuel oil quality are:

   1. Variations in fuel oil temperature

   2. Presence of water bottoms

   3. Contact of fuel with copper or copper alloys

   4. Contact of fuel with zinc.

   The rate of fuel gum formation is greatly increased by warm temperatures. Cyclic changes in temperature also can cause the tank to breathe such that more volatile components of the fuel will evaporate. In addition, this breathing may contribute to condensation buildup in the tank. These effects are mitigated by locating the fuel oil storage tanks underground where overall temperatures are lower and atmospheric fluctuations are minimized.

   The presence of water bottoms will promote tank rusting and corroding and will also supply a medium to support bacterial growth. Products of these processes will sometimes pick up existing gums, emulsify, and scatter throughout the fuel to the point where fuel quality may be degraded. As discussed in item b above, accumulated water bottoms will be removed at the interval specified in the Technical Specifications to help mitigate these effects.

   When fuel oil comes in contact with copper and copper alloys, the rate of gum formation is increased. The copper acts as a catalyst in promoting and speeding the

reaction. At LGS, none of the major components of the fuel oil transfer system that come into long-term contact with the fuel oil contain copper. However, some components in the injector system are made of copper alloys. Periodic exercising of the diesel generators will purge these components of any gum deposits before significant amounts are formed to impede fuel oil flow.

The role of zinc in the gumming process is not catalytic; however, the zinc may react adversely when exposed to fuel oil over a period of time. The zinc may form fuel soluble resinous materials that may degrade into insoluble gums as the fuel passes through the hot intake manifold and injectors. To preclude this occurrence at LGS, all sources of zinc have been removed from the fuel oil storage and transfer system.

d. Fuel Oil Specifications and Testing: The fuel oil purchased for the LGS diesel generators will be No. 2 diesel fuel and will meet the requirements of ASTM D975 (1981). To ensure proper fuel oil quality, samples will be tested in accordance with the plant technical specifications. Prior to the addition of new fuel to the storage tanks, the fuel will be tested for water and sediment content in accordance with ASTM D4176 (1982); and for kinematic viscosity, specific gravity, and flash point in accordance with ASTM D975 (1981). Within 31 days after obtaining this sample, it will also be tested for the remaining properties in Table 1 of ASTM D975 (1981). The exception to this is the analysis for sulfur which may be performed in accordance with ASTM D1552 (1979) or ASTM D2622 (1982). At periodic 31 day intervals, the fuel in the storage tanks will be sampled and tested for particulates in accordance with ASTM D2276 (1978) except that the filters specified in ASTM D2276-78 may have a nominal pore size of up to 3 microns. Fuel that does not pass the acceptance criteria of these standards will be brought into compliance or will be removed from the storage tanks and replaced with fresh fuel.

e. Particulate Contamination: To minimize the formation of rust on the tank interiors during the period between blast cleaning and initial loading of fuel oil, an elevated temperature will be maintained with the tanks. This elevated temperature is required to ensure proper curing of the epoxy coating and will also serve to maintain an elevated dew point, thereby precluding rust formation.

Alternatively for Unit 2, if the initial loading of fuel oil will occur more than one week after the final curing of the epoxy lining, the uncoated tank interior surfaces will be protected from corrosion by an application of preservative oil that will be inspected periodically and recoated if required. Prior to the initial loading of fuel oil, any accumulation of preservative oil along the top centerline and bottom vertical foot of the tank will be removed and wiped clean. The preservative oil remaining in the tank, although soluble in the fuel oil, will not cause the 40,000 gallon initial loading of fuel oil to exceed any ASTM D975 (1981) limit required of the diesel fuel oil.

If any particulates should accumulate in the fuel oil after the tanks are filled, from either rust or peeling of the epoxy coating, the transfer system is designed to prevent their entry into the diesel generator fuel oil injectors. The following points are applicable:

1. A basket strainer is provided on the fill connection to prevent solid particles or debris from entering the fuel oil storage tanks. In addition, the bottom of the tank is provided with a 36 inch diameter sump located 6 feet away from the tank fill nozzle. Sediment and water collected in this sump will not be

stirred when the tank is replenished because agitation of the fuel oil would occur only underneath the fill nozzles.

2. The fuel oil transfer pumps take suction from a point 11 inches above the tank bottom. Because most particulates will settle to the bottom, significant ingress of particulates is not expected to occur.

3. The pumps are equipped with a suction strainer to prevent the entrance of any large particles or debris.

4. The pumps are of a sump pump design in which the casing and impeller are submerged and located directly in the pump suction. Liberal tolerances exist between the casing and impeller such that any particulates that may pass through the suction strainer will not damage the internals.

5. Any particulates passing through the pump would be trapped by one of the five duplex filters or strainers located between the fuel oil transfer pump discharge and the diesel engine. As shown on drawing M-20, basket strainers are located on the day tank supply piping and on the suctions of both the engine-driven fuel oil pump and the dc motor-driven fuel oil pump. Line filters are located on the discharge of both of these pumps to provide fine filtration of the fuel immediately prior to admission to the injectors.

6. Each of the above duplex filters and strainers is equipped with differential pressure indicators and alarms to notify the operators of impending clogging. The basket strainers will alarm when the pressure differential exceeds 3 psid. Due to the higher pressure drop required for fine fuel filtration in the line filters, the alarms on these filters will not sound until the pressure drop exceeds 13 psid. Both of these settings will provide ample time for the operator to manually switch to the other filter element before the operability of the diesel generators is compromised.

The above described system and procedures will provide sufficient protection against internal corrosion of the tanks due to condensation, while also ensuring that sediment turbulence and other long-term storage concerns will not result in degraded quality of the fuel oil.

Cathodic protection is also provided around the fuel oil storage tanks.

Diesel Oil Transfer Pumps - One diesel oil transfer pump is provided for each storage tank. The pump is connected to the pump support flange such that the pump casing and impeller are submerged. The diesel oil transfer pump discharge lines run directly to the diesel oil day tanks. Because the capacity of the transfer pump is greater than the fuel oil consumption of the diesel engine, the pump can supply fuel oil for the diesel and simultaneously increase the inventory of the day tank. The fuel oil transfer pumps are started and stopped automatically by day tank level switches. The pumps can also be operated manually at the local engine control panel by control switches. Diesel fuel oil transfer pumps are powered by the Class 1E ac power system from the same electrical division as the diesel generator it supplies. A suction strainer is provided at the pump inlet and a duplex strainer is provided in the pump discharge line.

Diesel Oil Day Tanks - One 850 gallon capacity diesel oil day tank is provided for each diesel generator. Each tank is located in a separate compartment within the diesel generator enclosure that is capable of containing a liquid volume in excess of the day tank capacity.

The tanks are provided with connections for filling, overflow, vents, drains, supply and return piping, and with access for tank inspection. Each tank has capacity for sufficient fuel oil for a minimum of 3½ hours of continuous diesel generator operation at full load. In the unlikely event of a failure in one of the supply systems, the associated day tank low level alarm will annunciate when the fuel oil remaining in the tank will provide approximately one more hour of full load operation so that the operator can take corrective action to prevent loss of the diesel.

The day tanks are vented to outside the diesel generator enclosure through a flame arrestor and are protected against overpressure and vacuum conditions. Their location provides a slight positive pressure at the fuel pumps. Overflow lines from the tank return excess fuel oil to the storage tank.

Diesel Generator Fuel Pumps - Each diesel generator is provided with two positive displacement fuel oil pumps, one diesel engine-driven and one dc motor-driven. Relief valves and line filters are furnished on the discharge of each pump. The pumps, valves, and associated piping are all located on the diesel engine skid in the diesel generator enclosure.

The diesel fuel pumps take suction from the day tank and pump fuel oil to the injectors on the diesel engine. On remote manual or automatic engine starts, the dc motor-driven pump starts simultaneously with the engine-driven pump when the diesel is started, and shuts off automatically about 10 seconds after the diesel attains a speed above 800 rpm. The dc motor-driven pump is armed to restart automatically 4 seconds after stopping at the end of the starting sequence, should the fuel oil pressure at the engine-driven pump discharge drop below 10 psig. This provides a backup to the engine-driven pump during operation. When started by a low fuel oil pressure signal, the pump will stop only if the engine receives an emergency stop signal or if the operator places the local pump control switch in the OFF position.

On a local start, the dc motor-driven pump must be operated manually. The automatic restart feature will be armed when the pump start switch is returned to the AUTO position.

The source of power for the dc fuel oil pump motor is Class 1E 125 V dc power system from the respective electrical division of its diesel generator. The operating status of the dc motor-driven pump is indicated by alarms at the local control panel as "DC FUEL PUMP POWER OFF" or "DC FUEL PUMP RUNNING".

Both the dc motor-driven pump and the engine-driven pump supply more fuel to diesel engine than the engine can consume. The excess fuel is returned to the day tank.

Associated Piping - The diesel generator fuel oil system piping is all made of carbon steel except manufacture-supplied on-skid engine tubing, which may be steel, steel with copper braze, or other materials according to the specific application. The piping is shown on drawing M-20. The diesel oil supply and return lines of the four diesel generators associated with each unit are cross-connected so that any one of the diesel engines can be supplied from any one of the diesel oil storage tanks. The piping between the diesel oil storage tank and the diesel generator enclosure is buried. Corrosion protection for this underground piping is provided by protective wrapping and coating. Cathodic protection is also provided. All valves are located in a valve pit at

the diesel oil storage tank or within the diesel generator enclosure. Basket strainers are provided in each transfer pump discharge line to prevent solid particles or debris from entering the day tanks.

Dirty Fuel Oil Tank - Each diesel has a small tank mounted on its skid to collect any leakage from the injector area or from a drip pan beneath the blower. Tank volume is approximately 5 gallons. It has a sight glass and a high level switch that initiates an alarm on the local control panel and a common alarm in the control room.

9.5.4.3 Safety Evaluation

The diesel generator fuel oil system is designed to seismic Category I requirements as defined in Section 3.7. The components of the system are located in the diesel oil storage tank valve pit or the diesel generator enclosure, which are designed to seismic Category I requirements as discussed in Section 3.8.

Protection against hurricanes, tornadoes, and missiles is provided by locating system components either underground or within the seismic Category I diesel generator enclosure.

Evaluation of the diesel generator fuel oil system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection against wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

A single above ground fill connection to the fuel oil storage tanks is provided to supply each tank through an underground common header, as shown in drawing M-20. Each tank is equipped with a separate above ground vent line. Both the fill connection and the vent lines extend only a minimal distance above the ground. In the unlikely event of damage by tornado missiles, the following design features are present in the system to allow continued operation of the diesel generators:

a. Alternate paths for filling and venting each tank are available (e.g., manhole of the tank)

b. The vent line for each tank is backed up by a separate vacuum relief valve located within the tank valve pit. The valve pits are sealed; however, analyses have been performed which indicate that there is sufficient air mass within the 1880 ft^3 valve pit to relieve tank vacuum for a period of time in excess of 18 hours before the tank level drops below a point where the minimum required pump NPSH is not available.

In the event of crimping of the above ground tank vent lines, steps will be taken to repair the vents or open the valve pit manhole covers within this time period.

c. Cross-connections are provided in the fuel oil supply and return lines to each diesel to allow any diesel to be supplied from any storage tank.

As an example, if the storage tank A fill or vent lines were damaged so as to make the tank unavailable, and diesel generator B was not available, the following manual operator actions would be taken (drawing M-20): valves 1045B and 1101A would be closed and valves 1080A, 1080B, 1100A and 1100B would be opened. The B transfer pump would be started and would pump to the A day tank. When the A day tank is full, the full flow overflow line would return the diesel oil to the B storage tank. As noted in Section 9.5.4.2, the day tank has capacity for sufficient fuel for 3½ hours of continuous diesel generator operation at full load; sufficient fuel oil for approximately one hour of full load operation remains at the point where the low level alarm annunciates.

Therefore, credible tornado missile damage to the fill line or a vent line would not affect the safe shutdown of the plant.

Exposure of the fuel oil system outside the diesel generator enclosure to ignition sources is minimized by underground burial of the piping and storage tanks. The diesel generator day tank is separated from ignition sources by locating the tank in a separate compartment in the diesel generator enclosure. All fuel oil system piping inside the diesel generator enclosure is located in a pipe trench below the diesel generator elevation except for a short run of piping between the day tank and the fuel oil pumps located on the diesel generator skid (drawings M-145 and M-146).

The total capacity of the underground diesel generator fuel oil storage tanks is sufficient for seven days of continuous operation of the diesel generators while supplying post-accident power requirements.

The diesel generator fuel oil system is designed so that failure of any one component results in the loss of fuel supply to no more than one diesel generator. Physical redundancy of active components in each diesel generator fuel oil system is not provided. An independent fuel oil supply train is provided for each diesel generator. Each transfer pump is powered from the Class 1E bus served by its respective diesel generator. Failure of one pump or diesel generator will not affect the operability of any component in another train. Only a maximum of three of the four diesel generators supplied for each unit are required during a LOOP and/or LOCA to meet the safeguard load requirements. Therefore, failure of any one component of the diesel generator fuel oil system does not preclude safe shutdown of the plant following a LOOP and/or LOCA. Table 9.5-4 gives a failure mode and effects analysis of the system.

Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

The diesel oil transfer and return lines of the four fuel oil systems associated with each unit are cross-connected so that any one of the diesel engines can be supplied from any one of the diesel oil storage tanks, if required. These cross-connections are valved and require manual operation.

An adequate supply of diesel fuel oil is readily available from a large number of suppliers in the Philadelphia metropolitan area, with one day truck deliveries available. The plant is located one

mile south of Route 422, a major highway which runs west into Reading and east into Philadelphia. Route 422 has easy accesses to the Pennsylvania Turnpike and the Schuylkill Expressway (Route 76). Under extremely unfavorable environmental conditions, these major highways should be available to provide access to the plant. Truck delivery via these routes would allow fuel oil to be supplied to the site. If necessary, the fuel oil will be obtained from a company located in Pottstown (3 miles from the plant).

Each diesel oil day tank is provided with a temperature switch that shuts off the diesel oil transfer pumps on high temperature. This prevents the pumping of fuel oil to the day tank in case of a fire in the day tank. Diesel fuel oil protection against low temperatures is achieved by enclosing the equipment in heated enclosures and by burying near or below the frost line.

9.5.4.4 Tests and Inspections

The diesel generator fuel oil storage and transfer system was preoperationally tested in accordance with the requirements of Chapter 14 and is periodically tested in accordance with the requirements of Technical Specifications. Periodic testing includes fuel oil sampling to ensure that the fuel quality requirements of the Technical Specifications are met. If, as a result of this testing, it is determined that unacceptable biogrowth is present in the tank, the diesel generator will be declared inoperable and the corrective action discussed in Section 9.5.4.2 paragraph d taken. The fuel oil storage tanks are provided with concrete manholes that permit access to the tank connections for periodic inspection of the tanks, pumps, and instrumentation. The day tanks, fuel pumps, and associated piping, strainers and valves are in the diesel generator enclosure and are accessible for inspection during testing and operation.

In addition to the Technical Specifications surveillance testing program, a comprehensive instrumentation maintenance program will be performed in conjunction with the diesel generation inspection/ overhaul. This program will be based on the recommendations of the equipment vendor and operational experience.

9.5.4.5 Instrument Applications

Local and remote indicators, alarms, and pressure relief valves are provided to monitor the system process and protect system components.

The following functions are indicated locally:

a. Storage tank level

b. Transfer pump discharge pressure

c. Transfer pump discharge basket strainer upstream and downstream pressure

d. DELETED

e. Day tank level

f. Day tank temperature

g. Fuel pump suction basket strainer differential pressure (2)

h. Fuel pump discharge filter upstream and downstream pressure (2)

In addition, the storage tanks have dipsticks, and the dirty fuel oil tank has a sight glass.

The following functions are alarmed at the local engine control board and at a common trouble alarm in the control room:

a. Fuel oil pressure low

b. Fuel oil high differential pressure across fuel pump inlet duplex strainers

c. Fuel oil high differential pressure across fuel pump outlet duplex filters

d. Day tank low/high levels

e. Fuel oil high differential pressure across transfer pump discharge duplex strainers

f. Day tank high temperature

g. Dirty fuel oil tank/drip pan high level

The fuel oil storage tank low/high levels are alarmed in the control room only.

The following interlocks are provided on the diesel generator fuel oil system:

a. The day tank high temperature switch shuts down the transfer pump if a fire should occur in the day tank. This will cut off the fuel oil supply to the day tanks.

b. The diesel oil transfer pumps are started and stopped automatically by day tank level switches.

c. The diesel generator emergency stop switch signal overrides the dc auxiliary fuel oil pump run signal to ensure pump shutdown in the event of diesel generator engine shutdown.

Testing and maintenance of the system are discussed in Sections 17.2.2.4 and 17.2.2.6.

9.5.5 DIESEL GENERATOR COOLING WATER SYSTEM

The diesel generator cooling water system provides cooling water to the station diesel generators and is safety-related except for the electric circulating pump motor which is classified as non-safety related.

9.5.5.1 Design Bases

The design bases of the diesel generator cooling water system are as follows:

a. To cool the engine cylinder jackets, the combustion air, and the lubricating oil sufficiently to permit continuous operation of the diesel generator at full load.

b. To maintain the jacket coolant in a warmed condition while the diesel engine is in normal standby status to promote starting.

c. To ensure that the single failure of any active component will not affect the operation of more than one diesel generator.

d. To remain functional during and after an SSE.

e. To permit testing of active system components during plant operation.

f. To withstand wind, tornadoes, floods, and missiles.

The diesel generator cooling water system is designed to seismic Category I requirements or seismic category IIA as described in Section 3.2.2.d. The quality group classification and corresponding codes and standards that apply to the design of the system are discussed in Section 3.2.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

9.5.5.2 System Description

The diesel generator cooling water system consists of two separate cooling loops: the jacket water cooling loop and the air cooler coolant loop. These loops are shown schematically in drawings M-20. Each loop is cooled by the ESW system discussed in Section 9.2.2. The general arrangement of the diesel generator system is shown in drawings M-145 and M-146. The lube oil cooler coolant loop is discussed in Section 9.5.7.

9.5.5.2.1 Jacket Water Cooling Loop

During operation, the jacket water cooling loop circulates treated cooling water that cools the diesel generator cylinder jackets under ambient conditions which are discussed in Section 9.4.6. The jacket water cooling loop consists of the following:

a. An expansion tank

b. An engine-driven jacket water pump

c. A motor-driven circulation pump and an electric heater to keep the engine warm during shutdown periods

d. An automatic thermostatic control valve

e. A shell and tube heat exchanger to dissipate the heat from the jacket water (shell side) to ESW (tube side)

f. Alarms, trips, indicators, valves, and piping

The jacket water cooling loop component design parameters are given in Table 9.5-5. The diesel generator ESW inlet temperature used for design (95°F) is based on the maximum post-LOCA

ultimate heat sink temperature (Section 9.2.6). The use of this temperature in conjunction with appropriate fouling factors results in a conservative design because the seasonal variation in the ultimate heat sink ambient temperature ranges from 32°F to 88°F.

The jacket water cooling system is designed to completely fill without special venting provisions. System fill is performed in accordance with approved plant procedures. To ensure that all components and piping are maintained full of water, an expansion tank is connected to the pump suction piping. The expansion tank also serves the air cooler coolant loop. The expansion tank outlet nozzle is located approximately 8 feet above the top of the diesel engine.

The expansion tank is located at el 235'-1", and has a volume of 80 gallons. The diesel generator is located at el 217'. The difference in level between the expansion tank and the pump suction provides a positive static suction head for the pump. The pump has a rotary mechanical seal to prevent excessive leakage of water along the pump shaft. Normal maintenance of valves and system components in accordance with Section 17.2.2.6 will ensure that leakage rates will be kept below the amount requiring tank makeup within a 7 day period. Operational experience has shown that this is not a problem for the model of diesel generator used at LGS.

The need for addition of cooling water to the expansion tank is indicated by a local low level alarm and a common control room trouble alarm. A permanently installed, manually operated makeup water system is provided. In addition, coolant can be added through the tank water treatment connection if the normal makeup system is unavailable.

The engine-driven jacket water pump discharges the cooling water through the engine passages and the engine jacket header, and delivers it to a three-way thermostatically controlled valve. This valve directs the flow through or around the jacket water heat exchanger and back to the pump suction. Short-circuiting via the keep-warm system (described below) will be minimized by the line sizing of the keep-warm system (1½ inches) compared to the main loop (5 inches).

During engine shutdown periods, a centrifugal circulation pump, driven by a 1 hp ac motor, is designed to circulate the jacket coolant at a rate of 40 gpm through the 15 kW electric heater, the engine-driven pump, the jacket coolant piping, and the cylinder liner jackets. A branch line is provided to supply heated coolant to the air cooler coolant loop to keep it warm as an aid to quick starting.

The circulation pump runs continuously whenever the engine is shut down and maintains adequate water flow for keep-warm conditions when the engine is not operating. Under the control of the coolant heater thermostat, the heater cycles to maintain the keep-warm temperature of the coolant above 110°F. A relief valve, set at 40 psi, is provided in the coolant discharge line from the heater to protect the heater if the coolant flow is blocked and the heater fails to shut off automatically. A low coolant temperature alarm switch, set at 90°F decreasing, is provided in the coolant discharge line from the jacket header to give an alarm signal to the operator in the event of low coolant temperature (heater failure). When the engine is in operation, the recirculation is automatically stopped. The jacket coolant heater is electrically interlocked to the circulating pump motor starter so that the heater cannot operate unless this pump motor is in operation.

The cooling water in the closed cooling system is treated in accordance with current EPRI closed cooling water chemistry guidelines (E-0005-VC-00001).

The fouling factor on which the jacket water and air cooler coolant loop heat exchanger duties are based, as well as the ESW inlet design temperatures for these heat exchangers are provided in Tables 9.5-5 and 9.5-6. To preclude long-term corrosion and organic fouling in the diesel engine

cooling system, demineralized water is used along with corrosion and biofouling control chemicals recommended by a qualified water treatment vendor and meeting all requirements of the engine manufacturer. Treatment compounds are evaluated for compatibility with all materials prior to being used in the coolant loops.

Antifreeze compounds will not be used in the jacket water and air cooler coolant loops due to the potential for degraded heat exchanger performance. In lieu of antifreeze, engine temperatures will be maintained by compartment heating, jacket water heating, and lube oil heating. Compartment temperatures are normally maintained above 65ºF. If compartment temperatures should drop below 55°F, the condition will be alarmed in the control room and the operators will re-establish normal heating or provide temporary heating. If low temperatures continue to persist such that the keep-warm systems cannot maintain the water temperature at >90°F and/or lube oil temperature at >105°F, the common control room trouble alarm and additional local alarms will indicate the condition. The operators will then start the diesel generators to ensure that they were maintained in ready condition. Procedures for low load operation of the diesels will be followed (i.e., loading at a minimum of 50% power for 1 hour out of 12 hours at low load operation).

Sufficient capacity in each diesel generator cooling water system is provided so that the unit may be started from the standby condition and operated at full load. This operation can occur for at least 3 minutes without service water flow through the coolant heat exchanger before abnormally high temperature is reached.

9.5.5.2.2 Air Cooler Coolant Loop

The air cooler coolant loop is a closed-loop that provides cooling for the diesel generator combustion air and consists of the following:

a. An air cooler

b. An engine-driven air cooler water pump

c. An automatic thermostatic valve

d. An air cooler coolant heat exchanger

e. Alarms, indicators, valves, and piping.

The air cooler coolant loop design parameters are given in Table 9.5-6.

The engine-driven air cooler water pump discharges the treated cooling water through a three-way thermostatically controlled valve that directs the flow through or around the air cooler coolant heat exchanger. The water quality of the treated cooling water is the same as discussed in paragraph 9.5.5.2.1. The cooling water is then directed back to the engine where it goes through the air cooler and back to the pump suction. A constant water inventory is maintained in the system by an expansion tank that is connected to the pump suction piping. The expansion tank (Section 9.5.5.2.1) also serves the jacket water cooling loop. The air cooler and the air cooler coolant heat exchangers are shell and tube heat exchangers served by a closed-loop cooling water system and the ESW system, respectively.

9.5.5.3 Safety Evaluation

The diesel generator cooling water system is designed so that failure of any one component results in the loss of no more than one diesel generator. Since only three of the four diesel generators provided for each unit are required, failure of any one component of the diesel generator cooling water system does not preclude safe shutdown of the plant following a LOCA and/or a LOOP.

Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

Protection against hurricanes, tornadoes, and missiles is provided by locating system components within the diesel generator enclosure. Each diesel generator cooling water system is completely enclosed with its respective diesel in a concrete, missile-protected cell that is isolated from the other units.

The diesel generator cooling water system is designed to seismic Category I requirements as defined in Section 3.7 or seismic Category IIA as described in Section 3.2.2.d. The system components are housed with their respective diesel generator unit in the diesel generator enclosure that is designed to seismic Category I requirements as discussed in Section 3.8.

Evaluation of the diesel generator cooling water system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection against wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

9.5.5.4 Tests and Inspections

The diesel generator cooling water system was preoperationally tested in accordance with the requirements of Chapter 14 and is periodically tested in accordance with the requirements of the Technical Specifications. Operability of the cooling water system is checked during periodic testing of the diesel generator.

In addition to the Technical Specifications surveillance testing program, a comprehensive instrumentation maintenance program will be performed in conjunction with the diesel generation inspection/ overhaul. This program will be based on the recommendations of the equipment vendor and operational experience.

9.5.5.5 Instrument Applications

Local and remote indicators, switches, alarms, and pressure relief valves are provided to monitor the system's processes and protect systems components. When an alarm is received, the operator will investigate and initiate appropriate corrective action.

The following are provided to control system processes:

a. Jacket cooling water temperature switch - One temperature switch controls the standby heater. The switch is located downstream of the heater and is set to maintain a minimum jacket water temperature of 110°F.

b. Air cooler temperature controller - An air cooler temperature controller in the air cooler coolant loop (drawings M-20) will maintain the combustion air temperature below 145ºF via an air operated three-way valve which modulates the air cooler coolant flow through the air cooler heat exchanger.

c. Jacket water heat exchanger thermostatically controlled three-way bypass valve - This valve is set to maintain the jacket water system temperature between 155°F and 170°F during normal operation.

d. Engine Run Switch (jacket coolant pressure switch) - One pressure switch is provided on the engine-driven jacket water pump discharge. This switch operates at the coolant pressure corresponding to an engine speed of 800 rpm to provide a backup to the tachometer relay for actuation of the alarm delay, low speed, and high speed relays (Section 9.5.6.2).

The following functions are alarmed at the local engine control board and at a common trouble alarm in the control room (Section 8.3.1.1.3.10):

a. Jacket cooling water expansion tank low level - Operator action is required to open the manually operated fill valve and restore the normal water level in the expansion tank.

b. Jacket cooling water high temperature - Three switches are provided. Any one switch will initiate an alarm, and any two will shut down the diesel via the shutdown relay, except during an emergency. The switches operate to alarm at 195°F increasing and to reset at 185°F decreasing.

c. Jacket water coolant low temperature (heater failure) - One coolant low temperature switch is provided. The switch operates to alarm at 90°F decreasing.

d. Jacket cooling water low pressure - Three switches are provided. Any one switch will initiate an alarm, and any two switches will shut down the diesel via the shutdown relay, except during an emergency. The switches operate to alarm at 16 psi decreasing and reset at 18 psi increasing.

e. Jacket water circulating pump failure - The standby jacket water circulating pump motor is provided with a thermal overload protective device. Actuation of this device will shut down the pump and initiate an alarm.

f. Air cooler coolant low pressure - One switch is provided downstream of the air cooler heat exchanger. The switch operates to alarm when the coolant pressure is at 10 psi decreasing and resets at 13 psi increasing.

The following signals trip the diesel engine and its related generator circuit breaker except during emergency (LOCA) operation as described above:

a. Jacket cooling water high temperature

b. Jacket cooling water low pressure

9.5.6 DIESEL GENERATOR STARTING SYSTEM

The diesel generator starting system supplies sufficient compressed air at sufficient pressure to initiate an engine start so that within 10 seconds after receipt of the start signal, the diesel generator is ready to accept load. The diesel generator starting system is safety-related except for the components and piping that have been downgraded as discussed in Section 3.2.2.d.

9.5.6.1 Design Bases

The design bases of the diesel generator starting system are as follows:

a. To initiate an engine start so that within 10 seconds after receipt of the start signal the diesel generator is ready to receive load

b. To remain functional during and after an SSE

c. To ensure that the single failure of any active component does not result in the loss of the starting function of any other diesel generator

d. To allow testing of active components of the system during plant operation

e. To withstand wind, tornadoes, floods, and missiles

The seismic category, quality group classification, and corresponding codes and standards that apply to the design of the diesel generator starting system are discussed in Section 3.2.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. Portions of the Air Start System have been downgraded to Seismic Category IIA as shown on drawing M-20. These portions were designed and installed to Seismic Category I standards, however, they do not perform a safety related function. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

9.5.6.2 System Description

Each diesel generator is equipped with two independent air starting systems. Each consists of a reciprocating air compressor, one air receiver, associated piping, valves, filters, strainers, instrumentation and controls. Each compressor is driven by a 20 hp motor connected to a 480 V Class 1E ac power supply. The starting system is shown in drawing M-20, and major component

design parameters are listed in Table 9.5-7. The diesel generator general arrangement is shown in drawings M-145 and M-146.

In automatic operation, each of the motor-driven air compressors is controlled by a pressure switch to maintain the pressure in the air receivers above 225 psig. The compressors may be run manually. The air compressors are sized such that each compressor can fully charge its air receiver in no more than 30 minutes. Each air receiver was tested and provides at least five starts (in under ten seconds) of the diesel engine when fully charged. Each air receiver is provided with relief, drain, check, and shutoff valves to permit any receiver to be removed from service, repaired, and placed back in service, without affecting the air compressor or the other air receiver. Some diesel air receivers include a double valved normally closed connection which may be used to provide a backup air supply for certain MSRV's in the event PCIG is not available.

Each of the two air start trains consists of one solenoid-operated air start pilot valve, one manually operated air start pilot valve, one solenoid operated air vent valve, and one air start valve which admits the starting air to the engine-mounted air distributors and air start header.

Each air start distributor consists of a rotating cam that mechanically activates the correct pilot air valves to match the firing sequence. The pilot air valves admit control air to the pistons of the air start check valves, forcing them open to allow the starting air in the header to enter the cylinders in the proper sequence (drawing M-20).

Each of the two air start trains also supplies air to the Aft Main Bearing Lube Oil Booster, and to the Governor Actuator Booster. Either train may supply control air to the Combustion Air Temperature Control System.

The diesel engine start sequence is as follows:

> A start signal energizes both the start relay and the cranking time control relay. The start relay energization will close and vent the air start solenoid valves on both trains. This causes the air start valves to admit air to the air distributors and thence to the proper cylinders, which causes the engine to start rotating. Simultaneously, the air vent solenoid valves will be closed to prevent the loss of air between the air start valves and the distributors.

Normally at this point, the engine fires and the engine speed increases past 200 rpm, at which point the tachometer relay energizes the low speed relay to perform the following:

a. Disarm the start and cranking time control relays

b. De-energize the standby lube oil and jacket water keep- warm systems, the prelube pump, and the generator space heater - all via an auxiliary relay

c. Initiate generator field flashing

d. Enable the governor and voltage regulator setpoint controls to be manipulated for parallel operation (on a non-emergency start)

e. Energize the combustion air temperature control pilot solenoid valve

f. Enable automatic start of the diesel generator enclosure ventilation exhaust fan

g. Enable automatic start of the associated ESW pump (after a time-delay).

At 800 rpm, the tachometer relay energizes the alarm delay relay and the high speed relay that backs up the low speed relay for the functions listed in (a) and (e) above. The alarm delay relay picks up 10 seconds later to enable the diesel generator protective trip circuits and de-energize the dc auxiliary fuel oil pump. By this time, the engine will be up to operating speed, and all pressures will be up to operating values, so no alarm or shutdown will occur. The energization of the alarm delay relay and the high speed relay by the tachometer relay is backed up by parallel closure of the engine run switch (jacket coolant pressure switch), as discussed in Section 9.5.5.

An unsuccessful engine crank cycle is measured by the cranking time control relay which aborts the start attempt if 200 rpm is not reached within 7 seconds following the start signal. The system is designed for manual operation in the event of automatic starting air solenoid valve failure.

The following design features are provided to minimize concern over rust and moisture effects:

a. To prevent rust, none of the system pipes, air receivers, or filters are made of carbon steel.

b Filters are mounted upstream of the air start and vent solenoid valves. The filter elements are made of microfibrous material (not paper) from which coalesced liquid will drain into the bowl. The bowls are equipped with drainage provisions and will be drained periodically.

c. The design and construction of the Grove Flexflo air start valves used in this system is such that the presence of rust, other foreign particles, or liquids does not cause the valve to stick.

d. Drain connections are provided on the air receivers for removal of collected condensation.

e. Wye strainers are mounted upstream of the air start valves to remove any solid particles entrained by the air flow.

To prevent formation of rust particles in the starting system, none of the piping, filters or air receivers are constructed of carbon steel. The only components in the air start system fabricated of carbon steel are the bodies of the air start valves, the bodies of the air distributor and pilot air valve assemblies, and the valve poppet within the air start check valve. This is not of concern for the following reasons:

a. The moving components of the air distributors and the pilot air valves that are exposed to starting air are made of copper, bronze, or stainless steel. The bodies of the air start check valves are bronze. These components are all oil lubricated from the engine crankcase.

b. The air start valves consist of the valve body, the core, and a cylindrical diaphragm that completely isolates the starting air from the body. The core is provided with electroless nickel coating to prevent rusting.

Any entrained solid particles or liquid droplets are prevented from reaching critical system components by air strainers or filters. Drain connections are provided on the air receiver for draining off any collected condensate. The air start valves are not susceptible to valve sticking due to the presence of any foreign particles by virtue of their design and construction.

Administrative controls will be instituted to ensure that the air receivers will periodically be drained as recommended by the manufacturer.

Any oil droplets or vapors that may be present in the air leaving the compressors will condense and settle in the nominal 285 gallon air receivers and will be removed upon draining. The air receivers will return to the diesel compartment ambient temperature shortly after charging has been completed. If a small amount of oil should be removed from the receivers during the starting sequence, it would be of no consequence because:

a. Start and vent solenoid valves are protected from liquids by the filters described above.

b. Air start valves are not susceptible to liquid-caused problems as discussed above.

c. All engine-mounted components downstream of the air start valves are designed for and require oil lubrication.

The local control boards for the diesel generators contain control switches, auxiliary relays, and electrical equipment associated with the generator system. The local control panel is constructed of steel with continuously welded seams. All doors are gasketed and latched. The doors are louvered to allow ventilation of internally generated heat. The electrical relay and terminal box is totally enclosed and has gasketed doors. The raceway entrances to all electrical enclosures are sealed to prevent the entrance of dust or water, thus preventing the accumulation of dust on electrical control components. The contacts for the relays and switches have internal contact surfaces, and many are also enclosed with dust covers.

The motor control centers in each diesel generator cell are NEMA type 1, enclosed assemblies. All doors and bolted plates are gasketed. Additionally, the motor control centers are capped with a drip pan that prevents water, and dirt, from entering the enclosure.

9.5.6.3 Safety Evaluation

Safety-related components (including supporting structures) of the diesel generator starting system are designed to seismic Category I requirements as defined in Section 3.7. The system is located in the diesel generator enclosure that is designed to seismic Category I requirements as discussed in Section 3.8.

The diesel generator starting system is designed so that each diesel generator has an independent starting air system and the failure of one active component does not result in the loss of starting air to any other diesel generator. Only three of four diesel generators, for each unit, are required during a LOCA and/or LOOP to meet the safeguard load requirements. Therefore, failure of any one component of the diesel generator starting air system does not preclude safe shutdown of the plant following a LOCA and/or a LOOP. See Table 9.5-8 for a failure mode and effects analysis of the system.

Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

Each diesel generator unit is protected against the effects of natural phenomena such as tornadoes, hurricanes, and floods. Evaluation of the diesel generator starting system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection against wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

The starting air compressors are tripped during a LOCA; however, adequate compressed air for each diesel is stored in its associated air receivers. Each air start system holds sufficient air to start the diesel five times without compressor assistance.

As shown on drawing M-20, each compressor charges its receiver through a 1 inch line. A smaller (½ inch) line also connects from the air receiver pressure boundary. The following control devices are located at the compressor skid:

a. Pressure switches that control compressor start/stop operation; these are set to maintain receiver pressure above 225 psig.

b. Compressor unloading valves - Receiver pressure is supplied to the hydraulic unloader and unloader valve diaphragm actuator. During startup, the unloading valves hold the compressor suction valves open to prevent pressurization of the cylinders until the compressor achieves rated speed because the available motor torque is not sufficient to accelerate the compressor underload.

c. Hand switches that are used to place the compressor in "Off", "Auto", or "Run".

Because a failure of either the pressure switch, sensing line, unloader, or actuator could result in a loss of air receiver pressure, these compressor components serve a passive safety-related function to maintain air receiver pressure boundary integrity. Therefore, these compressor components and their supporting structure have been designated as Q-passive and seismic Category I.

Air consumption and associated air receiver pressure drop are permitted only by the start and the cranking time control relays as described in the starting sequence (Section 9.5.6.2) and by the control air supply to the Combustion Air Temperature Control System. During the factory tests, an engine was started an average of ten (10) times from a single receiver at 250 psig. Successful starts are not possible when the air receiver pressure drops below 80 psig.

Two solenoid air start valve trains are installed on each diesel. Each train supplies air to half of the cylinders. If one valve train fails, the other valve train supplies sufficient starting air. In addition,

manual air start valves are supplied on both air start valve trains. Failure of the compressors is indicated by an air receiver low pressure alarm and a common trouble alarm in the control room. This alarm is initiated by the receiver pressure falling below 200 psig, and is reset when the pressure increases above 215 psig. An operator will investigate the control room alarm and institute corrective action or declare the diesel inoperable. No harmful effects to the diesel engine will occur even if no operator action is taken.

9.5.6.4 Tests and Inspections

The diesel generator starting system was preoperationally tested in accordance with the requirements of Chapter 14 and is periodically tested in accordance with the requirements of Technical Specifications. Operability of the starting system is checked during periodic testing o the diesel generator.

9.5.6.5 Instrument Applications

Local indicators and controls, local and remote alarms, and pressure relief valves are provided to monitor the system process and protect the system components.

The following function is alarmed at the local engine control board and at a common trouble alarm in the control room:

a. Starting air pressure low

The following automatic function is provided:

a. The compressor associated with each receiver will start and stop to keep the receiver fully charged.

The following local indication is provided:

a. Receiver pressure

b. Starting air pressure

Pressure relief valves are provided on each of the air receivers and on the outlet of each air compressor.

9.5.7 DIESEL GENERATOR LUBRICATION SYSTEM

The diesel generator lubrication system provides essential lubrication to the components of the diesel generators. The system is safety-related except for the electrical circulating pump motor and the pre-lube pump motor which are classified as non-safety related.

9.5.7.1 Design Bases

The diesel generator lubrication system is designed to perform the following functions:

a. To supply, during diesel generator operation, a continuous flow of oil to all surfaces requiring lubrication at controlled pressure, temperature, and cleanliness

b. To warm and circulate the oil in normal standby status to promote diesel starting and prevent extreme lube oil viscosities

c. To ensure that the failure of any single active component does not affect the operation of more than one diesel

d. To remain functional during and after an SSE

e. To withstand wind, tornadoes, floods, and missiles

f. To permit testing of active system components during plant operation

The diesel generator lubrication system is designed to seismic Category I requirements or seismic category IIA as described in Section 3.2.2.d. The quality group classification and corresponding codes and standards that apply to the design of the system are discussed in Section 3.2.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

9.5.7.2 System Description

The diesel generator lubrication system consists of an oil sump in the engine frame, a suction strainer, an engine-driven lube oil pump, a filter, an oil cooler, a dual element strainer, an ac motor-driven prelube pump, a recirculation pump, an electric immersion heater, and a lube oil makeup tank. Major system design parameters are shown in Table 9.5-9. The diesel generator general arrangement is shown in drawing M-145 and M-146. A schematic diagram of the lubrication system is shown in drawing M-20. The components are discussed below.

The oil sump is a gravity collection-type enclosed in the engine crankcase, complete with a dipstick and a low level switch to provide an alarm. The lube oil sump level is maintained during both operation and engine shutdown in accordance with station procedures by manual operation of the lube oil makeup tank outlet valve. The input to this level control is gravity fed from the lube oil makeup tank, which is a vertical cylinder of sufficient capacity to supply lube oil for at least 7 days of continuous diesel generator operation.

During diesel generator operation, the lube oil is circulated through the engine by an engine driven lube oil pump. The engine-driven lube oil pump takes suction from the diesel generator sump and delivers the oil through the filter to a three-way thermostatically controlled valve that directs flow through or around the cooler. The oil then flows through a full flow strainer and back to the engine passages.

The filter is sized to ensure continuous full flow operation for a minimum of 7 days, using disposable cellulose cartridges. The filter elements are designed to remove particles down to 25 micron size and to absorb water. The filter is provided with a differential pressure indicator and a pressure switch that initiates an alarm on high differential pressure across the filter. The filters are manufactured with a built in relief valve that will bypass the filter on high differential pressure.

The lubricating oil cooler is a shell-and-tube heat exchanger with a removable tube bundle and floating head design. The tubes may be cleaned without removing any piping.

The strainer is a dual element-type sized to ensure continuous full flow operation. It is equipped with a differential pressure switch that initiates an alarm in the event of a high differential pressure across the strainer.

All pumps are of the positive displacement-type. The engine-driven pump has sufficient capacity to provide all lubricating oil requirements under full load operating conditions. The ac motor-driven prelube pump, fed from a Class 1E 480 V bus, will lubricate all wearing parts prior to a manual start. The circulating pump circulates lube oil from the sump through the electric immersion heater and back to the sump.

The immersion heater is provided to maintain the lube oil temperature at a preset value during standby periods.

There are two methods of manual operation of the diesel generator, local and remote. These are normally used for surveillance exercising. In local manual operation, the operator will start the prelube pump, which will operate for 140-180 seconds and then automatically shut down. The operator will then start the diesel generator. In remote manual operation, the operator will place the switch in START. This will start the prelube pump, which will operate for 3 minutes before an interlock permits the diesel generator to start. On emergency diesel generator start, the prelube pump does not operate because it is not required and would delay the diesel engine start.

There will be a monthly surveillance test on each diesel generator. All of these planned engine starts will be preceded with an engine prelube of about 3 minutes. The engine is gradually accelerated to rated speed, synchronized to the grid and slowly loaded. The engines are occasionally run for special tests, routine plant operations and every 6 months run to demonstrate fast start capability.

The power source for the prelube pump motor is a Class 1E bus. The motor-driven circulating pump takes oil from the sump and directs it through the immersion heater and back to the sump to keep the engine in a warm standby mode for quick start operation. This pump recirculates 13 gpm of lube oil and is powered whenever the diesel generator is shut down. A thermostat downstream of the heater controls operation of the heater to maintain a minimum lube oil temperature of 125°F. The power source for both the pump and the heater is a Class 1E 480 V bus, fed from either of two offsite sources. The switches controlling the lube oil heater and the lube oil circulating pump must both be placed in AUTO or the SWITCH NOT IN AUTO alarm on the local control panel and the D.G. TROUBLE alarm in the main control room will both be annunciated.

Lube oil vapors originating in the upper and lower crankcase compartments are drawn out of the engine by the crankcase evacuation system (drawing M-20). This built-in system maintains a subatmospheric pressure in the crankcase to minimize leakage of oil through the crankcase gaskets. It consists of an oil separator and air ejector connected to the crankcase breather housing. The ejector is operated by compressed air from the scavenging system air receiver (Section 9.5.8.2). The flow of air through the ejector draws crankcase vapors through the separator; the mixture is then carried to the ejector outlet and is discharged into the combustion exhaust outlet piping. The lube oil collected by the separator drains back to the crankcase.

9.5.7.3 Safety Evaluation

The diesel generator lubrication system and the crankcase evacuation system are designed to seismic Category I requirements as discussed in Section 3.7 or seismic category IIA as described

in Section 3.2.2.d. The systems are located within the diesel generator enclosure that is designed to seismic Category I requirements as discussed in Section 3.8.

The diesel generator lubrication system is an integral part of the diesel generator. The system meets the single failure criterion in that, if a failure in this system prevents the satisfactory operation of the associated diesel generator, the other three diesel generators will provide adequate power to safely shut down the plant or to mitigate the consequences of the postulated accidents.

Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

The crankcase evacuation system is an integral part of each diesel engine. It maintains a slight vacuum in the crankcase to minimize leakage of lubricating oil through the crankcase gaskets. It introduces a negligible amount of mass flow into the exhaust gas downstream of the turbocharger. While failure of this system would not directly cause a diesel trip, any abnormality in the engine crankcase that results in a positive pressure of greater than 0.6 inch H_2O, be it a failure of this system or any other, would be alarmed at the local control board and in the control room through the common trouble alarm.

To prevent possible damage or shutdown of a diesel engine during normal exercising from low lube oil, sump low level instrumentation is provided. Setpoints for alarms are sufficient to allow plant personnel adequate time for corrective action. During emergency operation, all lube oil trips are bypassed. Evaluation of the diesel generator lubrication system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection against wind and tornado effects	Section 3.3
b.	Flood design	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

9.5.7.4 Tests and Inspections

The diesel generator lubrication system was preoperationally tested in accordance with the requirements of Chapter 14 and is periodically tested in accordance with the requirements of Technical Specifications. Operability of the lubrication system is checked during periodic testing of the diesel generator.

The quality of the diesel generator lube oil will be maintained by complying with the surveillance standards set by the Fairbanks Morse Owners Group. The crankcase oil will be laboratory tested for dilution, sediment, and general detergent qualities on approximately six month intervals. Dilution can be suspected when low oil pressure exists, and a blue-gray exhaust smoke may indicate

excessive lube oil consumption. Degradation of the oil quality would necessitate lube oil replacement. During periods of continuous operation, the lube oil levels in the lubricating oil sumps will be monitored and there will also be checks of the differential pressures across the oil filter. The strainer is equipped with a D.P. Switch that indicates an alarm in the event of a high D.P. The D.P. across the strainer can be checked indirectly by reading D.P. across lube oil header and pump discharge subtracted from the filter differential pressure. Differential pressure of approximately 15 psi is alarmed at the local annunciator panel and at the common trouble alarm in the control room. Both the filter and the strainer will be cleaned or replaced when the differential pressure exceeds 15 psi, or as the maintenance inspection surveillance dictates. In addition to this monitoring, there will also be local panel alarm indication for high lube oil temperature, low lube oil level, and low lube oil pressure.

9.5.7.5 Instrument Application

Local and remote indicators, alarms, and pressure relief valves are provided to monitor the system's processes and to protect system components.

The following functions are alarmed at the local engine control board and on a common trouble alarm in the control room.

a. Lubricating oil low pressure

b. Lubricating oil high temperature

c. Lubricating oil high differential pressure across the filter

d. Lubricating oil high differential pressure across the strainer

e. Lubricating oil low level

f. Circulating oil pump failure/malfunction

g. Lube oil heating system failure

The following signals trip the diesel engine and related generator circuit breaker during normal operation (i.e., testing, LOOP, or manual start):

a. Lube oil high temperature

b. Lube oil low pressure

During emergency operation (LOCA) these trips are bypassed. Local indication is provided for the following:

a. Makeup tank level

b. Lube oil temperature at the engine-driven pump discharge

c. Lube oil temperature at the strainer outlet

d. Filter differential pressure

e. Lube oil pressure at the engine-driven pump discharge

f. Lube oil pressure at the strainer outlet

g. Lube oil pressure at the upper lube oil header

h. Crankcase pressure

i. Lube oil pressure at the turbocharger

The following interlocks are provided on the diesel generator lubrication system:

a. On emergency start signal, the prelube pump is prevented from starting

b. On a start signal, when the diesel reaches approximately 200 rpm, the circulating pump is tripped

c. The heater is only operable when the circulating pump is operating

d. The pre-lube pump and the circulating pump are each locked out on an emergency stop.

9.5.8 DIESEL GENERATOR COMBUSTION AIR INTAKE AND EXHAUST SYSTEM

The diesel generator combustion air intake and exhaust system supplies combustion air to the diesel engines, and exhausts the combustion products to the atmosphere (drawing M-20). The diesel generator combustion air intake and exhaust system is a safety-related system. The diesel generator enclosure ventilation system is discussed in Section 9.4.6.

9.5.8.1 Design Bases

The diesel generator combustion air intake and exhaust system is designed to the following design bases:

a. To be capable of supplying adequate combustion air and disposing of resultant exhaust products to permit continuous operation of the diesel generators at full load.

b. To remain functional during and after an SSE.

c. To ensure that the single failure of any one component does not result in the loss of more than one diesel generator.

d. To be capable of being tested during plant operation.

e. To withstand wind, tornadoes, floods, and missiles.

The diesel generator combustion air intake and exhaust system is designed to seismic Category I requirements. The quality group classification and corresponding codes and standards that apply to the design of the system are discussed in Section 3.2.

All piping and equipment has been designed to withstand seismic accelerations and operating loads, regardless of design code. The manufacturer has developed a highly reliable engine piping system over the 44 years that the design of this basic engine has been in use.

9.5.8.2 System Description

The diesel generator combustion air intake and exhaust system is shown schematically in drawing M-20 and the design parameters are listed in Table 9.5-10. The diesel generator general arrangement is shown in drawings M-145 and M-146.

Each diesel generator has a separate exhaust and intake system consisting of an air intake filter, an exhaust silencer, and the necessary interconnecting piping and expansion joints for connection to the engine turbochargers and exhaust manifold.

The intake system draws outside air from the diesel generator enclosure air intake plenum through an air filter that is capable of removing 85 percent of 10 micron and larger particles. The piping is carbon steel.

Exhaust gas-driven turbochargers draw in a volume of air that is directed to the combustion cylinders. The air is compressed by the turbochargers and cooled by circulating cooling water through the air coolers. The air coolers are fin-tube type and are mounted directly in the engine air inlet headers downstream of the turbochargers. Operating in series with the turbochargers is a mechanical blower driven off the engine crankshaft. The function of the blower is to provide scavenging air to the scavenging air receiver at low load and speed until the turbochargers build up speed and capacity. Scavenging air is used to blow the hot exhaust gases out of the cylinders. A separate line out of the scavenging air receiver provides air to the crankcase evacuation system ejector (Section 9.5.7.2).

Following combustion, the hot exhaust gases leave the cylinders through the exhaust manifold and are used to drive the turbochargers. The gas leaves each turbocharger through an expansion joint, enters the exhaust piping, which includes a silencer, and is finally discharged to the atmosphere. The exhaust silencer is of the "residential" type, constructed of welded carbon steel. The expansion joints for the engine exhaust and air intake system are stainless steel, of the unguided bellows-type, with flanged connections. The horizontal portion of the exhaust piping inside of the Diesel enclosure is carbon steel. The portion of the exhaust piping outside of the enclosure is stainless steel as shown in drawing M-20.

9.5.8.3 Safety Evaluation

All safety related equipment and supports for this system are designed to seismic Category I requirements as discussed in Section 3.7.

The diesel generator combustion air intake and exhaust system is designed so that failure of any one component results in the loss of no more than one diesel generator. The loss of one diesel generator does not preclude adequate core cooling under accident conditions. Therefore, failure of any one component of the diesel generator combustion air intake and exhaust system does not preclude safe shutdown of the plant following a LOCA and/or a LOOP. See Table 9.5-11 for a failure mode and effects analysis of the system.

Protection against hurricanes, tornadoes, and missiles is provided by locating system components within the diesel generator enclosure. The vendor has certified that the equipment will be and/or remain operable for the range of design conditions given in Sections 3.3.2.1.a and 3.3.2.1.b.

As discussed in Section 9.5.1, water sprinklers are provided as the fire protection system for the diesel compartments. Gaseous extinguishing medium is not used in these compartments or in the surrounding areas outside the diesel generator enclosure, and therefore would not pose a hazard to the performance of the diesel generators.

Other gases that may intentionally or accidentally be released onsite are located remote to the diesel generator enclosures, and therefore would not pose a hazard to the performance of the diesel generators.

The probability of a fire outside the diesel generator enclosure concurrent with a LOOP that would cause products of combustion to foul the diesel air intake is extremely low. A spontaneous main turbine trip would not result from this external fire. A fire in the fuel oil storage tank outside the enclosure would immediately be alarmed in the control room and would be extinguished by a manually activated foam injection system provided with the tank. In the event of tank rupture, a continued foam application would cover the tank contents contained by an encircling dike. The fuel oil storage tank is located at a distance >120 ft from the diesel air intake. Lube oil storage consists of drum storage inside an enclosure and protected by a wet pipe sprinkler system. This lube oil storage enclosure is located east of the Unit 2 diesel generators, south of the auxiliary boiler enclosure, approximately 60 feet from the nearest Unit 2 diesel generator enclosure air intake. The area is protected by a fire hydrant system. Normal local winds would carry combustion products away from the diesel generator intakes as shown in the wind rose in EROL figures 2.3.2-1 through 2.3.2-3.

An analysis of a hypothetical fire in the diesel generator enclosure coincident with a single failure of the fire protection system and loss of offsite power has not been performed for the following reasons:

a. Quantities of combustibles sufficient to generate large amounts of smoke (e.g., lubricating oil) are contained in steel piping or components of high quality with respect to design, fabrication, and installation. The diesel and lube oil storage tanks in each diesel compartment are contained in separate, 3 hour rated enclosures.

b. A fire in a diesel compartment cannot precipitate a LOOP.

c. In accordance with the plant Technical Specifications, the diesel generator will be started and tested on a monthly basis. Therefore, it is unlikely that a large smoky fire, which is assumed to be initiated by the operation of the diesels, would occur coincident with a LOOP.

d. Failure of the automatic fire suppression system coincident with a large smoky fire and loss of all offsite power is not considered likely. Failure of the automatic deluge valve is the only single active failure that could preclude automatic fire suppression.

In the event such a remote combination of occurrences were to take place, the plant response would be as follows:

a. Fire detection alarms, located in the main control room, would alert plant personnel and identify the location of the fire

b. The fire detection alarm would alert the plant fire brigade, which would immediately respond to the alarm. Once the fire brigade arrived at the scene, the fire and its

effects would be controlled by a combination of manual application of mist sprays to minimize the effects of smoke on the adjoining diesel engines and by manually opening the water deluge valve to the suppression system of the affected diesel. A yard fire hydrant is located directly adjacent to the south side of the diesel cells. Each water deluge valve has a manual override lever and is located in the pipe tunnel adjacent to the diesel cell (section A-A of drawing M-146). The pipe tunnel is physically separated from the diesel compartment environment by a 3 hour fire barrier.

It is expected that the fire brigade arrival and manual deluge override would occur prior to the sequence of:

1. Failure of the ventilation fans due to the effects of the fire

2. Significant flow of smoke out through the inlet plenum of the affected diesel compartment

3. Significant mixing of smoke in the intakes of the adjacent diesels.

Evaluation of the combustion air intake and exhaust system with respect to the following areas is discussed in separate sections as indicated:

a.	Protection from wind and tornado effects	Section 3.3
b.	Flood protection	Section 3.4
c.	Missile protection	Section 3.5
d.	Protection against dynamic effects associated with the postulated rupture of piping	Section 3.6
e.	Environmental design	Section 3.11
f.	Fire protection	Section 9.5.1

The air intake opening of the diesel generator enclosure and the outlet of the exhaust duct are designed to prevent recirculation of exhaust products and contamination of the diesel intake air. The combustion air intake is located at the diesel generator enclosure air intake plenum. The screened air intake opening of the enclosure is located on the upper part of the south wall and is protected from rain, ice, and snow by a roof overhang (drawing M-146). The exhaust duct is terminated above the roof with a 6 foot piece of pipe. The exhaust pipe exit is over 17 feet higher than the enclosure air intake opening. The elbow at the base of the exhaust duct is heat traced to prevent accumulation of ice and snow.

As shown in drawing M-146, intake air for the diesel generators is drawn from the plenum side of the baffle plate; the temperature and humidity of this air will thus closely approximate that of the outdoor ambient environment. EROL section 2.3 contains information regarding the rate of ambient temperature and humidity experienced at the LGS site. The operability of the diesel

generators will not be affected for ambient temperatures ranging from –5ºF to 106ºF or humidities ranging from 10% to 100%.

At temperatures above design value of 95°F, a reduction in continuous rating of approximately 2% would be required. This is not a concern due to the short duration of temperatures greater than 95°F and the existence of margin between equipment ratings and design basis plant loads.

Periodic loading of the diesel generators during extended periods of light load operation (Section 8.3.1.1.3) will eliminate any harmful buildup of carbon, lube oil, or fuel during periods of low temperature operation.

Because of the above described configuration and because the specific gravity of the exhaust gases leaving the exhaust duct is approximately one-third of the standard air specific gravity, exhaust gas contamination of air at the enclosure intake opening will be negligible irrespective of outdoor ambient temperature, wind speed, or direction. The exhaust duct extension, beyond the diesel generator enclosure roof, further improves exhaust gas dispersion. This extension is considered nonsafeguard in that it is not required to meet the system design requirements, and in that its failure will not interfere with the exhaust duct gas flow and consequently the performance of the diesel generator.

The flange portion of the exhaust piping above the roof is stainless steel and fastened with a weak bolted connection. If this portion of piping were to be struck by a tornado or turbine missile, the flanged portion would either remain intact or break free and fall away from the exhaust stack to the roof or to the ground. The bolted connection is far weaker than the section of steel pipe and would break free before the pipe could be deformed to block flow. This section of pipe falling to the roof has been previously analyzed as being acceptable because the roof is designed to withstand turbine and tornado missiles. Also the possibility of small pieces of metal falling into the stack as a result of a missile hit has been previously analyzed as being acceptable because the arrangement of the pipe and the presence of the silencer would prevent the pieces from reaching the turbocharger. For the low probability event of the pipe breaking off, the vertical discharge velocity and low specific gravity of the exhaust ensure that the recirculation would not be a problem.

The engine silencers are provided with drains for removal of condensation and precipitation that might collect at this point. The drains will be open continuously to allow for precipitation to drain into a Seismic Category I, Q-listed loop seal. Any dust that might accumulate in the exhaust piping will be blown out by the exhaust gases during periodic testing.

The remote potential exists for snow to accumulate in the 90° elbow at the base of the stack, since this elbow is located outside the diesel generator enclosure at the bottom of the air intake plenum. The presence of snow or ice in the elbow could increase the back pressure on the engine, and thereby increase the engine acceleration time and decrease performance. This potential is not felt to be significant since: (1) the exhaust piping from the engine to the underside of the roof of the intake plenum is insulated and will therefore tend to retain heat from diesel exercises, and (2) the diesel bays are maintained at 65°F if plant heating steam is available and some heat will escape from the diesel bays to the intake plenum. Thus, extremely cold winter weather accompanied by a major snowstorm would be required to effect significant accumulation of snow in the exhaust stacks.

Nonsafety-grade electric heat tracing has been installed on the base of the exhaust stacks to provide heat in the event of a major snowstorm accompanied by extremely cold weather. In the event of failure of this system, the operators will start the affected diesel generator to provide heat.

The engine is not equipped with alarm or shutdown sensors for abnormal conditions in the intake and exhaust systems because the engines are designed to operate under all specified operating conditions.

9.5.8.4 Tests and Inspections

The system is preoperationally tested in accordance with the requirements of Chapter 14 and is periodically tested in accordance with the requirements of Technical Specifications. Operability of the combustion air intake and exhaust system is checked during the periodic testing of the diesel generator system.

The exhaust line is inspected as part of the ISI program.

9.5.8.5 Instrument Application

The following local indication is provided:

a. Exhaust manifold on the inlet to turbo charger temperature (2)

b. Blower discharge temperature

c. Cylinder exhaust temperature (each cylinder)

d. Combined exhaust temperature

e. Inlet air pressure

f. Blower discharge pressure

There are no alarms or interlocks on this system.

9.5.9 REFERENCES

9.5-1 Limerick Generating Station Units 1 and 2 Technical Requirements Manual, Fire Protection Section.

9.5-2 "American National Standard Fuel Oil Systems for Standby Diesel-Generators," American National Standards Institute (ANSI) N195 / American Nuclear Society (ANS) 59.51, approved 12 April 1976.

Table 9.5-1

NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS
USED IN DESIGN OF FIRE PROTECTION SYSTEMS

NUMBER	TITLE
11	Foam Extinguishing Systems
12	Carbon Dioxide Extinguishing Systems
12A	Halon 1301 Systems
13	Installation of Sprinkler Systems
14	Standpipe and Hose Systems
15	Water Spray Fixed Systems
20	Centrifugal Fire Pumps
24	Outside Protection
30	Flammable and Combustible Liquids Code
70	National Electric Code
72	National Fire Alarm Code, Edition 1996, Chapter 5
72A	Local Protective Signaling Systems
72D	Proprietary Signaling Systems
72E	Automatic Fire Detectors, Edition 1990
75	Electronic Computer Data Processing Equipment
78	Lightning Protection Code
90A	Air Conditioning and Ventilation System
231	Indoor General Storage
231C	Rack Storage of Materials

Table 9.5-2

INSULATION AND JACKETING MATERIALS USED FOR ELECTRICAL CABLING

CABLE APPLICATION	INSULATION	JACKETING
Communication	Polyvinyl chloride	Polyvinyl chloride
Lighting	Thermoplastic (THHN, THWN, or THW)	None
Grounding	Thermoplastic (THW)	None
Instrumentation	Cross-linked polyethylene	Neoprene
Perkiomen pipeline supervisory control	Cross-linked polyethylene/armored	Polyvinyl chloride(4) or neoprene
	Flamtrol	Flamtrol
Coaxial and triaxial	Cross-linked Polyolefin	Cross-linked polyolefin
600 V control	Cross-linked polyethylene	Neoprene
	Rubber	Polyvinyl chloride(5)

Table 9.5-2 (Cont'd)

CABLE APPLICATION	INSULATION	JACKETING
Meteorological towers cable	Rockbestos "Heatzone I"	Rockbestos "Heatzone I"
	Vulkene	Polyvinyl chloride(6)
600 V power	Cross-linked polyethylene	Neoprene
	Ethylene propylene	Hypalon
	Cross-linked polyethylene	Polyvinyl chloride(7)
	Cross-linked Polyethylene	Chlorinated polyethylene
5 kV power	Ethylene propylene rubber	Hypalon
15 kV power	Ethylene propylene rubber	Semi-conducting chlorinated polyethylene
	Cross-linked polyethylene	Polyvinyl chloride
Computer cables	Cross-linked Polyethylene	Neoprene or Flamtrol
	Rayolin F	Flamtrol
Multiconductor(1)	Cross-linked polyethylene	Neoprene
Multiconductor (shielded)(1)	Cross-linked polyethylene or cross-linked modified polyolefin	Neoprene or cross-linked polyolefin

Table 9.5-2 (Cont'd)

CABLE APPLICATION	INSULATION	JACKETING
Twisted-shielded pairs(1)	Cross-linked polyalkene and	Cross-linked modified polyolefin polyvinylidene fluoride
Thermocouple(1)	Cross-linked polyethylene	Cross-linked polyethylene
Coaxial (RG type)(1)	Cross-linked polyethylene	Cross-linked polyethylene
Coaxial (twin conductor)(1)	Alkaneimide polymer cross-linked polyolefin	Cross-linked polyethylene
Coaxial (high temperature, radiation resistant)(1)	Cross-linked polyethylene	Cross-linked polyethylene
Twisted pairs or triples (high performance)(1)	Polyalkene and polyvinylidene fluoride	Cross-linked polyvinylidene fluoride and cross-linked polyolefin
Armored Coaxial Cable for Video signals from Drywell video cameras(3)	Cross-linked polyethylene	Polyvinyl Chloride
Armored Multiconductor cable for Drywell video camera control and audio signals(3)	Cross-linked polyethylene	Polyvinyl Chloride

Table 9.5-2 (Cont'd)

(1) These cables are associated with the PGCC.

(2) Insulation for lighting cables and grounding cables is specified as flame retardant in accordance with the National Electric Code. Insulation and jacketing for all other cables, with the exception of communications cables, are specified to meet the IEEE 383 flame test requirements.

(3) These cables are used with the Health Physics temporary video cameras and Remote Console. The cables route video signals, control and audio signals to and from the Remote Console, which is located outside the Drywell, to the cameras located inside the Drywell during outages.

The following cables are restricted to use in specific installations:

(4) Perkiomen pipeline direct burial supervisory control cable (outside plant)

(5) Meteorological towers cable (outside plant)

(6) Postaccident sampling system vendor-supplied cable which is in solenoid valve cabinets only.

(7) Main condenser areas and the condensate pump rooms

Table 9.5-3

DIESEL GENERATOR FUEL OIL SYSTEM
DESIGN PARAMETERS

DIESEL OIL STORAGE TANKS	
Quantity	4 (100% capacity each)
Type	Underground, horizontal, cylindrical
Capacity, each	41,500 gallons
Design pressure	Atmospheric
Design temperature	Ambient
Code design requirements	UL58, AWS, ASTM, SSPC National Fire codes Built to ASME Section III, Class 3 but not stamped Nondestructive examination in accordance with ASME Section III
DIESEL OIL TRANSFER PUMPS	
Quantity	4 (100% capacity each)
Type	Vertical, centrifugal sump
Capacity, each	20 gpm
Head	40 feet
Motor power rating	1½ hp
Code design requirements	Hydraulic Institute Standards
DIESEL OIL DAY TANK	
Quantity	4 (100% capacity each)
Type	Indoor, vertical, cylindrical, aboveground
Capacity, each	850 gallons
Design pressure	Atmospheric
Design temperature	Ambient
Code design requirements	ASME Section III, Class 3
ENGINE-DRIVEN FUEL PUMP	
Quantity	4 (100% capacity each)
Type	Positive displacement
Capacity, each	9 gpm
Head	25 psig
Code design requirements	DEMA

Table 9.5-3 (Cont'd)

DC MOTOR-DRIVEN PUMP

Quantity	4 (100% capacity each)
Type	Positive displacement, rotary
Capacity, each	10 gpm
Head	35 psig
Motor power rating	¾ hp
Code design requirements	DEMA

Table 9.5-4

DIESEL GENERATOR FUEL OIL SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

COMPONENT	MALFUNCTION	EFFECT ON SYSTEM
Storage tanks (one per diesel)	Loss of one tank	Supply to one diesel is lost; however, the capability is provided to supply that diesel from any of the other storage tanks.
Day tanks (one per diesel)	Loss of one tank	The fuel supply to one of the four diesels is lost. However, only three diesels for each unit are required for a safe shutdown following a LOCA and a LOOP. (See Note)
Transfer pumps (one per diesel)	Loss of one pump	Same as first item
Line between day tank and supply line isolation valve down-stream of cross connect (one per diesel)	Rupture of pipe	Same as second item
Line between storage tank and supply line isolation valve upstream of cross connect (one per diesel)	Rupture of pipe	Same as first item
Fuel oil pump (engine-driven, one per diesel)	Pump fails	Dc-driven pump automatically starts

Note: Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

Table 9.5-5

DIESEL GENERATOR JACKET WATER COOLING LOOP DESIGN PARAMETERS

EXPANSION TANK	
Quantity	1 per diesel (4 total)
Capacity, each	80 gallons
Design code requirements	ASME Section III, Class 3
ENGINE-DRIVEN WATER PUMP	
Quantity	1 per diesel (4 total)
Typ	Centrifugal
Capacity, each	800 gpm
Head	46 psi
Design code requirements	Manufacturer's standard
MOTOR-DRIVEN CIRCULATION PUMP	
Quantity	1 per diesel (4 total)
Type	Centrifugal
Capacity, each	40 gpm
Head	6.5 psi
Motor power rating	1 hp
Design code requirements	Manufacturer's standard
JACKET WATER HEAT EXCHANGER	
Quantity	1 per diesel (4 total)
Type	Shell and tube
Duty, each(1)	2,965,000 Btu/hr
Shell design	
Fluid	Treated water
Flow rate	800 gpm
Design pressure	150 psi
Design temperature	300ºF
Tube design	
Fluid (design inlet temperature)	ESW (109.5ºF)
Flow rate (nominal)	700 gpm
Design pressure	150 psi
Design temperature	300ºF
Design code requirements(2)	ASME Section III, Class 3 & Commonwealth of Pennsylvania

Table 9.5-5 (Cont'd)

STANDBY JACKET COOLANT HEATER

Quantity	1 per diesel (4 total)
Type	Immersion, electric
Rating	15 kW
Design code requirements	ASME IV

(1) Based on a fouling factor of 0.0025

(2) Replacement Sub-Assembly(ies) purchased after 11/2000 procured in accordance with US NRC Generic Letter 89-09 and ASME Section III, Class 3, equivalent requirements.

Table 9.5-6

DIESEL GENERATOR AIR COOLER COOLANT LOOP DESIGN PARAMETERS

AIR COOLER

Quantity	2 per diesel
Type	Shell and tube
Tube design	
Fluid	Treated water
Flow rate	400 gpm
Design pressure	30 psi
Design temperature	300ºF
Shell design	
Fluid	Air
Flow rate	15,000 cfm
Design pressure	30 psi
Design temperature	300ºF
Design code requirements	Manufacturer's standard

ENGINE-DRIVEN AIR COOLER WATER PUMP

Quantity	1 per diesel (4 total)
Type	Centrifugal
Capacity, each	400 gpm
Head	26 psi
Design code requirements	Manufacturer's standard

AIR COOLER COOLANT HEAT EXCHANGER

Quantity	1 per diesel (4 total)
Type	Shell and tube
Duty, each(1)	2,346,000 Btu/hr
Shell design	
Fluid	Treated water
Flow rate	400 gpm
Design pressure	150 psi
Design temperature	300ºF
Tube design	
Fluid (design inlet temperature)	ESW (95ºF)
Flow rate (nominal)	700 gpm
Design pressure	150 psi
Design temperature	300ºF
Design code requirements(2)	ASME Section III, Class 3, & Commonwealth of Pennsylvania

(1) Based on a fouling factor of 0.0025

(2) Replacement Sub-Assembly(ies) purchased after 11/2000 procured in accordance with US NRC Generic Letter 89-09 and ASME Section III, Class 3, equivalent requirements.

Table 9.5-7

DIESEL GENERATOR STARTING SYSTEM DESIGN PARAMETERS

STARTING AIR COMPRESSORS	
Quantity	2 per diesel, 8 total per Unit (100% capacity each)
Type	Reciprocating
Capacity, each	44 cfm
Motor power rating	20 hp
Voltage	460 V ac, three-phase, 60 Hz
Code design requirements	Manufacturer's standard
AIR RESERVOIR	
Quantity	2 per diesel, 8 total per Unit (100% capacity each)
Type	Vertical, cylindrical
Design Pressure	275 psig
Capacity, each	5 normal diesel starts
Code design requirements	ASME Section III, Class 3

Table 9.5-8

DIESEL GENERATOR STARTING SYSTEM
FAILURE MODES AND EFFECTS ANALYSIS

COMPONENT	MALFUNCTION	EFFECT ON SYSTEM
Air compressor (two per diesel)	Failure of a compressor to start	One of the dual air start systems is lost. The diesel is started by the other system.
Air reservoir (two per diesel)	Failure of the reservoir	Same as above
Line between air compressor and isolation valve	Rupture of pipe	Same as above
Line between the isolation valve and the air reservoir	Rupture of pipe	Same as above
Line between the air reservoir and the diesel	Rupture of pipe	Same as above

Table 9.5-9

DIESEL GENERATOR LUBRICATION SYSTEM DESIGN PARAMETERS

ENGINE-DRIVEN LUBE OIL PUMP	
Quantity	1 per diesel (4 total)
Type	Helical gear
Capacity, each	500 gpm
Head	80 psi
Design code requirements	Manufacturer's Standards
LUBE OIL COOLER	
Quantity	1 per diesel (4 total)
Type	Shell and tube
Duty, each(1)	2,747,000 Btu/hr
Shell design	
Fluid	lube oil
Flow rate	500 gpm
Design pressure	150 psig
Design temperature (maximum)	300°F
Tube design	
Fluid	Emergency service water
Flow rate	700 gpm
Design pressure	150 psig
Design temperature (maximum)	300°F
Design code requirements(2)	ASME Section III Class 3, & Commonwealth of Pennsylvania
AC MOTOR-DRIVEN PRELUBE OIL PUMP	
Quantity	1 per diesel (4 total)
Type	Rotary
Capacity, each	35 gpm
Head	50 psi
Motor power rating	5 hp
Design code requirements	Manufacturer's Standards
CIRCULATING PUMP	
Quantity	1 per diesel (4 total)
Type	Rotary
Capacity, each	13 gpm
Head	25 psi
Motor power rating	3 hp
Design code requirements	Manufacturer's Standards

Table 9.5-9 (Cont'd)

STANDBY LUBE OIL HEATER

Quantity	1 per diesel (4 total)
Type	Immersion, electric
Rating	6 kW each
Design code requirements	ASME Section IV

LUBE OIL STRAINER

Quantity	1 per diesel (4 total)
Type	Dual Element, full flow
Capacity	500 gpm each
Performance	150 mesh
Design code requirements	ASME Section VIII

LUBE OIL FILTER

Quantity	1 per diesel (4 total)
Type	Single element, throwaway cellulose cartridges
Capacity, each	500 gpm
Design Requirement	25 microns
Performance	5 microns
Design code requirements	ASME Section VIII

(1) Based on normal conditions, lube oil thermostatically controlled.

(2) Replacement Sub-Assembly(ies) purchased after 11/2000 procured in accordance with US NRC Generic Letter 89-09 and ASME Section III, Class 3 equivalent requirements.

Table 9.5-10

DIESEL GENERATOR COMBUSTION AIR INTAKE AND
EXHAUST SYSTEM DESIGN PARAMETERS

AIR INLET FILTERS	
Quantity	1 per diesel (4 total)
Type	Floor-mounted
Capacity, each	16,000 cfm
Design pressure drop	10 in wg
Rated pressure drop, clean	2 in wg maximum
Design code requirements	Manufacturer's standard
EXHAUST SILENCER	
Quantity	1 per diesel (4 total)
Type	Residential
Attenuation compatibility	Low frequencies 23-26 dB, high frequencies 18-20 dB
Design code requirements	Manufacturer's standard

Table 9.5-11

DIESEL GENERATOR COMBUSTION AIR INTAKE AND EXHAUST SYSTEM FAILURE MODES AND EFFECTS ANALYSIS

COMPONENT	MALFUNCTION	EFFECT ON SYSTEM
Inlet air Filter	Filter becomes clogged	Air supply to one diesel is lost; however, only three diesels for each unit are required for a safe shutdown following a LOCA and a LOOP. (See Note)
Inlet air piping	Rupture of pipe	Same as above
Exhaust gas piping	Rupture of pipe	Same as above
Exhaust Silencer	Failure of silencer causing flow obstruction	Same as above

Note: Any combination of three-out-of-four divisions (EDGs) is acceptable for a single failure. However, for ECCS requirements (as stated in paragraph 6.3.1.1.2), an EDG operable configuration of 2 out of 4 is also acceptable.

Table 9.5-12

LIGHTING SYSTEM
MINIMUM INTENSITIES OF ILLUMINATION

LOCATION [1]	Normal Maintained Footcandles	Emergency Lighting AC Supplied	(Footcandles) DC Supplied
Auxiliary Equipment (PGCC) Room el 289'	30	10	Silhouette
Main Control Rool el 269" – 0"	100	20	3
Fire Pump-Room (Circulating Water Pump Structure)	20	Silhouette	
Cable Spreading Room el 254' –0"	30	10	Silhouette
4 kV Switchgear Room el 239' – 0"	30	10	3
Remote Shutdown Room el 289'	30	10	3
13 kV Switchgear Area el 217' –0"	30	Silhouette	
Access from Control Room to Emerg Auxiliary Equip.	As indicated by applicable areas below	5	Silhouette
Access from Control Room to Reactor Area	As indicated by applicable areas below		
<u>Reactor Enclosure</u>			
El 177" – 0" El 201' – 0" El 217' – 0" El 253' – 0" El 283' – 0" El 313' – 0" & el 331' –0" El 352' – 0"	Refueling floor –30 Operating areas –20 Nonoperating Areas -10	Silhouette	
Diesel Generator Enclosure el 217' – 0"	30	10	3
Turbine Operating Floor	30	Silhouette	
Corridors & Stairways	20	Silhouette	Silhouette
Emergency Spray Pond Pump Structure Control Panels and Switchgear Area	20	Silhouette	
<u>Radwaste</u>			
Nonoperating Areas	10	Silhouette	
General	20	Silhouette	

[1] Locations are inclusive of vital and hazardous areas

Table 9.5-13

REMOTE EMERGENCY SHUTDOWN LOCATIONS
MINIMUM INTENSITIES OF ILLUMINATION
(footcandles)

		EMERGENCY		
LOCATION[1]	NORMAL	AC	DC	SELF-CONTAINED 8 HR UNITS
Area 8, el 289' Panels C201	30	10	3	0.5
Area 8, el 239' 4 kV Switchgear rooms	30	10	3	0.5
DG Building, el 217'	30	10	3	0.5
Various Locations Hand-Operated Valves[2] and Other Manually Actuated Devices	10	Hand-held Lanterns		0.5

(1) Access paths to the above areas are provided with at least 0.5 footcandle of emergency dc lighting by the self-contained lighting units.

(2) Valves, breakers, switches, and other devices which must be manipulated in order to achieve safe shutdown in the event of a fire. (Appendix 9A)

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LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIGURE 9.1-1

Figure 9.1-2 thru 9.1-4

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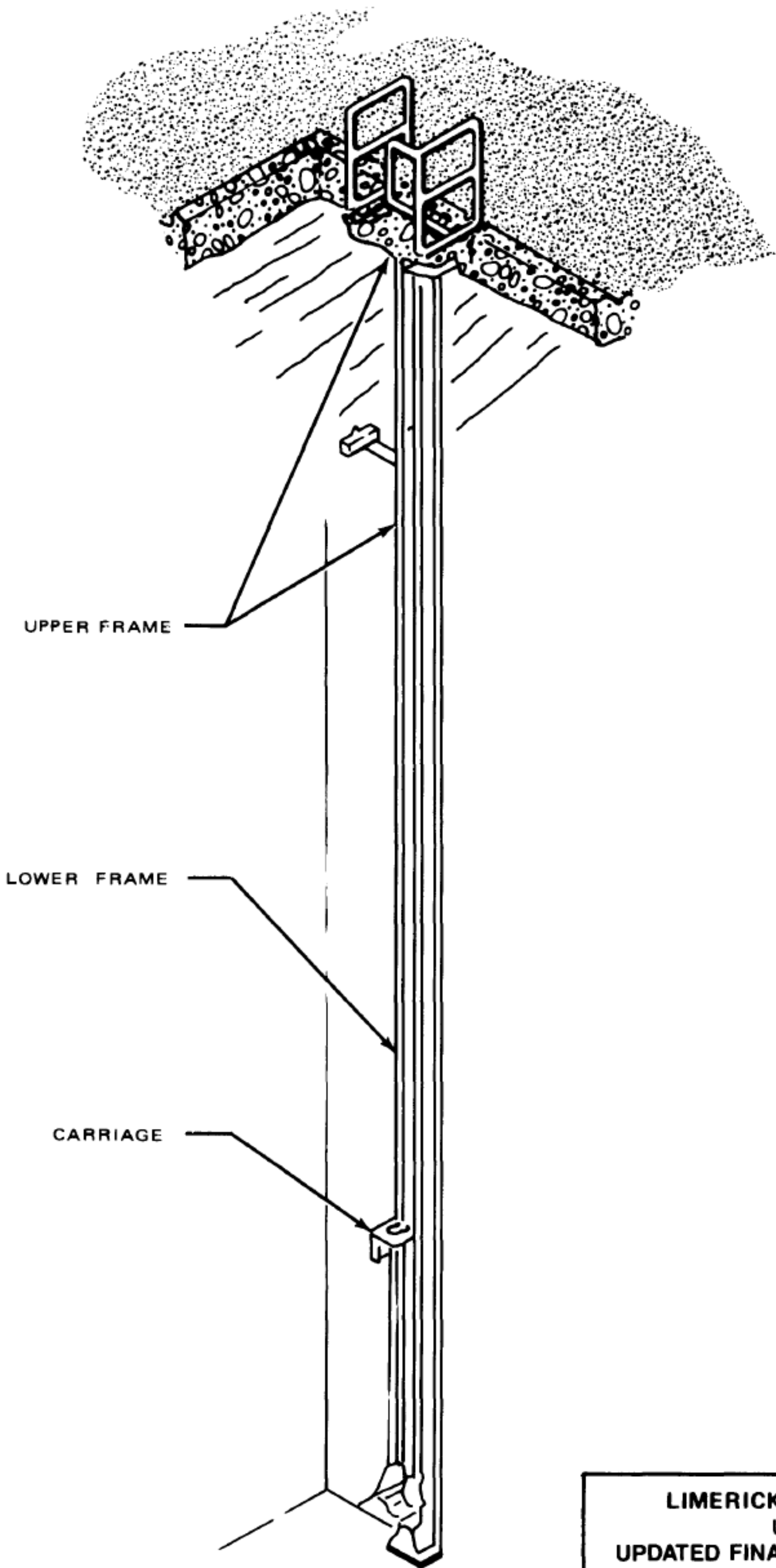

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FUEL PREPARATION MACHINE
SHOWN INSTALLED IN
FACSIMILE FUEL POOL

FIGURE 9.1-5

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UNITS 1 AND 2
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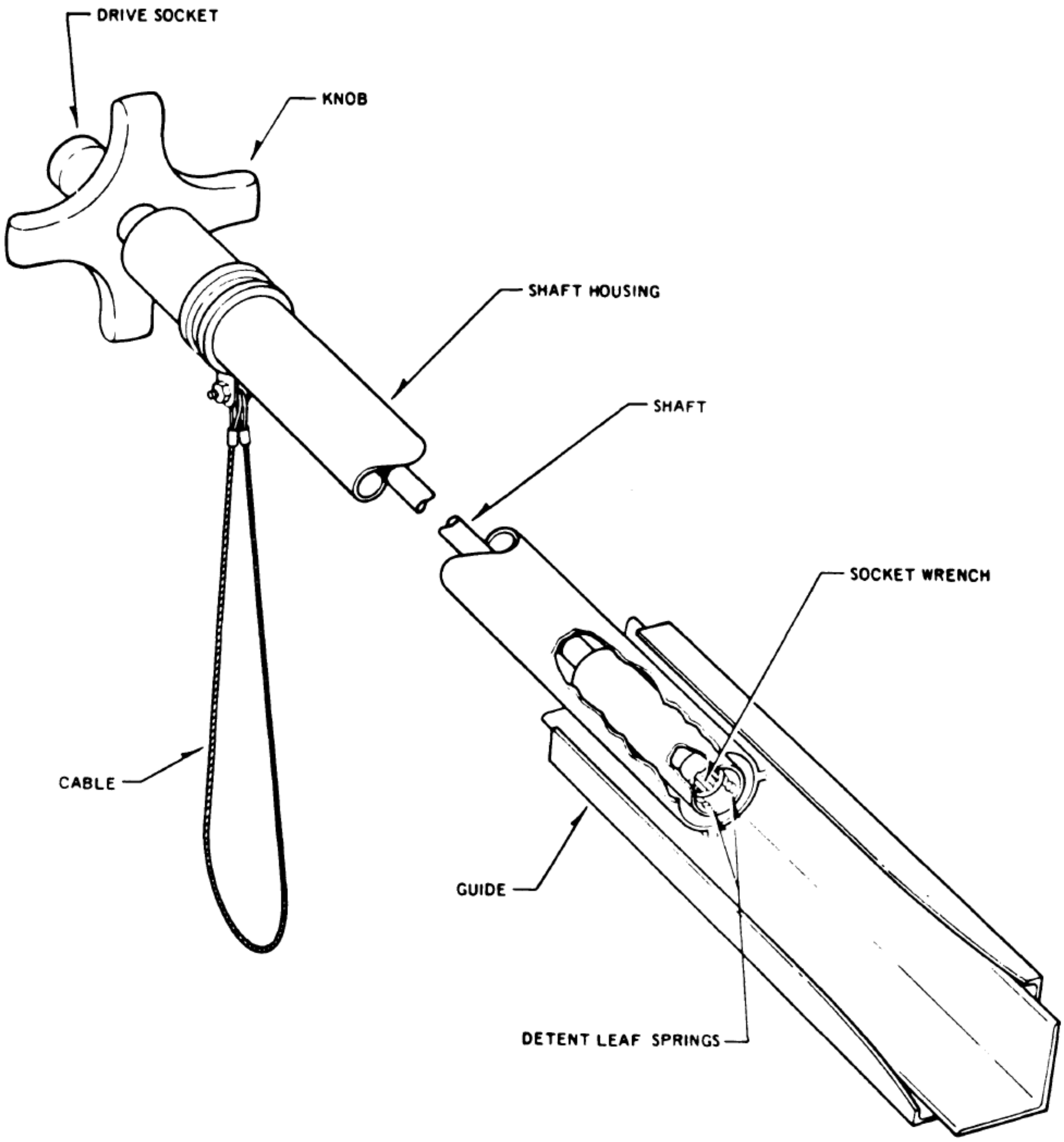
NEW FUEL INSPECTION STAND

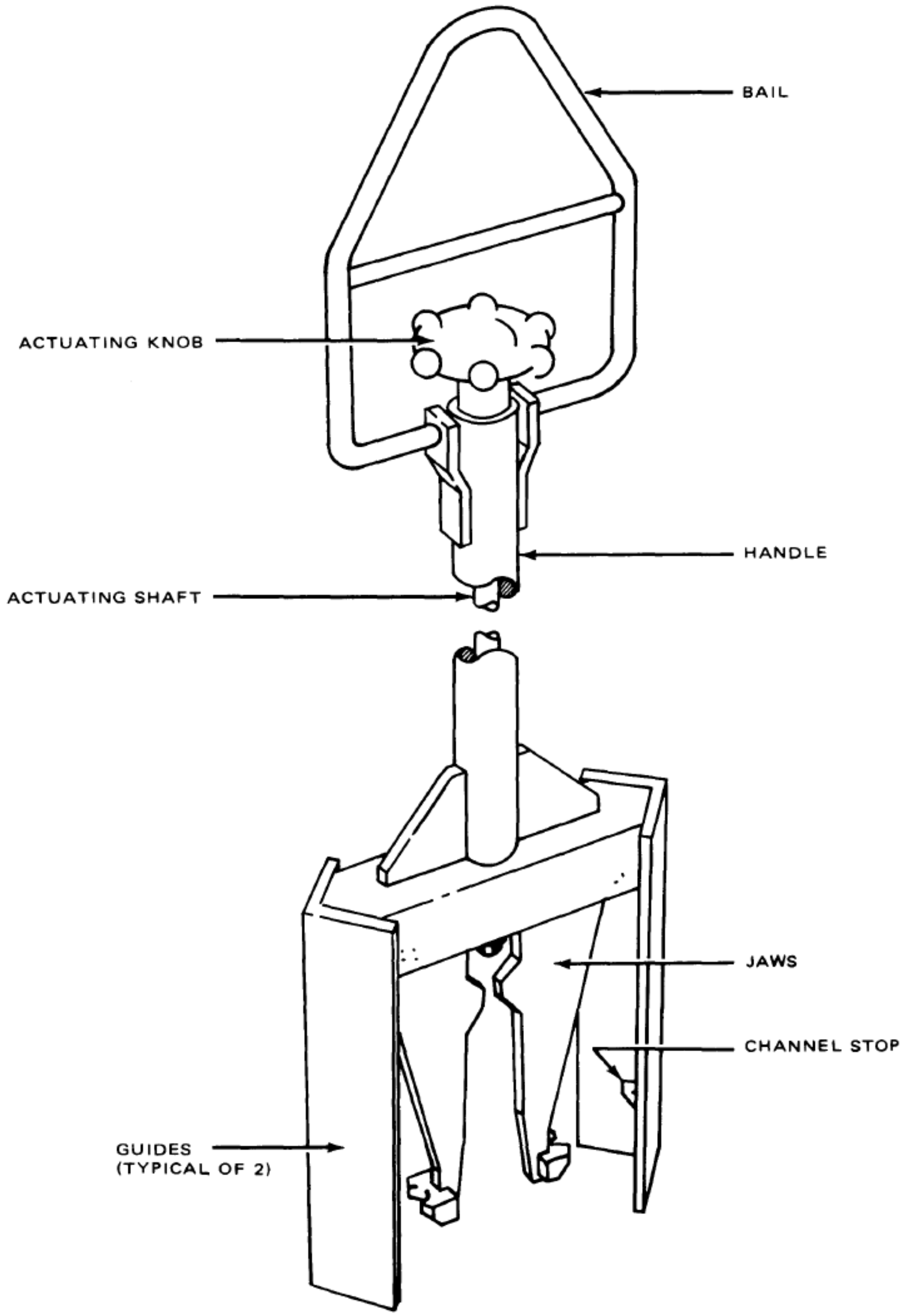
FIGURE 9.1-6 Rev. 2 July/92



LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

CHANNEL BOLT WRENCH

FIGURE 9.1-7



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UNITS 1 AND 2
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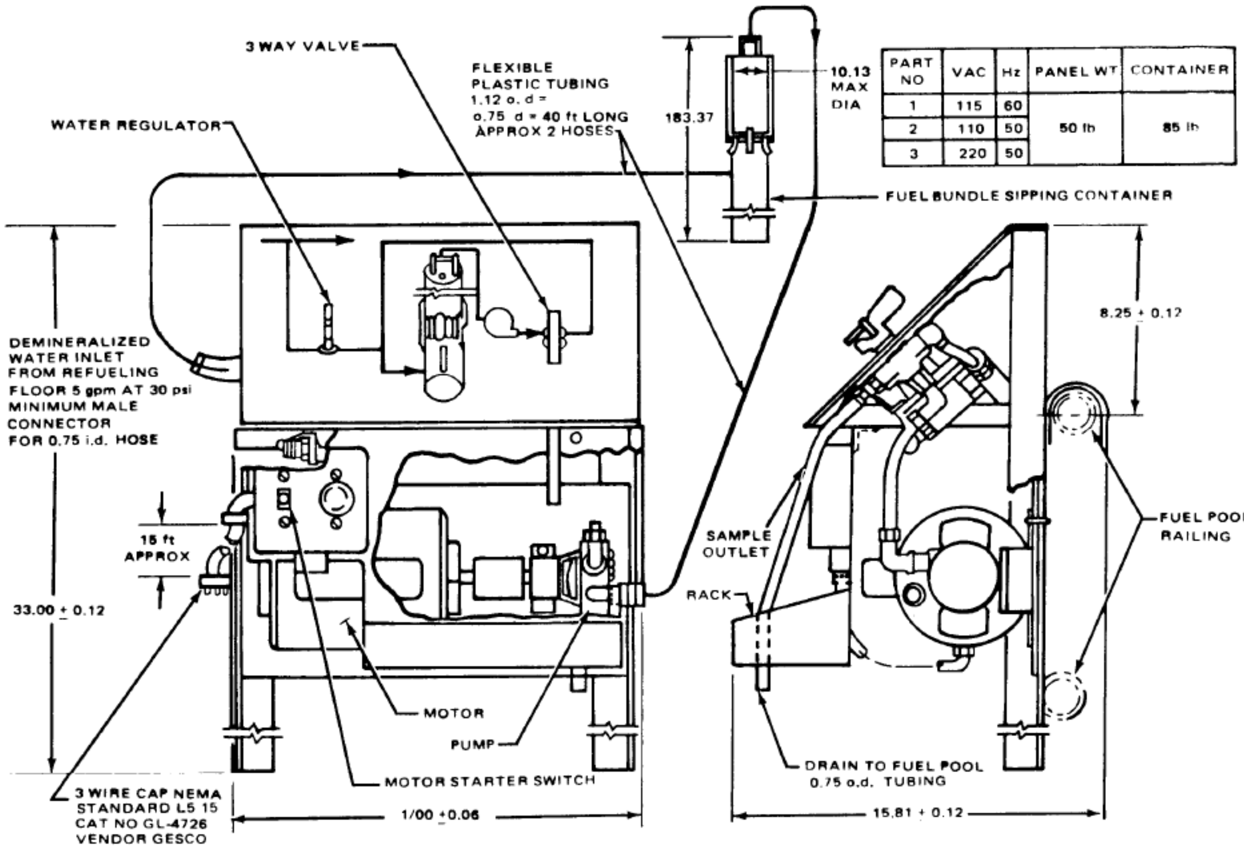
CHANNEL HANDLING TOOL

FIGURE 9.1-8



PART NO	VAC	Hz	PANEL WT	CONTAINER
1	115	60	50 lb	85 lb
2	110	50		
3	220	50		

LIMERICK GENERATING STATION
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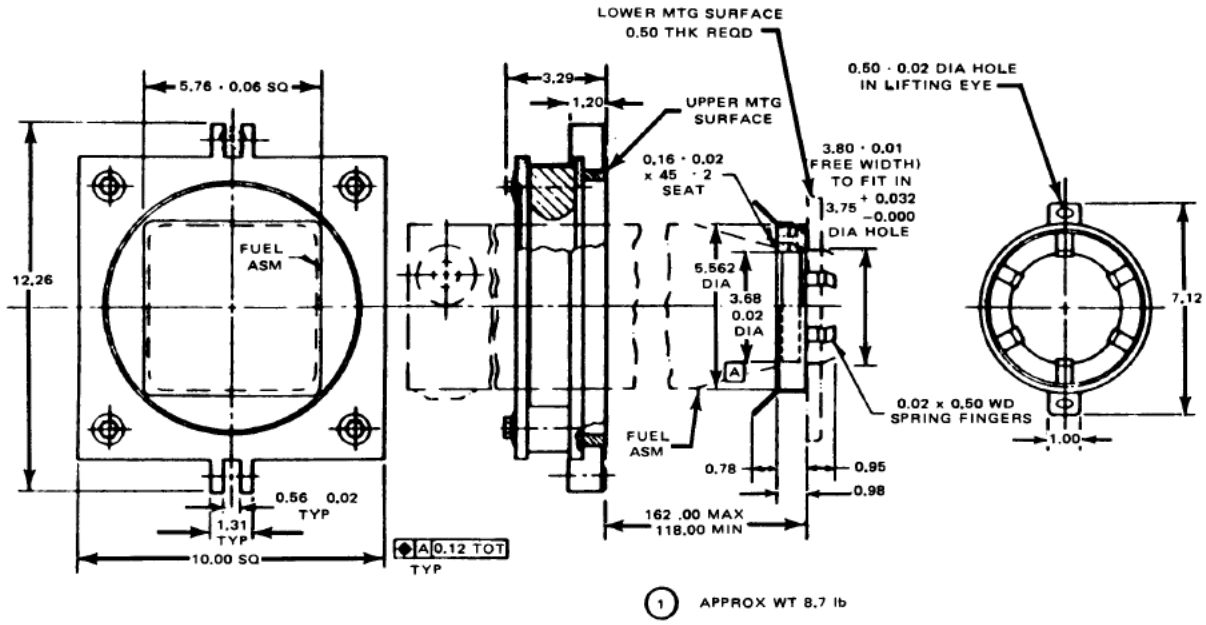
FUEL POOL SIPPER

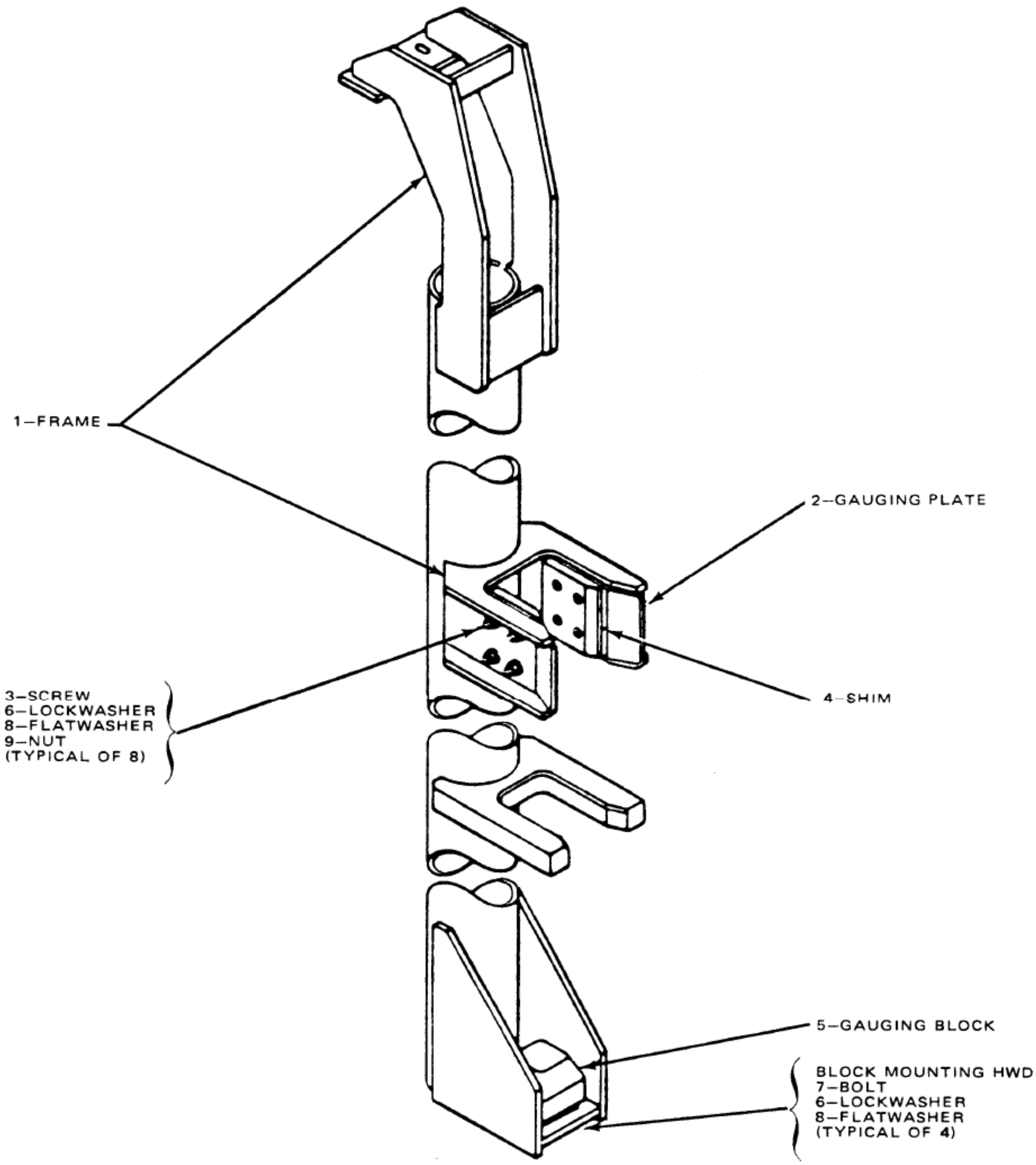
FIGURE 9.1-9



LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FUEL INSPECTION FIXTURE

FIGURE 9.1-10



LIMERICK GENERATING STATION
UNITS 1 AND 2
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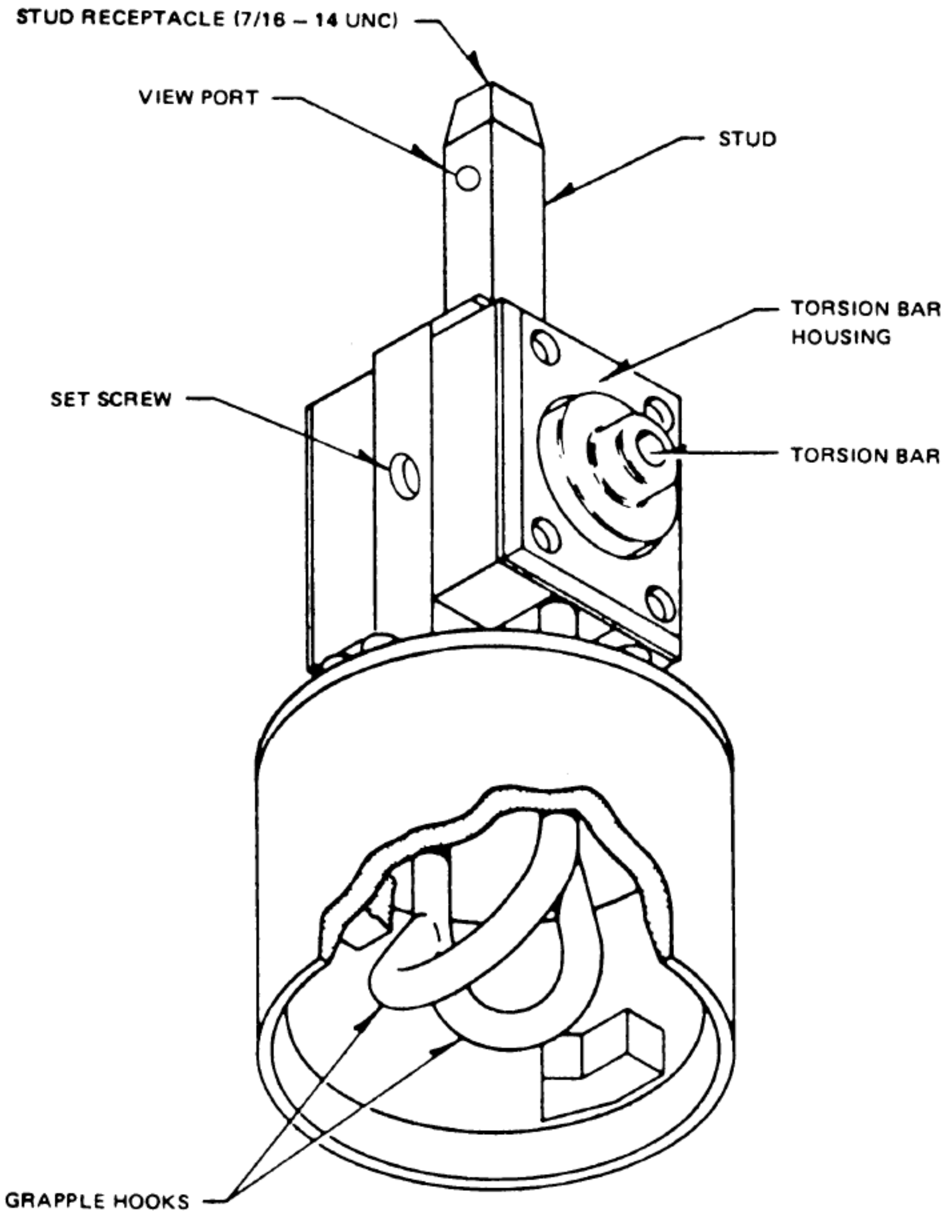
CHANNEL GAUGING FIXTURE

FIGURE 9.1-11



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GENERAL-PURPOSE GRAPPLE

FIGURE 9.1-12

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REFUELING OUTAGE FLOW DIAGRAM

FIGURE 9.1-13 Rev. 2 July/92

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UNITS 1 AND 2
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SIMPLIFIED SECTION OF NEW FUEL HANDLING FACILITIES (SECTION X-X, FIGURE 9.1-17)

FIGURE 9.1-14 Rev. 1 July/91

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LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

SIMPLIFIED SECTION OF REFUELING FACILITIES
(SECTION Y-Y, FIGURE 9.1-17)

FIGURE 9.1-15 Rev. 1 July/91

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LIMERICK GENERATING STATION
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SIMPLIFIED SECTION OF
FUEL SHIPPING FACILITIES
(SECTION Z-Z, FIGURE 9.1-17)

FIGURE 9.1-16 Rev. 1 July/91

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Figure 9.1-17

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[redacted]

Figures 9.5-1 thru 9.5-12

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APPENDIX 9A - FIRE PROTECTION EVALUATION REPORT

TABLE OF CONTENTS

APPENDIX 9A - FIRE PROTECTION EVALUATION REPORT

LIST OF TABLES

LIST OF TABLES (Cont'd)

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APPENDIX 9A - FIRE PROTECTION EVALUATION REPORT

9A.1 INTRODUCTION

On September 30, 1976, the Director of the Division of Project Management, of the Office of Nuclear Reactor Regulation, requested a re-evaluation of the fire protection program for the LGS. Attached to that document was Appendix A to BTP ASB 9.5-1, "Guidelines for Fire Protection for Nuclear Power Plants Docketed Prior to July 1, 1976". The following report was prepared in response to that request and discusses the fire protection program as it relates to nuclear safety and addresses our conformance to BTP CMEB 9.5-1 (which superseded BTP ASB 9.5-1).

It is the licensee's philosophy that fire protection be provided for all company facilities to minimize the effects of a fire. Therefore, proper fire protection was an original design objective for LGS. Responsibility for the fire protection program is vested in licensee managerial personnel in the same manner as other operating and design responsibilities. To support these responsibilities, the licensee employs qualified fire protection personnel to ensure an adequate fire protection program is provided.

Bechtel Power Corporation provided the fire protection engineers and consultants to develop the design concept, prepare specifications, and select experienced fire protection contractors. Bechtel has designed the fire protection systems for several operating nuclear plants and has a specialized staff that monitors the latest in fire protection methods.

The term "fire protection system" refers to the integrated complex of components and equipment provided for detection and suppression of fires. In addition to this system, the "fire protection program" includes the concepts of design and layout implemented to prevent or mitigate fires, administrative controls and procedures, and personnel training. The fire protection program uses a defense-in-depth approach aimed at preventing fires, minimizing the effect of any fires that occur, providing appropriate fire detection and suppression equipment, and training personnel in fire prevention and fire fighting.

LGS has been evaluated with regard to fire protection to verify that the total fire protection program provides reasonable assurance that a fire will not prevent the performance of necessary safe shutdown functions and will not cause an undue risk to the health and safety of the public.

Section 9A.2 of this report provides a general description of the fire detection and suppression systems provided for LGS. Section 9A.3 presents point-by-point comparisons of the LGS fire protection program with the guidelines set forth in BTP CMEB 9.5-1 and 10CFR50, Appendix R. Section 9A.4 provides an evaluation of the combustible loadings in the plant and the ability of specific fire barriers to withstand postulated fires. Section 9A.5 provides an evaluation of the ability to safely shut the plant down in the event of a fire in any fire area. Section 9A.6 discusses special topics. Section 9A.7 provide a listing of references associated with this document.

9A.2 FIRE PROTECTION SYSTEM DESCRIPTION

This chapter provides a description of the fire suppression and fire detection systems. The specific guidelines contained in BTP CMEB 9.5-1 are addressed in Section 9A.3.

Figure 9A-1 shows the legend and symbols for P&IDs. The P&ID for the fire protection system is shown in Figure 9A-2.

9A.2.1 FIRE PROTECTION WATER SUPPLY SYSTEMS

9A.2.1.1 Water Source

The source of water for the fire protection system is two cooling tower basins which have a capacity of 7,200,000 gallons each, for a total capacity of 14,400,000 gallons. For a system pumping capacity of 5000 gpm, this allows continuous operation of both fire pumps for 48 hours. If one cooling tower basin or supply line is not available, the remaining water source provides both fire pumps with a 24 hour supply of water. Water for the fire pumps is taken from either Unit 1 or Unit 2 cooling tower water basins through connections to the circulating water lines. Check valves are installed at the pump discharges to prevent water from one source from being pumped into the other source.

9A.2.1.2 Pumps

There are two (2) horizontal centrifugal-type fire pumps, each capable of 2500 gpm at a system head of 125 psig. The 100% capacity lead pump is electric motor-driven and the 100% capacity lag pump is diesel engine-driven. The pumps and their controllers are UL-listed.

The fire water system is capable of delivering 100 gpm per hose station at no less than 65 psig to any hose station, considering the operation of two hose stations simultaneously with the largest water demand flowing from any automatic suppression system in the vicinity of the hose stations. In addition to the 100 gpm per hose station, 300 gpm is assumed at the nearest outside fire hydrant to support manual fire fighting activities. This meets BTP section C.6.b.(11) requirement of 500 gpm for manual hose streams in addition to the largest suppression system design. When the fire pumps are not running, the standpipes are maintained full of water by a 2 inch connection to the service water system which is capable of replenishing 50 gpm for leakage. When a portion of the fire water system is activated, a low pressure switch set at 100 psig provides a signal to start the motor-driven pump automatically. If the motor-driven pump fails to start, the diesel-driven pump receives a start signal at a lower pressure signal setpoint of 95 psig to start the diesel-driven pump automatically. Both pumps are stopped manually.

A third Fire pump is provided as a backup to the two primary pumps. This pump is diesel engine driven and is placed in service as stated in the technical requirements manual bases 3/4 7.6 to satisfy the requirement of providing an alternate pump.

The electric power for the motor-driven fire pump is taken from a load center that is supplied from the non-Class 1E, 13 kV switchgear. The primary power source for the switchgear is the unit auxiliary transformer, and the secondary power source is the offsite power supplies. If the primary power source fails, the switchgear is automatically transferred to one of the two offsite power supplies. Switching from one offsite power supply to the other can be performed manually from the control room.

9A.2.5 WATER DELUGE APPLICATION FOR CHARCOAL FILTERS

Charcoal filters in the ventilation systems of the plant are provided with water deluge application systems for fire protection. The water is supplied to the filters by means of a fixed piping system.

An indicating gate valve is manually opened when a thermal sensor actuates a local alarm system and registers an alarm condition on the fire protection panels in the control room. The operation is terminated manually by shutting the gate valve.

9A.2.6 WET STANDPIPES AND HOSE STATIONS

Wet standpipes are designed for Class II service in accordance with NFPA 14. All areas in the power block are within reach of at least one effective hose stream. Each hose station has nominally 100 feet of NFPA compliant fire hose. Hose stations are located outside entrances to normally unoccupied areas, and outside both entrances of the control room. Most areas of the plant have adjustable fog nozzles that can be adjusted down to a straight stream. In areas with electrical hazards, there are adjustable fog nozzles (intrinsically safe) that will not go down below a 30 degree fog pattern.

9A.2.7 FOAM EXTINGUISHING SYSTEM

A foam system is provided for the protection of the fuel oil transfer structure and one outdoor fuel oil storage tank, and is designed in accordance with NFPA 11. The foam is educted from a foam solution tank by water from the main fire water header. Contacts are provided to annunciate operation of the system in the control room.

The one storage tank is provided with a fixed foam maker at the tank. Foam making is initiated manually from a local station after a high temperature condition at the tank has been alarmed locally and annunciated on the fire protection panels in the control room. Fire protection inside the fuel oil transfer structure is provided by a foam play pipe with hose rack. When the play pipe is removed from its holder, an electric switch located in the holder actuates a control valve to allow foam solution to enter the hose. A squeeze-type play pipe valve enables the operator to control the flow of foam.

9A.2.8 DELETED

9A.2.9 HALON EXTINGUISHING SYSTEMS

Three independent Halon extinguishing systems are provided for the raised flooring at el 289' in the control structure. Two of the systems serve the auxiliary equipment room; one system is designed to discharge simultaneously into all floor sections on the Unit 1 side of the room, and the other system is designed to discharge simultaneously into all floor sections on the Unit 2 side of the room. The third Halon system serves the remote shutdown room.

The flooring in the auxiliary equipment room and the remote shutdown room consists of 1 foot high floor sections resting on the concrete slab at el 289'. The floor sections are of all-steel construction (except for aluminum honeycomb in the floor plates) and are used for the routing of cabling to and from the electrical equipment located in the two rooms. In the auxiliary equipment room, this equipment includes the PGCC equipment, the plant computers, the Samac panels, the river

evacuation and PA panel, a tone cabinet, and fault detection equipment. The PGCC for each unit consists of floor sections that are 8 feet wide and 20 feet long, each of which has vertical panels mounted near the center of the floor section. A termination cabinet is located at one end of each PGCC floor section. Smoke detectors are located in the floor sections and termination cabinets. The equipment located in the remote shutdown room consists of the remote shutdown panels for Unit 1 and Unit 2. Smoke detectors are located within the floor sections in the remote shutdown room.

The Halon extinguishing systems are designed in accordance with NFPA 12A. Each Halon system is designed to achieve a concentration of 20% by volume with the raised flooring that it serves fully installed and secured. Each system includes two banks of Halon cylinders, each of which has sufficient capacity to maintain a 20% concentration for 20 minutes. In addition to having two banks of Halon cylinders, each system consists of distribution piping and nozzles, heat detectors, and a manual selector switch. The heat detectors serve to actuate the Halon system; a predischarge alarm is sounded first, followed by a time-delayed discharge of Halon. The manual selector switch is used to designate which of the two banks of Halon cylinders in each system will discharge automatically. Halon cylinders can be discharged manually at the hand switch location or at the cylinder locations. The unused bank of cylinders can be used to provide a supplemental discharge of Halon by manually actuating the release.

9A.2.10 WATER CURTAIN SYSTEMS

Two types of water curtain suppression systems are provided in the plant: (a) systems that subdivide certain fire areas into two zones, and (b) systems that protect floor slab openings associated with equipment hatchways in the reactor enclosures.

Water curtain systems that serve to subdivide fire areas are provided at el 217', el 253', and el 313' in the reactor enclosures. Each water curtain system consists of an OS&Y gate valve, a deluge valve, a local pull station, piping, and open sprinkler heads. Each water curtain system is actuated manually, using the local pull station to open the deluge valve. The pull station is located inside a stairwell near the location of the water curtain. Actuation of a water curtain system is sounded throughout the plant by a coded alarm. Operation of the system is terminated manually by shutting the OS&Y gate valve, which is located near the stairwell in which the pull station is located.

Each of the water curtain systems is designed to achieve a discharge density of 0.3 gpm/ft^2 at floor level. This is accomplished through the use of open sprinkler heads arranged in a linear array across the top of the water curtain location. In addition, sprinkler heads discharging horizontally inward from the sides of the water curtain are provided where necessary to achieve the design discharge density.

Water curtain systems that serve to protect the equipment hatchways in the reactor enclosures are designed similarly to the water curtain systems described above. The equipment hatchways are located in the southeast corner of the Unit 1 reactor enclosure and the southwest corner of the Unit 2 reactor enclosure. Each hatchway consists of openings in the concrete floor slabs at el 253', el 283', and el 313', with the openings arranged above one another. The opening in each slab is protected by an individual water curtain system having its distribution piping located at the underside of the slab and arranged around the perimeter of the opening. Each water curtain system is actuated manually, using a local pull station to open the deluge valve. The pull station is installed inside the stairwell near the location of the water curtain. In addition to the pull station, each water curtain system can be actuated by use of an emergency trip valve located near the system's local control panel.

9A.2.11 PORTABLE FIRE EXTINGUISHERS

Portable fire extinguishers, using extinguishing agents compatible with the combustible material in the area in which they are located, are provided throughout the plant.

9A.2.12 FIRE AND SMOKE DETECTION SYSTEM

The fire and smoke detection system is in compliance with NFPA 72A (1979). The system also complies with the requirements of NFPA 72D (1975), with the following exceptions and clarifications:

a. No device is provided for permanently recording incoming signals with the date and time of receipt. (The logging of fire events by a device for permanently recording incoming signals is not needed, because plant operating procedures will require the operator on duty in the control room to update the plant log book with the date and time of alarms from the fire detection system and of initiation of any fire suppression system.)

b. Operation and supervision of the system is not the primary function of the operators. (The control room operators are responsible for monitoring and supervision of all plant systems, including the fire detection and fire suppression systems.)

c. The locations of early warning fire and smoke detectors were established under the direction of a registered fire protection engineer. (The locations of fire and smoke detectors are in compliance with the guidance of NFPA 72E, with the clarification that ionization-type detectors in certain areas of the plant are located in accordance with subsections 4-3.1 and 4-3.1.1 of NFPA 72E. These subsections allow detector location to be determined based on engineering judgement considering ceiling shape, ceiling surfaces, ceiling height, configuration of contents, combustible characteristics, and ventilation. In areas where concrete floor slabs are supported by structural steel beams, the diffusion of ionized particles throughout the compartment volume during the incipient stage of the fire will negate the effect of beam depth and result in an appropriate level of detection capability.

d. NFPA 72D (1979) references NFPA 72E (1978) for testing of smoke detectors. NFPA 72E (1978) requires functional testing of smoke detectors semiannually. Functional testing of smoke detectors at Limerick will be done in accordance with the Technical Requirements Manual.

e. In fire area 2, the smoke detection system is upgraded to NFPA 72, 1996, Chapter 5 for detector location and spacing.

f. In fire area 98, the smoke detection system above the ASD System is upgraded to NFPA 72, 2010, Chapter 17 for detector location and spacing.

g. In fire area 25, the locations of in-cabinet and under floor smoke detectors accepted was by the NRC in their review of GE NEDO-10466A Power Generation Control Complex Design Criteria and Safety Evaluation.

h. In fire area 111, the smoke detection system above the ASD System is upgraded to NFPA 72, 2010, Chapter 17 for detector location and spacing.

Fire and smoke monitoring, detection, and alarm are accomplished by installing smoke detectors and/or heat-responsive detectors in areas where fire potential exists. Fire and smoke detection systems for annunciation are separate from fire detection systems for actuation of fire extinguishing systems, except for the 13kV Switchgear Area (Fire Area 2). The smoke detection system in the 13 kV Switchgear Area (Fire Area 2) provides early warning notification while also providing an input signal to the double interlock preaction system that provides localized protection.

Although the fire and smoke detection system is primarily a Class B system, certain portions of it are designed as Class A. The local fire detection panels in safety-related areas of the plant (control structure, reactor enclosures, and diesel generator enclosures) and in the Unit 2 turbine enclosure are Class A. All other local fire detection panels are Class B. The detector systems and local panels for the Halon system in the raised flooring of the auxiliary equipment room are Class A. The heat detector wiring and local panel wiring for all sprinkler systems is Class B. Transmitter circuits from all local panels (both Class A and Class B) back to the fire protection alarm panel near the control room are Class B. Circuits in the fire protection alarm panel (00C926) are Class B.

Both the Class A and Class B portions of the fire and smoke detection system are electrically supervised to detect circuit breaks, ground faults, and power failure. Class A portions of the system have the capability to detect fire and smoke concurrent with a single break or single ground in the detection circuit; Class B portions of the system do not have this capability. Class A detection circuits utilize a four-wire system, whereas Class B detection circuits utilize a two-wire system with end-of-line resistor. Functional testing of the supervised circuits is done in accordance with the Technical Requirements Manual.

Annunciator circuits from the local fire suppression system panels to fire protection alarm panel 00C926 and from 00C926 to control room fire protection annunciator 0BC850 are not electrically supervised. Detection of smoke or fire is registered visually on a window of control room fire protection annunciator 0AC850 (identifying the location of the fire) and is sounded throughout the plant by a coded alarm. Trouble conditions (circuit breaks, ground faults, and power failures) in the fire and smoke detection system are registered by an audible alarm in the control room and by visual indication on the affected local fire detection panel as well as on a common window of control room fire protection annunciator 00C650. Actuation of any fire suppression system is sounded throughout the plant by a coded alarm. Trouble conditions in any fire suppression system are registered by an audible alarm in the control room and by visual indication on panel 00C926 and a common window of control room fire protection annunciator 0BC850.

9A.3 COMPARISON BETWEEN LGS FIRE PROTECTION PROGRAM AND NRC GUIDELINE DOCUMENTS

9A.3.1 NRC BRANCH TECHNICAL POSITION CMEB 9.5-1

The purpose of this section is to compare the fire protection provisions of LGS Units 1 and 2 with the guidelines in BTP CMEB 9.5-1.

To identify areas of potential impact and to facilitate comparison, a matrix addressing each guideline of the BTP and relating to the plant systems, equipment, and components, is included as Section 9A.3.1.1. The matrix has extracted all suggested guidelines from the BTP and given each an item number, 1 through 255. Each item has condensed a particular guideline and makes reference to the section in the BTP where that guideline can be found. The general degree of conformance to the guideline is indicated in the COMPARISON column, using codes defined as follows:

C - indicates conformance to the guideline or conformance to its intent. Substantiating statements may be included as part of the matrix or in Section 9A.3.1.2.

AC - indicates conformance to the guidelines by alternate means or methods. The manner of conformance is included in the matrix or discussed in Section 9A.3.1.2.

NC - indicates that the plant is not in conformance and no design changes are planned. The basis for nonconformance to the guideline is included in the matrix or discussed in Section 9A.3.1.2.

NA - indicates that the guideline is not applicable to LGS Units 1 and 2. Substantiating statements are included as part of the matrix in Section 9A.3.1.1.

In the REMARKS column, additional information is provided to explain or expand on the degree of conformance. Alternatively, reference may be made to Section 9A.3.1.2 (or other sections in this report) for a more detailed discussion. The item numbers in Section 9A.3.1.2 correspond to those in Section 9A.3.1.1.

9A.3.1.1 Detailed Comparison to Branch Technical Position CMEB 9.5-1

Specific items in the following table identify compliance to specific National Fire Protection Association (NFPA) codes (or standards) for the design, installation, and maintenance of fire protection systems. The fire protection systems at Limerick

Generating Station were originally designed and installed using the criteria found in the NFPA codes in order to comply with NRC guidance. NFPA codes provide guidance for the requirements for the performance of fire protection systems. This guidance provides reasonable assurance that the fire protection systems installed at Limerick Generating Station will provide timely warning and adequate suppression for the purpose of life safety and property protection.

The Fire Protection Program at Limerick Generating Station is based on a defense-in-depth philosophy with numerous barriers in place to ensure adequate protection of plant structures, systems and components as well as the health and safety of the public in the event of a postulated fire occurring. It is recognized that there are situations in the plant where verbatim compliance with all aspects of the NFPA codes have not been satisfied. When the fire protection systems were initially designed and installed, the NFPA codes were considered guidance documents, not verbatim compliance documents. Through the use of qualified designers, engineers, and installation personnel, alternative plant configurations may have been employed to satisfy the intent of the NFPA requirements.

Deviations that could potentially affect system performance are documented in the design record for the plant. Minor deviations, while considered during initial design and installation, are not necessarily documented in the design record for the plant.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9 5-1 ITEM NO.	COMPARISON	REMARKS
	Fire Protection Program			
1.	The fire protection program should 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.	C.1.a(1)	C	
2.	The fire protection program should 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 that a fire that is not promptly extinguished by the fire suppression activities will not prevent the safe shutdown of the plant.	C.1.a(2)	C	
3.	Responsibility for the overall fire protection program should be assigned to a person who has management control over all organizations involved in fire protection activities. Formulation and assurance of program implementation may be delegated to a staff composed of personnel prepared by training and experience in fire protection and personnel prepared by training and experience in nuclear plant safety to provide a balanced approach in directing the fire protection program for the nuclear power plant.	C.1.a(3)	C	
4.	The staff should be responsible for: (a) Fire protection program requirements, including consideration of potential hazards associated with postulated fires, with knowledge of building layout and systems design. (b) Post-fire shutdown capability. (c) Design, maintenance, surveillance, and quality assurance of all fire protection features (e.g., detection systems, suppression systems, barriers, dampers, doors, penetration seals, and fire brigade equipment). (d) Fire prevention activities (administrative controls and training). (e) Fire brigade organization and training. (f) Prefire planning.	C.1.a(3)	C	
5.	The organizational responsibilities and lines of communication pertaining to fire protection should be defined through the use of organizational charts and functional description.	C.1.a(4)	C	

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
6.	Personnel qualification requirements for fire protection engineer reporting to the position responsible for formulation and implementation of the fire protection program.	C.1.a(5)	C	See Section 3.1.2
7.	The fire brigade members' qualifications should include a physical examination for performing strenuous activity, and the training described in Position C.3.d.	C.1.a(5)(b)	C	
8.	The personnel responsible for the maintenance and testing of the fire protection systems should be qualified by training and experience for such work.	C.1.a(5)(c)	C	
9.	The personnel responsible for the training of the fire brigade should be qualified by training and experience for such work.	C.1.a(5)(d)	C	
10.	The following NFPA publications should be used for guidance to develop the fire protection program; No. 4, No. 4A, No. 6, No. 7, No. 8, No. 27.	C.1.a(6)	C	
11.	On sites where there is an operating reactor and construction of modification of other units is underway, the superintendent of the operating plant should have a lead responsibility for site fire protection.	C.1.a(7)	C	
	<u>Fire Hazards Analysis</u>			
12.	The fire hazards analysis should demonstrate that the plant will maintain the ability to perform safe shutdown functions and minimize radioactive releases to the environment in the event of a fire.	C.1.b	C	See Sections 9A.4 and 9A.5.
13.	The fire hazards analysis should be performed by fire protection and reactor systems engineers to (1) consider potential in situ and transient fire hazards: (2) determine the consequences of a fire in any location in the plant; and (3) specify measures for fire prevention, detection, suppression, and containment.	C.1.b	C	
14.	Fires involving facilities shared between units should be considered.	C.1.b	C	Fires are postulated to occur in structures such as the control structure and the spray pond pump structure that are common to both reactor units.
15.	Fires due to man-made site-related events that have a reasonable probability of occurring and affecting more than one reactor unit should be considered.	C.1.b	C	See Section 9A.3.1.2.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
16.	Establishment of three levels of fire damage limits according to safety function (hot shutdown; cold shutdown; design basis accidents.)	C.1.b	C	
17.	The fire hazards analysis should separately identify hazards and provide appropriate protection in locations where safety-related losses can occur.	C.1.b	C	
	Fire Suppression System Design Basis			
18.	Total reliance should not be placed on a single fire suppression system. Backup fire suppression capability should be provided.	C.1.c(1)	C	All automatic fire suppression systems are backed up by two methods of manual extinguishment (hose stations and portable extinguishers).
19.	A single active failure or a crack in a moderate energy line in the fire suppression system should not impair both the primary and backup fire suppression capability.	C.1.c(2)	C	See Section 9A.3.1.2.
20.	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 shutdown following an SSE.	C.1.c(3)	NC	See item 155.
21.	The fire protection systems should retain their original design capability for natural phenomena of less severity and greater frequency than the most severe natural phenomena.	C.1.c(4)	C	See Section 9A.3.1.2
22.	The fire protection systems should retain their original design capability for potential man-made site-related events that have a reasonable probability of occurring at a specific plant site.	C.1.c(4)	NC	See Section 9A.3.1.2
23.	The effects of lightning strikes should be included in the overall plant fire protection program.	C.1.c(4)	C	Lightning protection is provided per NFPA No. 78
24.	The consequences of inadvertent operation or of a crack in a moderate energy line in the fire suppression system should meet the guidelines specified for moderate energy systems outside containment in SRP section 3.6.1.	C.1.c(5)	C	See Section 9A.3.1.2.
	Alternative or Dedicated Shutdown			
25.	Alternative or dedicated shutdown capability should be provided where the protection of systems whose functions are required for a safe shutdown is not provided by established fire suppression methods or by Position C.5.b.	C.1.d	C	See item 20 of Section 9A.3.2.2.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	Implementation of Fire Protection Programs			
26.	The fire protection program for buildings storing new reactor fuel and for adjacent fire areas that could affect the fuel storage area should be fully operational before fuel is received at the site.	C.1.e(1)	C	The fire protection program for the new fuel area will be completed and fully operational before fuel is received at the Site.
27.	The fire protection program for an entire reactor unit should be fully operational prior to initial fuel loading in that reactor unit.	C.1.e(2)	C	
28.	Special considerations for the fire protection program on reactor sites where there is an operating reactor and construction or modification of other units is under way.	C.1.e(3)	C	See Section 9A.3.1.2.
	Administrative Controls			
29.	Establishment of administrative controls to maintain the performance of the fire protection system and personnel.	C.2	C	
	Fire Brigade			
30.	The guidance in Regulatory Guide 1.101 should be followed as applicable.	C.3.a	C	
31.	Establishment of site brigade: minimum number of fire brigade members on each shift; qualification of fire brigade members; competence of brigade leader.	C.3.b	C	
32.	The minimum equipment provided for the brigade should consists of turnout coats, boots, gloves, hard hats, emergency communications equipment, portable ventilation equipment, and portable extinguishers.	C.3.c	C	
33.	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. 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.	C.3.c	C	See Section 9A.3.1.2.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	At least two extra air bottles should be located onsite for each self contained breathing unit. In addition, an onsite 6-hour supply of reserve air should be provided and arranged to permit quick and complete replenishment of exhausted supply air bottles as they are returned. If compressors are used as a source of breathing air, only units approved for breathing air 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.			
34.	Recommendations for the fire brigade training program.	C.3.d	AC	See Section 9A.3.1.2.
	<u>Quality Assurance Program</u>			
35.	Establishment of quality assurance programs for the fire protection systems for safety-related areas; identification of specific criteria for QA programs.	C.4	AC	See Section 9A.3.1.2.
	<u>Building Design</u>			
36.	Fire barriers with a minimum rating of 3 hours should be provided to separate safety-related systems from any potential fires in nonsafety-related areas.	C.5.a(1)(a)	C	Structures housing safety-related systems are separated from nonsafety-related structures by 3 hour rated fire walls.
37.	Fire barriers with a minimum rating of 3 hours should be provided to separate redundant divisions of safety-related systems from each other.	C.5.a(1)(b)	AC	See Section 9A.3.1.2.
38.	Fire barriers with a minimum rating of 3 hours should be provided to separate individual units on a multiunit site.	C.5.a(1)(c)	C	Fire barriers rated for 3 hours are provided to separate Unit 1 structures from Unit 2 structures. Those structures that are common to both reactor units (such as the control structure and the central portion of the turbine enclosure) are separated form the adjacent structures of both reactor enclosures by 3 hour fire barriers.
39.	Fire barriers should be provided within a single safety division to separate components or cabling that present a fire hazard to other safety-related components.	C.5.a(2)	AC	See Section 9A.3.1.2.
40.	Openings through fire barriers for pipe, conduit, and cable trays which separate fire areas should be sealed or closed to provide a fire resistance rating equal to that required of the barrier.	C.5.a(3)	AC	See Section 9A.3.1.2.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
41.	Recommendations for internal sealing of conduits penetrating fire barriers.	C.5.a(3)	AC	See Section 9A.3.1.2
42.	Fire barrier penetrations that must maintain environmental isolation or pressure differentials should be qualified by test.	C.5.a(3)	C	Fire-rated penetration seals that are also required to perform other barrier functions (such as maintaining a pressure differential) are qualified by test for all the intended functions. The fire barrier function of a penetration seal is not required to be performed simultaneously with other barrier functions.
43.	Penetration designs should utilize only noncombustible materials.	C.5.a(3)	AC	See Section 9A.3.1.2.
44.	The penetration qualification tests should use the time-temperature exposure curve specified by ASTM E-119.	C.5.a(3)	C	The time-temperature exposure curve used in qualification tests for penetration seals is a specified by ASTM E-119-73.
45.	Acceptance criteria for penetration qualification tests.	C.5.a(3)	AC	See Section 9A.3.1.2.
46.	Penetration openings for ventilation systems should be protected by fire dampers having a rating equivalent to that required of the barrier.	C.5.a(4)	AC	See Section 9A.3.1.2.
47.	Flexible air duct couplings in ventilation and filter systems should be noncombustible.	C.5.a(4)	C	
48.	Door openings in fire barriers should be protected with equivalently rated doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory.	C.5.a(5)	AC	See Section 9A.3.1.2.
49.	Fire doors should be self-closing or provided with closing mechanisms.	C.5.a(5)	AC	See Item 40 of Section 9A.3.2.2.
50.	Fire doors should be inspected semiannually to verify that automatic hold open, release, and closing mechanisms and latches are operable.	C.5.a(5)	AC	See Item 41 of Section 9A.3.2.1.
51.	Alternative means for ensuring that fire doors protect the door opening as required in case of fire.	C.5.a(5)	C	See Item 42 of Section 9A.3.2.2.
52.	The fire brigade leader should have ready access to keys for any locked fire doors.	C.5.a(5)	C	
53.	Areas protected by automatic total flooding gas suppression systems should have electrically supervised self-closing fire doors or should satisfy option (a) above.	C.5.a(5)	C	See Item 44 of Section 9A.3.2.1.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
54.	Personnel access routes and escape routes should be provided for each fire area.	C.5.a(6)	C	All fire areas are provided with personnel access routes and escape routes.
55.	Stairwells serving as escape routes, access routes for fire fighting, or access routes to areas containing equipment necessary for safe shutdown should be enclosed in masonry or concrete towers with a minimum fire rating of 2 hours and self-closing Class B fire doors.	C.5.a(6)	C	Stairwells of the type described in the guideline are each enclosed by a 2 hour rated envelope consisting or either reinforced concrete or concrete unit masonry walls with a minimum thickness of 8 inches. Each door opening that is a part of this envelope is provided with a UL Class B fire door. All penetrations through the walls of the envelope are sealed using penetration seal details that are qualified for use in 3 hour rated fire barriers.
56.	Fire exit routes should be clearly marked.	C.5.a(7)	C	
57.	Each cable spreading room should contain only one redundant safety division.	C.5.a(8)	NC	The cable spreading room for each reactor unit contains all four divisions of safety-related cabling. Raceways containing the different divisions of cabling are separated from each other in accordance with Regulatory Guide 1.75. Cabling associated with the remote shutdown panel is not routed through the cable spreading room.
58.	Cable spreading rooms should be separated from each other and from other areas of the plant by barriers having a minimum fire resistance of 3 hours.	C.5.a(8)	C	See Section 9A.3.1.2.
59.	Interior wall and structural components, thermal insulation materials, radiation shielding materials, and soundproofing should be noncombustible.	C.5.a(9)	AC	See Section 9A.3.1.2.
60.	Interior finishes should be noncombustible.	C.5.a(9)	AC	See Section 9A.3.1.2.
61	Metal deck roof construction should be non-combustible and listed as “acceptable for fire” in the UL Building Materials Directory, or listed as Class 1 in the Factory Mutual Approval Guide.	C.5.a(10)	C	See Section 9A.3.1.2.
62.	Suspended ceilings and their supports should be of noncombustible construction.	C.5.a(11)	C	See Section 9A.3.1.2.
63.	Concealed spaces should be devoid of combustibles except as noted in Position C.6.b.	C.5.a(11)	AC	See Section 9A.3.1.2.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
64.	Transformers installed inside fire areas containing safety-related systems should be of the dry-type or insulated and cooled with noncombustible liquid.	C.5.a(12)	C	All indoor transformers are either air cooled, dry-type, or cooled by noncombustible gases.
65.	Outdoor oil-filled transformers should have oil spill confinement features or drainage away from the buildings.	C.5.a(13)	C	See Section 9A.3.1.2.
66.	Outdoor oil-filled transformers should be located at least 50 feet distant from the building, or building walls within 50 feet of oil-filled transformers should be without openings and have a 3 hour fire resistance rating.	C.5.a(13)	AC	See Section 9A.3.1.2.
67.	Floor drains sized to remove expected fire fighting water flow without flooding safety-related equipment should be provided in areas where fixed water fire suppression systems are installed.	C.5.a(14)	AC	See Section 9A.3.1.2
68.	Floor drains should be provided in areas where hand hose lines may be used if such fire fighting water could cause unacceptable damage to safety-related equipment.	C.5.a(14)	AC	See Section 9A.3.1.2.
69.	Where gas suppression systems are installed, the drains should be provided with adequate seals, or the gas suppression system should be sized to compensate for the loss of the suppression agent through the drains.	C.5.a(14)	C	See Section 9A.3.1.2.
70.	Drains in areas containing combustible liquids should have provisions for preventing the backflow of combustible liquids to safety-related areas through the interconnected drain systems.	C.5.a(14)	C	See Section 9A.3.1.2.
71.	Water drainage from areas that may contain radioactivity should be collected, sampled, and analyzed before discharge to the environment.	C.5.a(14)	C	Potentially radioactive liquid wastes are collected and monitored prior to discharge.
	<u>Safe Shutdown Capability</u>			
72.	Fire damage should be limited so that one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station is free of fire damage.	C.5.b(1)	C	
73.	Fire damage should be limited so that one train of systems necessary to achieve and maintain cold shutdown conditions from either the control room or emergency control station can be repaired within 72 hours.	C.5.b(1)	C	

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
74.	Alternative means of ensuring that one train of systems necessary to achieve and maintain hot shutdown is free of fire damage.	C.5.b(2)	AC	See Item 18 of Section 9A.3.2.2.
75.	Provision of alternative or dedicated shutdown capability in certain fire areas.	C.5.b(3)	C	See Item 20 of Section 9A.3.2.2
76.	Alternative or Dedication Shutdown Capability	C.5.c	C	See Items 25 through 36 of Section 9A.3.2.
	Control of Combustibles			
77.	Safety-related systems should be separated from combustible materials where possible; where not possible, special protection should be provided to prevent a fire from defeating safety system function.	C.5.d(1)	C	To the maximum extent possible, significant concentrations of combustible materials are located outside structures containing safety-related components. In those cases for which this is not possible, such as the standby diesel generator fuel oil day tanks, special fire protection consisting of automatic fire suppression systems and/or construction capable of withstanding a fire is provided.
78.	Bulk gas storage (compressed or cryogenic) should not be permitted inside structures housing safety-related equipment. Flammable gases should be stored outdoors or in separate detached buildings.	C.5.d(2)	NC	See Section 9A.3.1.2.
79.	High pressure gas storage containers should be located with the long axis parallel to building walls.	C.5.d(2)	NC	See Section 9A.3.1.2.
80.	Use of compressed gases inside buildings should be controlled.	C.5.d(2)	C	See Section 9A.3.1.2.
81.	The use of plastic materials should be minimized. Halogenated plastics such as PVC and neoprene should be used only when substitute noncombustible materials are not available.	C.5.d(3)	C	See Section 9A.3.1.2.
82.	Storage of flammable liquids should comply with NFPA 30.	C.5.d(4)	C	Liquid fuels are stored either in aboveground tanks that have been provided with suitable fire barriers or in underground tanks.
83.	Hydrogen lines in safety-related areas should be either designed to seismic Class I requirements, or sleeved, or equipped with excess flow valves.	C.5.d(5)	C	Hydrogen lines in safety-related areas are designed to seismic Class I requirements.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	Electrical Cable Construction, Cable Trays, and Cable Penetrations			
84.	Only metal should be used for cable trays.	C.5.e(1)	C	Cable trays are of all-metal construction.
85.	Only metallic tubing should be used for conduit. Thin-wall metallic tubing should not be used.	C.5.e(1)	NC	See Section 9A.3.1.2.
86.	Flexible metallic tubing should only be used in short lengths to connect components to equipment.	C.5.e(1)	C	Flexible metallic tubing used at raceway connections to components is limited to 5 feet in length.
87.	Other raceways should be made of noncombustible materials.	C.5.e(2)	C	Gutter-type raceways are of all-metal construction.
88.	Redundant safety-related cable systems outside the cable spreading room should be separated from each other and from potential fire exposure hazards in nonsafety-related areas by 3 hour fire barriers.	C.5.e(2)	AC	See Section 9A.3.1.2.
89.	These cable trays should be provided with continuous line-type heat detectors.	C.5.e(2)	NC	See Section 9A.3.1.2.
90.	Cables should be designed to allow wetting down with fire suppression water without electrical faulting.	C.5.e(2)	C	Cable insulating systems include proprietary jacketing materials designed for wetting.
91.	Redundant safety-related cable trays outside the cable spreading room should be accessible for manual fire fighting. Manual hose stations and portable hand extinguishers should be provided.	C.5.e(2)	C	
92.	Safety-related cable trays of a single division that are separated from redundant divisions by a 3 hour fire barrier and are accessible for manual fire fighting should be protected from the effects of a potential exposure fire by providing automatic water suppression.	C.5.e(2)	AC	See Section 9A.3.1.2.
93.	Safety-related cable trays that are not accessible for manual fire fighting should be protected by an automatic water systems.	C.5.e(2)	NA	Safety-related cable trays are not routed through areas that are inaccessible for Manual fire fighting.
94.	Safety-related cable trays that are not separated from redundant divisions by 3 hour fire barriers should be protected by automatic water suppression systems.	C.5.e(2)	AC	See Section 9A.3.1.2 and Item 92 above.
95.	The capability to achieve safe shutdown considering the effects of a fire involving fixed and transient combustibles should be evaluated with and without actuation of the automatic suppression system.	C.5.e(2)	C	See Section 9A.5.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
96.	Electric cable construction should pass the flame test in IEEE 383.	C.5.e(3)	AC	See Section 9A.3.1.2.
97.	Cable raceways should be used only for cables.	C.5.e(4)	C	
98.	Miscellaneous storage and piping for combustible liquids or gases should not create a potential exposure hazard to safety-related systems.	C.5.e(5)	C	See Section 9A.3.1.2.
	Ventilation			
99.	Smoke and corrosive gases should be discharged directly outside to an area that will not affect safety-related plant areas.	C.5.f(1)	AC	See Section 9A.3.1.2.
100.	To facilitate manual fire fighting, separate smoke and heat vents should be provided in certain areas.	C.5.f(1)	NC	See Section 9A.3.1.2.
101.	Release of smoke and gases containing radioactive materials to the environment should be monitored.	C.5.f(2)	C	See Section 9A.3.1.2.
102.	Any ventilation system designed to exhaust potentially radioactive smoke or gases should be evaluated to ensure that inadvertent operation or single failures will not violate the radiologically controlled areas of the plant.	C.5.f(2)	AC	See Section 9A.3.1.2.
103.	The power supply and controls for mechanical ventilation systems should be run outside the fire areas served by the system.	C.5.f(3)	AC	See Section 9A.3.1.2.
104.	Engineered safety feature filters should be protected in accordance with the guidelines of Regulatory Guide 1.52.	C.5.f(4)	C	See Section 9A.3.1.2.
105.	Air intakes for ventilation systems serving areas containing safety-related equipment should be located remote from the exhaust air outlets and smoke vents of other fire areas.	C.5.f(5)	C	Air intakes serving areas which contain safety-related equipment are remote from exhaust and smoke outlets of other fire areas.
106.	Stairwells should be designed to minimize smoke infiltration during a fire.	C.5.f(6)	C	Stair towers are provided with self-closing doors, which will minimize smoke infiltration during a fire.
107.	Where total flooding gas extinguishing systems are used, ventilation dampers, should be controlled in accordance with NFPA 12 and NFPA 12A.	C.5.f(7)	C	See Section 9A.3.1.2.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	Lighting and Communication			
108.	Fixed self-contained lighting units with individual 8 hour battery power supplies should be provided in areas that must be manned for safe shutdown and for access and egress routes to and from all fire areas.	C.5.g(1)	AC	See Item 108 of Section 9A.3.1.2, and Item 23 of Section 9A.3.2.2.
109.	Sealed beam battery-powered portable hand lights should be provided for emergency use.	C.5.g(2)	C	Portable lights are provided
110.	Fixed emergency communications independent of the normal plant communication system should be installed at preselected stations.	C.5.g(3)	AC	See Section 9A.3.1.2.
111.	A portable radio communications system should be provided for use by the fire brigade and other operations personnel required to achieve safe plant shutdown.	C.5.g(4)	AC	See Section 9A.3.1.2.
	Fire Detection			
112.	Detection systems should be provided for all areas that contain or present a fire exposure to safety-related equipment.	C.6.a(1)	AC	See Section 9A.3.1.2.
113.	Fire detection systems should comply with the requirements of Class A systems as defined in NFPA 72D and Class I circuits as defined in NFPA 70.	C.6.a(2)	AC	The fire and smoke detection system is partially Class A and partially Class B, as described in Section 9A.2.12. (Class A and Class B systems are defined in the 1975 edition of NFPA 72D.)
114.	Fire detectors should be selected and installed in accordance with NFPA 72E.	C.6.a(3)	C	See Section 9A.2.12.
115.	Testing of pulsed line-type heat detectors should demonstrate that the frequencies used will not affect the actuation of protective relays in other plant systems.	C.6.a(3)	NA	Pulsed line-type detectors are not used in the plant.
116.	Fire detection systems should give audible and visual alarm and annunciation in the control room.	C.6.a(4)	C	

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
117.	Where zoned detection systems are used in a given fire area, local means should be provided to identify which zone has actuated.	C.6.a(4)	C	A coding system has been established for all fire alarms in the plant so that the location of a fire can be determined from the sound of the alarm. A list of these codes and their corresponding detection areas will be posted at each fire alarm pull station.
118.	Local audible alarms should sound in the fire area.	C.6.a(4)	C	Fire alarms are annunciated throughout the plant, as well as in the local area in which a fire detector has been actuated.
119.	Fire alarms should be distinctive and unique so they will not be confused with any other plant system alarms.	C.6.a(5)	C	
120.	Primary and secondary power supplies which satisfies the provisions of section 2220 of NFPA 72D should be provided for the fire detection system and for electrically operated control valves for automatic suppression systems.	C.6.a(6)	AC	See Section 9A.3.1.2.
	<u>Fire Protection Water Supply Systems</u>			
121.	An underground yard fire main loop should be installed to furnish anticipated water requirements.	C.6.b(1)	C	An underground yard fire main loop has been provided and is in compliance with NFPA 24.
122.	Type of pipe and water treatment should be design consideration with tuberculation as one of the parameters.	C.6.b(1)	C	The yard fire main loop utilizes cement-lined cast iron pipe to reduce tuberculation. Water used fire protection service meets the requirements of NFPA 22 and does not require treatment.
123.	Means of inspecting and flushing the systems should be provided.	C.6.b(1)	C	Following its installation, the yard fire main loop was flushed and tested in accordance with NFPA 24 (1973), sections 98 and 99. Flushing of the loop is accomplished through the use of sectional control valves to direct the flow and yard hydrants to serve as discharge points.
124.	Approved visually indicating sectional control valves should be provided to isolate portions of the main for maintenance or repair.	C.6.b(2)	C	Postindicator valves provided for sectionalized control and isolation of portions of the yard fire main loop.
125	Valves should 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 system.	C.6.b(3)	C	A key-operated gate valve with a curb box is provided in each lateral from the yard fire main loop to a fire hydrant.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
126.	The fire main system piping should be separate from service or sanitary water system piping.	C.6.b(4)	C	See Section 9A.3.1.2.
127.	A common yard fire main loop may serve multiunit nuclear power plant sites if cross-connected between units. Sectional control valves should permit maintaining independence of the loop around each unit.	C.6.b(5)	C	The yard fire main loop is common to both reactor units. The loop is cross-connected between units and provided with sectional control valves.
128.	A sufficient number of pumps should be provided to ensure that 100% capacity will be available assuming failure of the largest pump or a LOOP.	C.6.b(6)	C	Two fire pumps (one diesel-driven and one electric motor-driven) are provided, each capable of supplying 100% of the systems flow requirements.
129.	Individual fire pump connections to the yard fire main loop should be separated with sectionalizing valves between connections.	C.6.b(6)	C	
130.	Each pump and its driver and controls should be separated from the remaining fire pumps by a 3 hour fire wall.	C.6.b(60	C	
131.	The fuel for the diesel fire pump should be separated so that it does not provide a fire source exposing safety-related equipment.	C.6.b(6)	C	The diesel oil day tank is located in a curbed area within the diesel-driven fire pump compartment. This compartment is located in the circulating water pump structure, which is separated from all structures containing safety-related equipment.
132.	Alarms indicating pump running, driver availability, failure to start, and low fire main pressure should be provided in the control room.	C.6.b(6)	AC	Pump running, driver availability, and failure to start are annunciated in the control room. Fire main pressure is indicated in the control room but not annunciated.
133.	The fire pump installation should conform to NFPA 20.	C.6.b(6)	C	
134.	Outside manual hose installation should be sufficient to provide an effective hose stream to any onsite location where fixed or transient combustibles could jeopardize safety-related equipment. Hydrants should be installed approximately every 250 feet on the yard main system.	C.6.b(7)	AC	Hydrants are space between 250 rod and 300 feet apart along the fire main loop.
135.	Recommendations for hose houses and hose carts.	C.6.b(7)	AC	See Section 9A.3.1.2.
136.	Threads compatible with those used by local fire departments should be provided on all hydrants, hose couplings, and standpipe risers.	C.6.b(8)	C	

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
137.	Two separate, reliable freshwater supplies should be provided.	C.6.b(9)	C	The cooling tower basins of the Unit 1 and Unit 2 circulating water systems are used as the two sources of water for the fire pumps.
138.	Recommendations for tanks used to supply fire protection water.	C.6.b(9)	NA	Tanks are not utilized for fire protection Water supply.
139.	Recommendations for tanks used to supply fire protection water.	C.6.b(10)	NA	Tanks are not utilized for fire protection water supply.
140.	The fire water supply should be based on the largest expected flow rate for a period of 2 hours, but not less than 300,000 gallons.	C.6.b(11)	C	See Section 9A.3.1.2.
141.	The fire water supply should be capable of delivering the design demand over the longest route of the water supply system.	C.6.b(11)	C	In the event that a portion of the yard fire main loop is valved out of service, the fire pumps are capable of delivering the design demand over the longest route of the water supply system.
142.	Recommendations for freshwater lakes or ponds used to supply fire protection water.	C.6.b(12)	NA	Lakes or ponds are not utilized for fire protection water supply.
143.	Recommendations concerning use of other water systems for fire protection and the ultimate heat sink.	C.6.b(13)	NA	The fire protection system and the ultimate heat sink do not share a common water supply.
144.	Recommendations concerning use of other water systems as the source of fire protection water.	C.6.b(14)	AC	See Section 9A.3.1.2.
145.	Recommendations concerning connection of sprinkler systems and manual hose station standpipes to the yard fire main loop.	C.6.c(1)	C	See Item 19.
146.	Each sprinkler and standpipe system should be equipped with OS&Y gate valve or other approved shutoff valve and water flow alarm.	C.6.c(1)	AC	See Section 9A.3.1.2.
147.	Safety-related equipment should be protected from sprinkler discharge if such discharge could result in unacceptable damage to the equipment.	C.6.c(1)	AC	See Section 9A.3.1.2.
148.	Control and sectionalizing valves in the fire water systems should be electrically supervised (with indication in the control room) or administratively controlled.	C.6.c(2)	C	See Section 9A.3.1.2.
149.	All valves in the fire protection systems should be periodically checked to verify position.	C.6.c(2)	C	

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
150.	Fixed water extinguishing systems should conform to requirements of NFPA 13 and NFPA 15.	C.6.c(3)	AC	See Section 9A.3.1.2.
151.	Recommendations for interior manual hose installations.	C.6.c(4)	NC	See Section 9A.3.1.2.
152.	Individual standpipes should be at least 4 inches in diameter for multiple hose connections and 2.5 inches in diameter for single hose connections.	C.6.c(4)	AC	See Section 9A.3.1.2.
153.	Standpipe and hose station installations should follow the requirements of NFPA 14.	C.6.c(4)	C	
154.	Hose stations should be located as dictated by the fire hazards analysis to facilitate access and use for fire fighting operations.	C.6.c(4)	C	
155.	Recommendations concerning seismic design of standpipes and hose connections.	C.6.c(4)	NC	See Section 9A.3.1.2.
156.	Recommendations concerning hose nozzle selection.	C.6.c(5)	C	
157.	Fire hose should be hydrostatically tested in accordance with NFPA 1962. Hose stored in outside hose houses should be tested annually. Interior standpipe houses should be tested every 3 years.	C.6.c(6)	C	
158.	Consideration of foam suppression systems for flammable liquid fires.	C.6.c(7)	C	See Section 9A.3.1.2.
	<u>Halon Suppression Systems</u>			
159.	Halon fire extinguishing systems should comply with NFPA 12A ad NFPA 12B. Only UL-Listed or FM-approved agents should be used.	C.6.d	C	Design and installation of the Halon 1301 system is in accordance with NFPA 12A.
160.	Provisions for locally disarming automatic Halon systems should be key-locked and under administrative control. Automatic Halon systems should not be disarmed unless controls as described in Position C.2.j are provided.	C.6.d	NC	Administrative controls do not exist permitting disarming of the Halon system.
161.	Preventive maintenance and testing of the systems, including check-weighing of the Halon cylinders, should be done at least quarterly.	C.6.d	C	

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
162.	Considerations for design of Halon suppression systems.	C.6.d	C	See Section 9A.3.1.2.
	Carbon Dioxide Suppression Systems			
163.	Carbon dioxide extinguishing systems should comply the requirements of NFPA 12.	C.6.e	NA	
164.	Carbon dioxide extinguishing systems should comply with with a predischarge alarm system and a discharge delay to permit personnel egress.	C.6.e	NA	
165.	Provisions for locally disarming automatic carbon dioxide systems should be key-locked and under administrative control. The systems should not be disarmed unless controls as described in Position C.2.c are provided.	C.6.e	NA	
166.	Considerations for design of carbon dioxide suppression systems.	C.6.e	NA	
167.	Fire extinguishers should be provided in areas that contain, or could present a fire exposure hazard to, safety-related equipment in accordance with NFPA 10.	C.6.f	C	See Section 9A.3.1.2
168.	Dry chemical extinguishers should be installed with due consideration given to possible adverse effects on safety-related equipment.	C.6.f	C	
	Primary and Secondary Containment			
169.	Fire protection for the primary and secondary containment areas should be provided for hazards identified by the fire hazards analysis.	C.7.a(1)	C	Fire hazards have been identified, as discussed in Section 9A.4, and fire suppression system have been provided

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
				accordingly. The types and locations of suppression systems are identified in Table 9A.1 and Figures 9A-4 through 9A-12.
170.	Because of the general inaccessibility of primary containment during normal plant operation, protection should be provided by automatic fixed systems.	C.7.a(1)	NC	See Section 9A.3.1.2.
171.	Operation of the fire protection systems should not compromise the integrity of the containment or other safety-related systems.	C.7.a(1)(a)	C	The fire protection systems does not penetrate the primary containment boundary. Also see Item 24.
172.	Recommendations for protection of safety-related cables and equipment inside noninerted containments.	C.7.a(1)(b)	NA	The primary containment is inerted with nitrogen during reactor operation.
173.	Recommendations concerning fire detection inside the primary containment.	C.7.a(1)(c)	NC	See Section 9A.3.1.2.
174.	For BWR drywells, standpipe and hose stations should be placed outside the drywell with adequate lengths of hose, no longer than 100 feet, to reach any location inside the drywell with an effective hose stream.	C.7.a(1)(d)	C	The hose reels located nearest the drywell entrances are equipped with a 100 foot length of fire hose. To supplement this hose length, a hose station equipped with enough hose to reach any location within the drywell is located near each drywell entrance.
175.	Recommendations for reactor coolant pump oil collection system in noninerted containments.	C.7.a(1)(e)	NA	The primary containment is inerted with nitrogen during normal reactor operation.
176.	For secondary containment areas, cable fire hazards that could affect safety should be protected as described in Position C.5.e(2).	C.7.a(1)(f)	--	See Items 88 through 95.
177.	Self-contained breathing apparatus should be provided near the containment entrances for fire fighting and damage control personnel. These units should be independent of any breathing apparatus provided for general plant activities.	C.7.a(2)	C	See Item 33.
	<u>Control Room Complex</u>			
178.	The control room complex should be separated from other areas of the plant by 3 hour rated fire barriers.	C.7.b	C	The control room is separated from other parts of the control structure by 3 hour rated floor slabs at el 269' and el 289'. Three hour rated walls at the north, south, east, and west sides of the control room separate it from the reactor enclosures and turbine enclosures.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
179.	Recommendations concerning peripheral rooms in the control room complex.	C.7.b	NC	See Section 9A.3.1.2.
180.	Recommendations concerning the use of Halon and carbon dioxide flooding systems in the peripheral rooms.	C.7.b	NA	The peripheral rooms adjacent to the control room are not provided with Halon or carbon dioxide flooding systems.
181.	Recommendations concerning manual fire fighting capability in the control room.	C.7.b	C	See Section 9A.3.1.2.
182.	Recommendations concerning fire detection in the control room.	C.7.b	AC	See Section 9A.3.1.2.
183.	Breathing apparatus for control room operators should be readily available.	C.7.b	C	See Item 33.
184.	Recommendations concerning control room ventilation.	C.7.b	C	See Section 9A.3.1.2.
185.	All cables that enter the control room should terminate in the control room.	C.7.b	C	
186.	Cables in under-floor and ceiling spaces should meet the separation criteria necessary for fire protection.	C.7.b	C	See Section 9A.3.1.2.
187.	Air handling functions should be ducted separately from cable runs in such spaces.	C.7.b	C	The space above the suspended ceiling in the control room is not used as an air plenum for ventilation of the control room. Ventilation air is deducted through the space above the suspended ceiling.
188.	Fully enclosed electrical raceways located in under-floor and ceiling spaces, if over 1 square foot in cross-sectional area, should have automatic fire suppression inside.	C.7.b	C	None of the fully enclosed raceways in the space above the suspended ceiling in the control room has a cross-sectional area exceeding 1 square foot. The raceways in the raised flooring of the auxiliary equipment room are provided with an automatic Halon suppression system, as described in Section 9A.2.9.
189.	Recommendations concerning automatic fire suppression in under-floor and ceiling spaces.	C.7.b	AC	See Section 9A.3.1.2.
190.	There should be no carpeting in the control room.	C.7.b	NC	See Section 9A.3.1.2.
	<u>Cable Spreading Room</u>			
191.	Recommendations concerning automatic fire suppression in the cable spreading room.	C.7.c	C	See Section 9A.3.1.2.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
192.	Open-head deluge and open directional spray systems should be zoned.	C.7.c	NA	Open-head water suppression systems are not used in the cable spreading room.
193.	Cable spreading rooms should have at least two remote and separate entrances for access by fire brigade personnel.	C.7.c(1)	C	
194.	Cable spreading rooms should have an aisle separation between tray stacks at least 3 feet wide and 8 feet high.	C.7.c(2)	NC	Cable trays in the cable spreading rooms are arranged to provide aisleways with a minimum headroom approximately 6.5 feet high and and a minimum width between tray stacks of approximately 3 feet. At certain locations, structural supports for the cable trays reduce the aisle width to a minimum of 17 inches. All points in the cable spreading rooms can be reached by an effective hose stream.
195.	Cable spreading rooms should have hose stations and portable extinguishers installed immediately outside the room.	C.7.c(3)	C	The locations of hose stations in the vicinity of the cable spreading rooms are shown in Figure 9A.7.
196.	Cable spreading rooms should have area smoke detection.	C.7.c(4)	C	The fire and smoke detection system is described in Section 9A.2.12. The number of detectors located in each fire area is listed in Table 9A.1.
197.	Cable spreading rooms should have continuous line-type heat detectors for cable trays inside the cable spreading room.	C.7.c(5)	NC	Continuous line-type heat detectors are not used in cable trays. Smoke detectors are provided in the cable spreading room (as specified in Table 9A-1) and will provide early warning for cable tray fires occurring in the cable spreading room. See Item 89 for further discussion.
198.	Drains to remove fire-fighting water should be provided.	C.7.c	C	
199.	When gas systems are installed, drains should have adequate seals or the gas extinguishing system should be sized to compensate for losses through the drains.	C.7.c	NA	
200.	A separate cable spreading room should be provided for each redundant division.	C.7.c	NC	See Item 57.
201.	Cable spreading rooms should not be shared between reactors.	C.7.c	C	Each reactor unit is provided with its own separate cable spreading room.
202.	Each cable spreading room should be separated from the others and from other areas of the plant by 3 hour fire barriers.	C.7.c	C	See Item 58 of Section 9A.3.1.2.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
203.	The ventilation system for the cable spreading room should be designed to isolate the area upon actuation of the gas extinguishing system.	C.7.c	NA	
204.	Separate manually actuated smoke venting that is operable from outside the room should be provided for the cable spreading room.	C.7.c	C	Portable smoke ejectors are used to clear smoke and toxic gases from the cable spreading rooms.
	Plant Computer Rooms			
205.	Recommendations concerning fire protection for computers performing safety-related functions.	C.7.d	NA	The plant computer is not safety-related.
206.	Nonsafety-related computers outside the control room should be separated from safety-related areas by 3 hour fire barriers and should be protected as needed to prevent damage to safety-related equipment.	C.7.d	AC	The plant computer is nonsafety-related and is located in the auxiliary equipment room. The auxiliary equipment room is separated from other areas of the plant by 3 hour fire barriers, but the computer is not separated (other than by distance) from safety-related panels in the auxiliary equipment room. Automatic fire suppression for the raised flooring in the auxiliary equipment room is discussed in Section 9A.2.9.
	Switchgear Rooms			
207.	Switchgear rooms containing safety-related equipment should be separated from the remainder of the plant by 3 hour fire barriers. Redundant switchgear safety divisions should be separated from each other by 3 hour fire barriers.	C.7.e	AC	The safety-related switchgear rooms at el 239’ in the control structure are separated from each other and from the remaining areas of the plant by 3 hour rated fire walls. The concrete slab above these rooms is a 3 hour rated barrier, and the slab below the room is capable of a 3 hour fire rating with the exception of exposed structural steel members supporting the slabs.
208.	Automatic fire detectors should alarm and annunciate in the control room and alarm locally.	C.7.e	C	Each safety-related switchgear room is provided with smoke and heat detectors that annunciate in the control room and alarm locally.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
209.	Fire hose stations and portable fire extinguishers should be readily available outside the switchgear rooms.	C.7.e	C	
210.	Drains should be provided to prevent water accumulation from damaging safety-related equipment.	C.7.e	AC	See Section 9A.3.1.2.
211.	Remote manually actuated ventilation should be provided for venting smoke when manual fire suppression effort is needed.	C.7.e	NC	Ventilation features separate from the normal ventilation system are not provided for the switchgear rooms. Smoke removal can be accomplished using portable exhaust fans, if necessary.
	Remote Safety-Related Panels			
212.	Recommendations concerning separation and electrical isolation of remote safety-related panels.	C.7.f	AC	See Section 9A.3.1.2.
213.	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 readily available in the general area.	C.7.f	C	
	Safety-Related Battery Rooms			
214.	Safety-related battery rooms should be separated from each other and other areas of the plant by 3 hour rated fire barriers.	C.7.g	AC	The safety-related battery room are located in the control structure. These rooms are separated from each other and from the remaining areas of the plant by 3 hour rated fire walls. The floor slabs above and below the battery rooms are capable of 3 hour fire ratings with the exception of exposed structural steel members supporting the concrete slabs.
215.	DC switchgear and inverters should not be located in safety-related battery rooms.	C.7.g	AC	See section 3.1.2.
216.	Automatic fire detection should be provided to annunciate in the control room and alarm locally.	C.7.g	C	Each safety-related battery room is provided with smoke and heat detectors that annunciate in the control room and alarm locally.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
217.	Ventilation system in the battery rooms should be capable of maintaining the hydrogen concentration below 2%.	C.7.g	C	See Section 9A.3.1.2.
218.	Loss of ventilation should be alarmed in the control room.	C.7.g	C	See Section 9A.3.1.2.
219.	Portable extinguishers and manual hose stations should be readily available outside the battery rooms.	C.7.g	C	
	Turbine Building			
220.	The turbine building should be separated from adjacent structures containing safety-related equipment by 3 hour fire barriers.	C.7.h	C	The turbine enclosure is separated from the reactor enclosure and control structure by 3 hour rated fire walls.
221.	The fire barriers should be designed so as to maintain structural integrity in the event of collapse of the turbine structure.	C.7.h	C	See Section 9A.3.1.2.
222.	Openings and penetration in the fire barrier should be minimized and should not be located where the turbine oil system or generator hydrogen cooling system creates a fire exposure hazard to the barrier.	C.7.h	C	See Section 9A.3.1.2.
	Diesel Generator Areas			
223.	Diesel generators should be separated from each other and from other areas of the plant by 3 hour rated fire barriers.	C.7.i	C	The individual diesel generator cells, each of which encloses a single diesel generator, are separated from adjacent fire areas by 3 hour rated barriers consisting of 24 inch thick reinforced concrete walls and 18 inch thick reinforced concrete slabs. Each door opening in the 3 hour rated walls is provided with a UL Class A fire door. All penetration through the 3 hour rated walls and floor slabs are sealed using penetration seal details that are qualified for use in 3 hour rated fire barriers.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
224.	Automatic fire suppression should be installed to combat diesel generator or lubricating oil fires. Such systems should be designed for operation when the diesel is running without affecting the diesel.	C.7.i	AC	See Section 9A.3.1.2.
225.	Automatic fire detection should be provided to annunciate in the control room and alarm locally.	C.7.i	C	
226.	Portable extinguishers and manual hose stations should be readily available outside the area.	C.7.i	C	Portable extinguishers are available outside the diesel generator cells. Fire hydrants located in the yard can reach any area of the diesel generator cells.
227.	Drainage for fire fighting water and means for local manual venting of smoke should be provided.	C.7.i	AC	See Section 9A.3.1.2.
228.	Day tanks with total capacity up to 1100 gallons are permitted in the diesel generator area under specified conditions.	C.7.i	C	The day tank for each diesel generator has a capacity of 850 gallons.
229.	The day tank should be located in a separated enclosures with a 3 hour fire rating.	C.7.i	C	The day tank for each diesel generator is located in a vault that is separated from the remainder of the diesel generator cell by 3 hour rated fire walls.
230.	The day tank enclosures should be capable of containing the entire contents of the tank.	C.7.i	C	
231.	The day tank enclosure should be protected by an automatic fire suppression system.	C.7.i	C	The preaction sprinkler system provided in each diesel generator cell includes coverage of the day tank vault.
	Diesel Fuel Oil Storage Areas			
232.	Recommendations concerning diesel fuel oil tanks.	C.7.j	C	Each diesel generator is provided with a diesel fuel oil storage tank that has a capacity of 41,500 gallons. All eight tanks are located adjacent to each other and are buried underground.
233.	Above-ground tanks should be protected by an automatic fire suppression system.	C.7.j	NA	See Item 232.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	Safety Related Pumps			
234.	Pump houses and rooms housing redundant safety-related pump trains should be separated from each other and from other areas of the plant by 3 hour rated fire barriers.	C.7.k	C	The safety-related pump compartments located at el 177' in the reactor enclosure are separated from each other and from other areas of the plant by 3 hour rated fire walls. The spray pond pump structure is located remote from other plant structures, and the two divisions of pumps within the structure are separated by a 3 hour rated fire wall.
235.	These rooms should be protected by automatic fire suppression unless a fire hazards analysis can demonstrate that a fire will not endanger equipment required for safe shutdown.	C.7.k	C	The HPCI compartment and the RCIC pump compartment are protected by automatic preaction sprinkler systems. Fires originating in other safety-related pump compartments would not endanger other safety-related equipment required for safe shutdown, as discussed in Section 9A.5.
236.	These rooms should be provided with automatic fire detection to annunciate in the control room and alarm locally.	C.7.k	C	
237.	Portable extinguishers and manual hose stations should be readily accessible.	C.7.k	NC	Portable extinguishers are provided for use in all areas housing safety-related pumps. Manual hose stations are provided for use in all areas housing safety-related pumps, except for the spray pond pump structure. In consideration of the low combustible loading in the spray pond pump structure, portable extinguishers are deemed adequate to control and extinguish a fire at any pump.
238.	Floor drains should be provided to prevent water accumulation from damaging safety-related equipment.	C.7.k	C	
239.	Provisions should be made for manual control of the ventilation systems to facilitate smoke removal.	C.7.k	C	The ventilation systems in areas housing safety-related pumps are provided with controls that are sufficient to permit manual control of the ventilation as necessary to facilitate smoke removal.
240.	Recommendations for fire protection of the new fuel area.	C.7.l	NA/AC	The normal storage area for new fuel is the spent fuel pool. Prior to plant operation and during the initial phases of plant operation, new fuel may be stored in a temporary outdoor storage area. Fire protection for this temporary new fuel storage area will be provided in accordance with guidelines established by ANI.

CMEB 9.5-1

NO.	CMEB 9.5-1 GUIDELINE	ITEM NO.	COMPARISON	REMARKS
	Spent Fuel Pool Area			
241.	Protection for the spent fuel pool area should be provided by hose stations and portable extinguishers.	C.7.m	C	Hose stations and portable extinguishers are located near the spent fuel pool.
242.	Automatic fire detection should be provided to annunciate in the control room and to alarm locally.	C.7.m	NC	See Section 9A.3.1.2, item 112.j.
	Radwaste and Decontamination Areas			
243.	Fire barriers, automatic fire suppression and detection, and ventilation controls should be provided.	C.7.n	C	See Section 9A.3.1.2.
	Safety-Related Water Tanks			
244.	Fire protection provisions for safety-related water tanks.	C.7.o	NA	The plant has no safety-related water tanks.
	Records Storage Areas			
245.	Records storage areas should be so located and protected that a fire in these areas does not expose safety-related systems or equipment.	C.7.p	C	
	Cooling Towers			
246.	Cooling towers should be of noncombustible construction or so located and protected that a fire will not adversely affect any safety-related systems or equipment.	C.7.q	C	The cooling towers are of noncombustible construction except for the fill material, which is polyvinyl chloride. No safety-related structures or systems are located near the cooling towers such that they could be affected by a fire in the cooling towers.
247.	Cooling towers should be of noncombustible construction when the basins are used for the ultimate heat sink or for the fire protection water supply.	C.7.q	AC	See Section 9A.3.1.2.
	Miscellaneous Areas			
248.	Location and protection of miscellaneous areas.	C.7.r	C	See Section 9A.3.1.2.

NO.	CMEB 9.5-1 GUIDELINE	CMEB 9.5-1 ITEM NO.	COMPARISON	REMARKS
	Storage of Acetylene/Oxygen Fuel Gases			
249.	Gas cylinder storage locations should not be in areas that contain or expose safety-related equipment or the fire protection systems that serve those safety-related areas.	C.8.a	C	Compressed gas storage cylinders for welding are located outdoors, away from safety-related components.
250.	A permit system should be required to use this equipment in safety-related areas of the plant.	C.8.a	C	
	Storage Areas for Ion Exchange Resins			
251.	Unused ion exchange resins should not be stored in areas that contain or expose safety-related equipment.	C.8.b	AC	Storage areas for dry ion exchange resins in safety-related equipment areas utilize approved metal storage containers.
	Hazardous Chemicals			
252.	Hazardous chemicals should not be stored in areas that contain or expose safety-related equipment.	C.8.c	AC	Procedural controls exist to ensure hazardous chemical storage in safety-related areas do not pose a fire risk.
	Materials Containing Radioactivity			
253.	Materials that collect and contain radioactivity should be stored in closed metal tanks or containers that are located in areas free from ignition sources or combustibles.	C.8.d	C	
254.	These materials should be protected from exposure to fires in adjacent areas.	C.8.d	C	
255.	Consideration should be given to requirements for removal of decay heat from entrained radioactive Materials.	C.8.d	C	Provisions for accommodating decay heat are considered when selecting containers.

9A.3.1.2 Explanatory Notes for Comparison to Branch Technical Position CMEB 9.5-1

Item 6

BTP Guideline

The position responsible for formulation and implementation of the fire protection program should have within his organization or as a consultant a fire protection engineer who is a graduate of an engineering curriculum of accepted standing and shall have completed not less than 6 years of engineering attainment indicative of growth in engineering competency and achievement, 3 years of which shall have been in responsible charge of fire protection engineering work. These requirements are the eligibility requirements as a Member in the Society of Fire Protection Engineers.

LGS Design

The Vice President, LGS, is responsible for the formulation and implementation of the fire protection program. In this capacity, he has access to the services of corporate support personnel, other Exelon sites, or vendors as necessary in the capacity of a fire protection engineer. The individual meets the requirements for membership in the Society of Fire Protection Engineers (i.e., a graduate of an engineering curriculum of accepted standing and shall have completed not less than 6 years of engineering attainment indicative of growth in engineering competency and achievement, 3 years of which shall have been in responsible charge of fire protection work).

In addition, fire protection consultants are available to assist in design and review tasks as required.

Item 15

BTP Guideline

Fires involving facilities shared between units and fires due to man-made site-related events that have a reasonable probability of occurring and affecting more than one reactor unit (such as an aircraft crash) should be considered.

LGS Design

The control structure, the spray pond pump structure, and the radwaste enclosure are common to the two reactor units. Fires are postulated to occur in these structures just as in other structures, and appropriate provisions are made for fire prevention, fire detection, and fire suppression.

For a discussion of fires due to man-made site-related events, refer to Item 22.

Item 19

BTP Guideline

A single active failure or a crack in a moderate energy line (pipe) in the fire suppression system should not impair both the primary and backup fire suppression capability. For example, neither the failure of a fire pump, its power supply or controls, nor a crack in a moderate energy line in the fire suppression system, should result in loss of function of both sprinkler and hose standpipe systems in an area protected by such primary and backup systems.

LGS Design

As described in Section 9A.2.1.2, fire water is supplied by two redundant pumps, each of which is capable of providing the design fire protection system flow rate at the design pressure. Power for the motor-driven fire pump is provided from either of two independent offsite power sources. The controls for the diesel engine-driven fire pump are dc-operated and are powered from batteries which supply only the engine-driven fire pump. Therefore, no single failure of the power supplies or controls can affect both fire pumps.

If a crack should occur in the yard fire main loop, sectional isolation valves can be used to isolate the damaged portion of the loop without affecting the majority of the loop. There is no single active failure that could affect the operability of both the sprinkler systems and manual hose stations for a given area. The standpipes supplying water to the sprinklers and manual hose stations have been designed to minimize the probability of a moderate energy crack occurring in these portions of piping. The standpipes were designed in accordance with NFPA requirements, for which the materials and standards of construction are the same as for ANSI B31.1, "Power Piping." The standpipes were seismically analyzed for safe shutdown earthquake loads in order to verify piping integrity under such loads. In the unlikely event that a crack does occur in a standpipe that supplies water to sprinklers and hose stations serving the same area, such that the ability to achieve design flow rates for the sprinklers and hose stations is affected, an effective hose stream could be provided to the area from a hose station attached to the closest unaffected standpipe.

Item 21

BTP Guideline

The fire protection systems should retain their original design capability for natural phenomena of less severity and greater frequency than the most severe natural phenomena (approximately once in 10 years) such as tornadoes, hurricanes, floods, ice storms, or small intensity earthquakes that are characteristic of the geographic region.

LGS Design

The fire pumps, the yard fire main loop, distribution piping within structures, manual hose stations, and fixed suppression systems are conservatively designed so as to retain their operability following the occurrence of natural phenomena with severities corresponding to a recurrence interval of once in 10 years.

Item 22

BTP Guideline

The fire protection systems should retain their original design capability for potential man-made site-related events such as oil barge collisions or aircraft crashes that have a reasonable probability of occurring at a specific plant site.

LGS Design

Transportation activities taking place near LGS, and the potential for accidents affecting the plant, are discussed in Section 2.2. As indicated in Section 2.2.2.4, there is no commercial traffic on the Schuylkill River in the vicinity of the site. As discussed in Section 2.2.3, the potential effects of an explosion occurring on nearby highways are exceeded in severity by the potential effects of a

railway explosion. Structures housing safety-related systems and components are designed to withstand impact from missiles generated by a railway explosion. Portions of fire protection systems that are located outside the safety-related structures could potentially be damaged by missiles generated by a railway explosion. However, such damage will not jeopardize safe shutdown capability since the systems and components, excluding offsite power, needed for safe shutdown are protected from damage due to missile impact and are isolated from the effects of fires occurring outside the safety-related structures.

Hazards to the plant resulting from aircraft operating in the vicinity of the site are discussed in Section 3.5.1.6. The control structure, reactor enclosure, and spray pond pump structure are designed to withstand the impact of the design aircraft (a Learjet) without loss of structural integrity. Portions of fire protection systems that are located outside these structures could potentially be damaged by aircraft impact. However, such damage will not jeopardize safe shutdown capability since the systems and components, excluding offsite power, needed for safe shutdown are protected from damage due to aircraft impact and are isolated from the effects of fires occurring outside the control structure, reactor enclosure, and spray pond pump structure.

Item 24

BTP Guideline

The consequences of inadvertent operation of or a crack in a moderate energy line in the fire suppression system should meet the guidelines specified for moderate energy systems outside containment in SRP section 3.6.1.

LGS Design

Moderate energy leakage cracks in fire suppression system piping are analyzed as discussed in Section 3.6. Section 3.6.1.2.2 summarizes the results of the moderate energy fluid system analysis and also provides references to other UFSAR sections that discuss the design bases and criteria that were used in the moderate energy fluid system analysis. The analysis demonstrates that the occurrence of a crack in moderate energy piping, including the fire suppression system piping, will not prevent the plant from being brought to a safe, cold shutdown.

Automatic suppression systems have been designed and located so that operation of the systems, either intentional or inadvertent, will not cause damage to redundant trains of safety-related equipment that is needed for safe shutdown of the plant. To the greatest extent practical, safety-related electrical components are located outside the coverage zones of automatic suppression systems. Where necessary, components that are needed in order to achieve safe shutdown and also are located within automatic suppression system coverage zones are designed to remain functional in the event of suppression system actuation. Four of the areas that are provided with automatic water-type suppression systems are the HPCI pump compartment, the RCIC pump compartment, the diesel generator cells, and the 13.2 kV switchgear room. Actuation of the suppression systems in the HPCI and RCIC pump compartments could cause damage significant enough to affect the operability of the systems in those compartments. In the diesel generator cells, baffles are provided to protect the generators and control devices from damage due to suppression system actuation. In the 13.2 kV switchgear room, the design features of the system mitigate the effects due to spurious actuation or MELB. This system is supervised with instrument air and incorporates a double interlock deluge valve that is maintained normally closed. Sprinkler flow is initiated only when two seperate inputs are received; one from a pneumatic actuator, due to the melting of the sprinkler fusible link(s) allowing the supervised air to be

released; and the other from the fire detection system that sends a signal to an electric solenoid valve. Loss of any of these four systems (HPCI, RCIC, or a single diesel generator and 13.2 kV switchgear room) due to suppression system actuation is acceptable, since redundant systems will remain available to bring the plant to a safe, cold shutdown.

There are no cases in which safe shutdown components have electrical interconnections with fire detection or fire suppression systems. Therefore, safe shutdown components cannot be inadvertently actuated or shut down due to either normal or abnormal signals in the control and power circuits of the fire detection and fire suppression systems.

The HPCI and RCIC pump compartments and the diesel generator cells are the only safety-related areas of the plant that are provided with automatic suppression systems and also are potentially subject to steam flooding as a result of high energy pipe breaks. Elevated compartment temperatures due to steam flooding could result in suppression system actuation if the temperatures are high enough to cause the deluge valve to open and the fusible links on the sealed sprinkler heads to open. However, loss of the HPCI system, RCIC system, or a single diesel generator due to suppression system actuation is acceptable, since redundant systems will remain available to bring the plant to a safe, cold shutdown.

Automatic (water) suppression systems located in safety-related areas of the plant are of the type that have fusible heads (either preaction or wet pipe). These systems cannot be actuated in the absence of a significant heat source in the vicinity of the sprinkler heads. Therefore, electrical anomalies in the circuits of the smoke and heat detection systems or the suppression system power supplies cannot cause inadvertent actuation of these suppression systems.

Item 28

BTP Guideline

On reactor sites where there is an operating reactor and construction or modification of other units is under way, the fire protection program should provide for continuing evaluation of fire hazards. Additional fire barriers, fire protection capability, and administrative controls should be provided as necessary to protect the operating unit from construction fire hazards.

LGS Design

Administrative procedures will be prepared to protect the operating Unit 1 from fire hazards associated with construction of Unit 2. Special precautions will be taken to prevent and control fire hazards. Use of open flames and welding or cutting equipment will be properly supervised.

Construction of both the underground yard fire main and the fire water distribution piping inside both units of the plant will be completed prior to Unit 1 operation so that manual hose station coverage will be available in Unit 2 as well as Unit 1. Portable fire extinguishers will also be available in the Unit 2 portions of the plant during its construction. The construction site will be kept clean and orderly and contractors' sheds will be kept outside the confines of new construction.

Item 33

BTP Guideline

Self-contained breathing apparatus using full face positive- pressure masks approved by the 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. 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 should be located onsite for each self-contained breathing unit. In addition, an onsite 6 hour supply of reserve air should be provided and arranged to permit quick and complete replenishment of exhausted supply air bottles as they are returned. If compressors are used as a source of breathing air, only units approved for breathing air shall be used; compressors shall be operable assuming a LOOP. Special care must be taken to locate the compressor in areas free of dust and contaminants.

LGS Design

Self-contained breathing apparatus will be available for use by control room personnel and fire brigade members. The breathing apparatus will have a minimum operating life of 4 hours for control room personnel and 1 hour for fire brigade members.

An onsite reserve air supply of six hours for at least five persons will be provided in stored air bottles. Compressors, if used, will be units approved for breathing air.

Item 34

BTP Guideline

Recommendations for the fire brigade training program.

LGS Design

Fire Protection program objectives for training fire brigade members is accomplished by using a combination of in plant areas and an off-site training facility that simulates plant physical conditions. Drills are conducted in conformance with plant fire drill procedures.

An off-site facility enables drills to include the use of live fire conditions. These elements plus the use of breathing apparatus and full protective clothing create actual conditions that would be encountered during a real plant fire emergency. Additional drills, including backshift unannounced drills are conducted in plant areas throughout the year. Unannounced drills are scheduled on a "per shift basis" in accordance with the corporate fire protection procedures.

Local fire departments are offered annual training associated with the responsibilities and duties of the plant fire brigade and offsite responders, operational precautions when fighting fires on nuclear power plant sites including awareness of the need for radiological protection of personnel and the special hazards associated with a nuclear power plant site.

Item 35

BTP Guideline

The quality assurance programs of applicants and contractors should ensure that the guidelines for design, procurement, installation, and testing and the administrative controls for the fire protection systems for safety-related areas are satisfied. The QA program should be under the management

control of the QA organization. This control consists of (1) formulating a fire protection QA program that incorporates suitable requirements and is acceptable to the management responsible for fire protection or verifying that the program incorporates suitable requirements and is acceptable to the management responsible for fire protection, and (2) verifying the effectiveness of the QA program for fire protection through review, surveillance, and audits. Performance of other QA program functions for meeting the fire protection program requirements may be performed by personnel outside of the QA organization. The QA program for fire protection should be part of the overall plant QA program.

LGS Design

The QA program described below will be under the management control of the licensee and their agent's organizations during the construction and operation phases.

a. Design and Procurement Document Control

The design review performed to compare the LGS design to the BTP guidelines provides assurance that necessary design features are included in appropriate design and procurement documents.

Deviations from the design and procurement documents will be controlled by mechanisms specified in the 10CFR50, Appendix B, QA program for this project.

b. Instructions, Procedures, and Drawings

These requirements will be met through the use of a documented, final installation inspection and through implementation of a written preoperational test.

c. Control of Purchased Material, Equipment, and Services

Based upon the status of procurement and the identification of significant design or manufacturing features, certain fire protection equipment may be subject to shop inspection during manufacture.

Receipt inspection at the site shall be performed.

d. Inspection

These requirements will be met through the use of a documented, final installation inspection and through implementation of a written preoperational test.

e. Test and Test Control

Documented preoperational test procedures including evaluation of results and follow-up action, if indicated, shall be employed to meet these requirements.

f. Inspection, Test, and Operating Status

Installation inspections, as described in Item 4 above, shall be documented in such a manner as to indicate the acceptability of the item/activity inspected. Deficiencies

shall be identified and corrected in accordance with mechanisms specified in the 10CFR50, Appendix B, QA program for this project.

Satisfactory completion of the preoperational test and release for operation shall be accomplished and documented in accordance with mechanisms specified in the 10CFR50, Appendix B, QA program for this project.

g. Nonconforming Items

Nonconforming items shall be identified, controlled, and corrected in accordance with the mechanisms specified in the 10CFR50, Appendix B, QA program for this project.

h. Corrective Action

Conditions adverse to fire protection (such as failures, malfunctions, deficiencies, deviations, defective components, and nonconformances) during the construction phase shall be reported and corrected in accordance with mechanisms specified in the 10CFR50, Appendix B, QA program for this project.

i. Records

Records shall be prepared and maintained to furnish evidence that the criteria described in Items 1 through 10 are being met for activities affecting the fire protection program.

j. Audits

The activities described above are subject to audit. In addition, implementation of receipt inspections, final installation inspections, and preoperational tests shall be subject to audit to conform with documented instructions, procedures, and drawings.

Item 37

BTP Guideline

Fire barriers with a minimum rating of 3 hours should be provided to separate redundant divisions of safety-related systems from each other.

LGS Design

Redundant divisions of safety-related systems will be separated from each other so as to achieve the three levels of fire damage limits established in Position C.1.b. The provision of fire barriers between redundant divisions of safety-related systems that do not have safe shutdown functions is not required. Fire barriers will be provided between redundant divisions of safe shutdown systems as necessary to ensure that one train of equipment necessary to achieve safe shutdown is maintained free of fire damage to the degree specified in Position C.1.b unless specified otherwise in Section 9A.5.

The reactor enclosures, turbine enclosures, diesel generator enclosures, radwaste enclosure, and administration building are separated from each other by 3 hour rated fire walls. Walls internal to these structures (and also the spray pond pump structure) which serve as boundaries between different fire areas are provided with fire ratings or construction details consistent with the fire hazard existing in each area. The locations of fire-rated walls are shown on Figures 9A-4 through 9A-12, and the walls surrounding each fire area are further described in the fire area discussions contained in Sections 9A.5.3 through 9A.5.9.

The structural steel beams supporting the floor slabs at el 254', el 269', el 289' and el 304' in the control structure have been fireproofed to provide a 3 hour rating for the complete floor assembly. The structural steel beams supporting floor slabs in other areas have not been fireproofed. The fire ratings of floor slabs above and below each fire area are listed in the fire area discussions contained in Sections 9A.5.3 through 9A.5.9. Those slabs which are shown as "3 hr*" are capable of being rated as 3 hour fire barriers, except for the lack of fireproofing on the structural steel beams supporting the slab.

Reinforced concrete walls without penetrations are considered to qualify for a 3 hour fire rating, provided that the wall has a thickness of at least 6 inches. Concrete block walls designated as fire walls are constructed in accordance with UL Design No. U904, as a minimum. Fire walls incorporating metal studs with lath and plaster are constructed in accordance with UL Design No. U409. Fireproofing material is applied to structural steel beams in accordance with UL Design No. N706, N712, N742, or N760.

Item 39

BTP Guideline

Appropriate fire barriers should be provided within a single safety division to separate components that present a fire hazard to other safety-related components or high concentrations of safety-related cables within that division.

LGS Design

The diesel generator day tanks constitute the most significant fire hazard posed by components within safety-related systems. As stated in Item 229, the day tank for each diesel generator is located in a vault that is separated from the remainder of the diesel generator cell by 3 hour rated fire walls. The HPCI, RCIC, RHR, and LPCI systems contain lesser fire hazards in the form of lubricating oil associated with the pumps and drivers in these systems. These pumps are located at el 177' in the reactor enclosure, which is compartmentalized to separate the pumps from each other and from other safety-related systems.

Fire barriers are not provided solely for the purpose of separating safety-related cables from other safety-related cables in the same division. Separation by distance or by fire barriers between redundant divisions is provided as necessary to ensure safe shutdown capability in the event of a fire. Separation to ensure independence between Class 1E and non-Class 1E circuits and between redundant divisions of Class 1E circuits is discussed in Section 8.1.6.1.14.

Item 40

BTP Guideline

Openings through fire barriers for pipe, conduit, and cable trays which separate fire areas should be sealed or closed to provide a fire resistance rating at least equal to that required of the barrier itself.

LGS Design

Pipe, conduit, and cable tray penetrations through fire-rated barriers will be sealed to provide a fire resistance rating that is consistent with that of the overall barrier. Such seals in fire barrier penetrations will be installed in accordance with the manufacturer's tested configurations where possible. Individual penetration seals that include configurations or features that constitute deviations from the manufacturer's tested configuration are reviewed and accepted by LGS's authorized insuring agency for use as fire-rated seals.

Item 41

BTP Guideline

Openings inside conduit larger than 4 inches in diameter should be sealed at the fire barrier penetration. Openings inside conduit 4 inches or less in diameter should be sealed at the fire barrier unless the conduit extends at least 5 feet on each side of the fire barrier and is sealed either at both ends or at the fire barrier with noncombustible material to prevent the passage of smoke and hot gases.

LGS Design

In areas of the plant that contain safety-related equipment, conduits that penetrate fire barriers will be sealed internally to prevent the passage of smoke and hot gases. For each penetrating conduit that extends 5 feet or more on both sides of the fire barrier, noncombustible seals will be provided on both sides of the fire barrier at the access point (junction box, termination at a cable tray, or equipment connection) that is closest to the fire barrier. For each penetrating conduit that extends less than 5 feet on either side of the fire barrier, a 3 hour fire rated seal will be provided either at the fire barrier or on one side of the barrier at the access point that is closest to the barrier. For the cases in which access to the interior of a conduit has been provided at the fire barrier via a junction box or condulet, the 3 hour seal is located at the barrier. Where no access has been provided at the barrier, the 3 hour seal is located at the access point that is closest to the barrier. For the cases in which the penetrating conduit is larger than 4 inches in diameter and the 3 hour seal is not located at the barrier, the conduit forms part of the fire barrier in combination with the seal. Conduits in this category are schedule 40 rigid steel and will maintain their integrity while exposed to a 3 hour fire.

Any installation which deviates from the above criteria for internal conduit seals is documented in a technical evaluation in the form of a fire hazards and safe shutdown analysis that is performed and reviewed by personnel responsible for fire protection and safe shutdown analyses for the plant. Each technical evaluation documents the as-built configuration and presents the rationale for concluding that the affected seal does not degrade the effectiveness of the fire barrier in preventing the spread of a postulated fire and in limiting the migration of smoke and hot gases. Each technical evaluation performed is retained as part of the permanent plant records.

For conduits that enter the bottom of floor-mounted components that are mounted on fire-rated floor slabs, 3 hour rated seals are normally installed inside each conduit at the point where it enters the component. In some cases, however, the congestion of cables in a conduit prevents the fire

sealant material from being installed to the minimum thickness necessary to qualify as a 3 hour rated seal. In each such situation, a second seal is installed inside the conduit at the access point nearest to the component, with the thickness of the sealant material in the second seal being selected so that the combined thickness of the first and second seals is not less than the thickness required for a 3 hour rated seal.

For fire barriers that separate safety-related areas from nonsafety-related areas of the plant, conduit penetrations will be provided with internal seals in the same manner as discussed above for safety-related areas.

In areas of the plant not containing safety-related equipment, internal seals will be provided for conduits penetrating fire barriers that are adjacent to fire areas with high combustible loadings. The locations of the conduit seals with respect to the fire barrier being penetrated will be the same as discussed above for safety-related areas.

Item 43

BTP Guideline

Penetration designs should utilize only noncombustible materials.

LGS Design

All materials used in fire-rated penetration seals are either noncombustible or are listed by an independent testing laboratory for flame spread, smoke generation, and fuel contribution of 25 or less, as determined by testing in accordance with ASTM E-84. Alternatively, the fire retardation of caulking and adhesive materials that are used in small quantities as part of penetration seal assemblies may be demonstrated by successful completion of the fire test specified in section 3.B of the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops," issued in February of 1976. The following different types of seals will be used in fire-rated applications:

a. Cement-type grout.

b. Foamed silicone polymer. This is a self-vulcanizing material that results from the mixture of two liquid components.

c. Solid silicone polymer. The polymer is impregnated with a powdered high density filler.

d. Flexible boot with ceramic fiber. The boot material is silicone rubber with woven glass fiber reinforcing. Ceramic fiber is installed inside the boot, in the space between the penetrating object and the edge of the penetration. Stainless steel compression straps and silicone adhesives are used in attaching the boot.

e. Flexible boot with gel. The boot material is silicone rubber with woven glass fiber reinforcing. The boot is filled with a high density silicone dielectric gel. Stainless steel compression straps and silicone adhesives are used in attaching the boot.

Item 45

BTP Guideline

The acceptance criteria for the test should require that:

a. The fire barrier penetration 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.

b. The temperature levels recorded for the unexposed side are analyzed and demonstrate that the maximum temperature does not exceed 325°F.

c. The fire barrier penetration remains intact and does not allow projection of water beyond the unexposed surface during the hose stream test. The stream shall be delivered through a 1½ inch nozzle set at a discharge angle of 30% with a nozzle pressure of 75 psi and a minimum discharge of 75 gpm with the tip of the nozzle a maximum of 5 ft from the exposed face; or the stream shall be delivered through a 1½ inch nozzle set at a discharge angle of 15% with a nozzle pressure of 75 psi and a minimum discharge of 75 gpm with the tip of the nozzle a maximum of 10 ft from the exposed face; or the stream shall be delivered through a 2½ inch national standard play pipe equipped with $1^1/_8$ inch tip, nozzle pressure of 30 psi, located 20 ft from the exposed face.

LGS Design

In accordance with American Nuclear Insurer's NEL-PIA/MAERP, Standard Test method for penetration fire stops, a maximum allowable temperature of 325°F above ambient is applicable to temperature measurements taken at the seal surface on the unexposed side at locations not involving interfaces with objects that penetrate the seal. In accordance with IEEE 634 (1978), a maximum allowable temperature of 700°F is applicable to temperature measurements taken on the unexposed side at interfaces between the seal material and objects that penetrate the seal.

The acceptance criteria for penetration qualification tests are in agreement with those specified in paragraphs (a) and (c) above. The maximum unexposed side temperature criteria used by the ANI test standard was 325°F above ambient. Annular pipe anchors are used in the type of penetration involving a single pipe routed through a steel penetration sleeve that is embedded in a concrete wall. The pipe anchor consists of a steel plate spanning the annular space between the pipe and the penetration sleeve, and which is welded to both the pipe and the penetration sleeve over its entire circumference. Fire resistance for this type of penetration assembly is provided by installing mineral wool in the annular space to a minimum depth of 12 inches. This configuration has been tested for a 3 hour fire rating at the National Gypsum Company Research Center in cooperation with Factory Mutual Research. The assembly withstood the fire test and hose stream test with a maximum temperature of 425°F on the unexposed side of the annular anchor, measured at a location 1 inch from the surface of the pipe. This temperature is attributable to heat conduction through the steel pipe. This seal configuration is acceptable because no cables are associated with the penetration.

<u>Item 46</u>

<u>BTP Guideline</u>

Penetration openings for ventilation systems should be protected by fire dampers having a rating equivalent to that required of the barrier.

<u>LGS Design</u>

Except for Fire Areas 3, 4, 5, and 6, ventilation ducts that penetrate fire barriers are provided with 3 hour rated fire dampers at penetrations of 3 hour rated barriers and with 1.5 hour rated dampers at penetrations of 1 hour fire barriers. Both classifications of fire dampers are UL-listed and manufactured to comply with NFPA 90 and the Commonwealth of Pennsylvania Fire Protection Code.

Fire Areas 3, 4, 5, and 6 ventilation duct penetrations, which communicate with Fire Area 2, have fire damper assemblies which have been evaluated per an Engineering Evaluation, dated 03/26/98 (Reference NCR-ECR LG 98-00470) and are commensurate with the postulated fire in these areas.

<u>Item 48</u>

<u>BTP Guideline</u>

Door openings in fire barriers should be protected with equivalently rated doors, frames, and hardware that have been tested and approved by a nationally recognized laboratory.

<u>LGS Design</u>

Door openings in fire barriers are protected with equivalently rated doors, frames, and hardware that have been rated as follows:

a. Hollow metal doors are listed by UL and classified as Class A (3 hour) for use in 3 hour rated fire barriers, Class B (1.5 hour) for use in 2 hour rated fire barriers, or Class C (¾ hour) for use in 1 hour rated fire barriers.

b. Roll-up doors less than 120 ft^2 in size are labeled with classification markings as described above for hollow metal doors. Roll-up doors larger than 120 ft^2 are not provided with UL classification labels but are certified by their manufacturer to be manufactured in compliance (except for size) with the requirements for doors of this class and type that are normally labeled as Class A.

c. Watertight doors are not provided with UL classification labels but are certified by the manufacturer to be equivalent to the requirements of the UL classification for special purpose type fire door and frame assemblies that are rated as Class A.

d. Missile-resistant doors are certified by the manufacturer to be designed so that the doors provide a degree of fire resistance equivalent to a 3 hour fire rating based on exposure to temperatures as defined by the NFPA standard time-temperature curve. Because the missile-resistant doors are custom designed for each specific application, they are not provided with UL classification labels. Only three

missile-resistant doors are specified for use in fire barriers, two of which are 3'-0" by 7'-0" single-leaf doors and one of which is a 7'-0" by 10'-0" double-leaf door. The manufacturer has verified by calculation that the deformation of these doors resulting from exposure to a standard 3 hour fire will remain within the values specified in the acceptance criteria of ASTM E-152-81.

e. Steamtight, airlock, and bullet-resistant doors are labeled as described above for hollow metal doors, except for doors with conditions that do not exactly match the physical units tested and approved by UL. Doors that are not labeled are certified by the door manufacturers to be fabricated in the same manner as the labeled units, except for variances due to special functions required for the doors. These variances include the following:

   1. Door size - the size of double-leaf door tested by UL is 6'-0" by 7'-2" whereas the maximum size of the LGS doors is 9'-0" by 10'-0".

   2. Door thickness - the maximum thickness tested by UL is 2¾" whereas the maximum thickness of the LGS doors is 4¼".

   3. LGS' double-leaf steamtight and airlock doors contain a removable mullion that is not present in the UL-tested assemblies.

   4. Minor hardware differences as follows:

      (a) Customized hinges

      (b) Locksets by Sonicbar Door Systems

      (c) Additional security hardware

      (d) Surface-mounted hardware

   5. LGS' bullet-resistant doors have additional structural features for greater strength that were not included in the tested doors.

      The fire loadings on either side of the subject doors are low. The maximum equivalent severity in adjacent compartments is 35 minutes. In none of the cases are the in situ combustibles located immediately adjacent to the doors.

f. Door/frame assemblies not installed in tested configurations that have been evaluated to withstand for three hours the maximum fire expected in the Fire Area.

Doors that are specified for use in fire barriers but are not listed by UL are identified in the fire area discussions contained in Sections 9A.5.3 through 9A.5.9 by a double asterisk (**) following the indicated fire rating.

<u>Item 58</u>

<u>BTP Guideline</u>

Cable spreading rooms should be separated from each other and from other areas of the plant by barriers having a minimum fire resistance of 3 hours.

LGS Design

The cable spreading rooms are separated from each other and from adjacent fire areas by 3 hour rated fire barriers consisting of either reinforced concrete or concrete unit masonry walls with a minimum thickness of 12 inches, and reinforced concrete slabs with a minimum thickness of 12 inches. Exposed structural steel supporting the floor slabs above and below the cable spreading rooms are coated with fireproofing material in order to achieve a 3 hour fire rating. Each door opening in the 3 hour rated fire walls is provided with a UL Class A fire door. All penetrations through the 3 hour rated walls and slabs are sealed using penetration seal details that are qualified for use in 3 hour rated fire barriers. HVAC duct penetrations through the 3 hour rated walls are equipped with 3 hour rated fire dampers.

Item 59

BTP Guideline

Interior wall and structural components, thermal insulation materials, radiation shielding materials, and soundproofing should be noncombustible.

LGS Design

Most interior walls are constructed of either reinforced concrete, or concrete masonry units. Limited use is made of walls constructed of metal studs with either gypsum wallboard or gypsum plaster on expanded metal lath. Structural components consist of structural steel or reinforced concrete. Soundproofing materials, if required, will be noncombustible. Radiation shielding consists of concrete, concrete masonry unit, or steel plates, or other noncombustible materials.

Thermal insulation materials are noncombustible, with the following exceptions:

a. Insulation for domestic cold water piping (in the administration building only) is a closed-cell foamed elastomer with an ASTM E-84 flame spread rating of 25 or less.

b. Insulation for the offgas refrigeration equipment (located only in the offgas enclosure) has an ASTM E-84 flame spread rating of 25 or less.

c. Insulation for duct-work and plenums of the ventilation systems has an ASTM E-84 flame spread rating of 25 or less and a smoke generation rating of 50 or less.

Item 60

BTP Guideline

Interior finishes should be noncombustible.

LGS Design

Areas containing systems or equipment required for safe shutdown of the plant are unfinished, or are finished with materials that are either noncombustible or (except for floor coverings and vinyl

cove base) are rated by an independent testing laboratory for flame spread and smoke generation of 25 or less.

Floor coverings in areas containing systems or equipment required for safe shutdown of the plant are Class I material as defined in NFPA 101. In order to qualify for this classification, the floor covering material must have a minimum critical radiant flux of 0.45 watts per square centimeter as determined by NFPA 253 ("Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source").

Vinyl cove base is considered trim and incidental finish and may be Class III material as defined in NFPA 101. As such, it is rated for flame spread of 200 or less and smoke generation of 450 or less. Trim and incidental finish shall not exceed 10% of the aggregate wall and ceiling area of a room.

Item 61

BTP Guideline

Metal deck roof construction should be noncombustible and listed as "acceptable for fire" in the UL Building Materials Directory, or listed as Class 1 in the Factory Mutual System Approval Guide.

LGS Design

Metal deck roof construction is used only for the turbine enclosure, which is a nonsafety-related structure. The roof is constructed to meet the requirements of a Class 1 roofing system in accordance with the Factory Mutual System Approval Guide.

Item 62

BTP Guideline

Suspended ceilings and their supports should be of noncombustible construction.

LGS Design

Two different design details are used for the suspended ceiling in the control room. One detail includes mineral fiber panels resting on a metal grid system which is supported by steel wires. A second detail, used above the peripheral rooms adjacent to the control room, includes gypsum board panels supported from galvanized steel studs. The materials used in both of these details are either noncombustible or are listed by an independent testing laboratory for flame spread, smoke generation, and fuel contribution of 25 or less.

Item 63

BTP Guideline

Concealed spaces should be devoid of combustibles except as noted in Position C.6.b.

LGS Design

There are no combustible materials in the space above the suspended ceiling in the control room, other than electrical cables. These cables (associated primarily with control room annunciators and control room lighting) are routed in conduits, fully enclosed gutters, and cable trays. The cable trays are fully enclosed through the use of solid (steel) top and bottom covers. The only exposed cables in the space above the suspended ceiling are the control room annunciator cables that extend through the bottom covers on the cable trays. Since the annunciators are located immediately adjacent to the cable trays, the exposed length of cable is very short. The cable dropout openings in the tray bottoms will be sealed with ceramic fiber and a flame-retardant mastic coating to ensure that any fire originating within the cable trays is contained within the trays. Eleven smoke detectors are located above the suspended ceiling to provide early warning of fires occurring within the area.

Table 9A-3 lists the insulation and jacketing materials used for electrical cabling. As noted in the table, cable insulation and jacketing materials are specified to meet the IEEE 383 flame test requirements except for lighting, communications, and grounding cables. Lighting cables and communication cables are routed exclusively in conduit, and grounding cables are not routed through the space above the suspended ceiling in the control room.

Electrical cables are routed through the raised floor sections in the auxiliary equipment room. Access to the cables for manual fire fighting efforts is obtained by the removal of floor plates covering the floor sections. The floor plates are constructed of aluminum honeycomb bonded between sheet metal, and are easily removable using two quick-disconnect fasteners on each plate. Automatic fire detection systems and automatic Halon suppression systems are provided in the floor sections. Additional discussion of the auxiliary equipment room raised flooring and the Halon suppression system is provided in Sections 9A.2.9 and 9A.5.3.25.

Item 65

BTP Guideline

Outdoor oil-filled transformers should have oil spill confinement features or drainage away from the buildings.

LGS Design

The main transformers, the safeguard transformers, and the auxiliary transformers are each surrounded by a curb approximately 2 feet high. A floor drain is provided within each curbed area to drain liquids to the normal waste drainage system.

The fire walls that are located on three sides of each plant services transformer would prevent spilled oil from flowing toward the circulating water pump structure. The pavement in the vicinity of each transformer is sloped to provide drainage to nearby catch basins.

Item 66

BTP Guideline

Outdoor oil-filled transformers should be located at least 50 feet distant from the building, or by ensuring that such building walls within 50 feet of oil-filled transformers are without openings and have a fire resistance rating of at least 3 hours.

LGS Design

The main transformers are located more than 50 feet from any building. The plant services transformers are located adjacent to the circulating water pump structure, but are separated from it by free-standing 3 hour rated fire walls. The safeguard transformers and auxiliary transformers are located approximately 14 feet from the north side of the turbine enclosure. As described in Section 9A.2.4, the latter transformers are provided with automatically actuated deluge systems to suppress fires involving the transformers. This automatic suppression will prevent the turbine enclosure from being damaged as a result of a transformer fire. In addition, the turbine enclosure is nonsafety-related and does not contain any components that are needed in order to achieve safe shutdown of the plant.

Item 67

BTP Guideline

Floor drains sized to remove expected fire fighting water without flooding safety-related equipment should be provided in areas where fixed water fire suppression systems are installed.

LGS Design

Two water suppression systems are located in areas with no floor drains. A wet pipe system is located in the elevation 239' corridor (fire area 7) and localized preaction system in the 13.2 kV switchgear room, elevation 217' (fire area 2).

Although no floor drains are located in fire area 7, equipment in adjacent areas are provided with curbs, installed on 4" raised pads or the floor was sloped away from the equipment. Floor drains are also available in the adjacent battery rooms. No safety-related equipment (other than cabling) is located in fire area 7 which is also maintained as a combustible free zone, with the primary combustible loading from cables and cable tray encapsulating material. Although the UFSAR (Section 9A.5.3.7.c) states that ignition of electrical cabling in tray is "extremely unlikely in the absence of a fire source," a smoke detector system provides early warning of the slow developing incipient fire that would be typical for the types of combustibles in the area. The early activation of the smoke detection system provides an audible/visual annunciation in the control room whereby operator actions are expected to mitigate the consequences of the fire before it could develop sufficiently to cause the system to actuate. If the system were to actuate due to a fire event, a flow switch provides an additional alarm to the control room requiring immediate operator actions. As discussed in response to Item 68 below, credit was taken for the opening of doors due to fire brigade response, which would allow water from hand hoses to drain into adjacent nonsafety-related areas containing floor drains.

Although no floor drains are located in fire area 2, the design feature of the installed partial preaction system minimizes the impact to equipment. This system is supervised with instrument air and incorporates a double interlock deluge valve that is maintained normally closed. Sprinkler flow is initiated only when two separate inputs are received; one from a pneumatic actuator, due to the melting of the sprinkler fusible link(s) allowing the supervised air to be released; and the other from the fire detection system that sends a signal to an electric solenoid valve. This system is installed to protect redundant cable trays encapsulated with a 1-hour fire rated material. Although the UFSAR (Section 9A.5.3.2.c) states that ignition of electrical cabling in tray is "extremely unlikely in the absence of a fire source," a smoke detector system provides early warning of a fire throughout the entire area. The early activation of the smoke detection system provides an

audible/visual annunciation in the control room whereby operator actions are expected to mitigate the consequence of the fire before it could develop sufficiently to cause the system to actuate. However, should the system actuate due to a fire, the impact to safe shutdown is mitigated by the location of redundant components outside of this area. This is further supported by MELB evaluations performed in accordance with UFSAR Section 3.6 (Reference; Item 24 of Section 9A.3.1.1, "Detailed Comparison to Branch Technical Position CMEB 9.5-1", of Appendix 9A of the LGS UFSAR) that indicated that equipment was waterspray proof, or judged as not being required to ensure safe shutdown, containment integrity, or containment activity release to 10CFR50.67 limits. In addition, in accordance with Item 210 below, since floor drains were not provided in the safety-related switchgear rooms to prevent water accumulation, credit was taken for the opening of doors to drain water into areas not containing safety-related components.

Item 68

BTP Guideline

Floor drains should also be provided in other areas where hand hose lines may be used if such fire fighting water could cause unacceptable damage to safety-related equipment in the area.

LGS Design

All plant areas that are provided with drainage facilities have adequately sized drains to remove all the water discharged from a hand hose line. The only fire areas that are not provided with floor drains and which contain safety-related equipment that is needed for safe shutdown are the 4 kV switchgear compartments (fire areas 12 through 19), the static inverter compartments (fire areas 20 and 21), auxiliary equipment room (fire area 25), and remote shutdown room (fire area 26). The use of hand-held fire hoses in any of these fire areas will not result in flooding that causes unacceptable damage to safety-related equipment.

A fire hose can be used in the 4 kV switchgear compartments only by bringing the hose in through a doorway from adjacent fire areas. For fire areas 12, 14, 16, and 18, the fire hose would be brought in from the generator equipment area (fire zone 113B) along the north side of the control structure. Water discharged from a hose in one of these 4 kV switchgear compartments would flow through the open doorway to fire zone 113B and drain into the floor drains in that area. For fire areas 13, 15, 17, and 19, the fire hose would be brought in from the equipment hatch corridor (fire areas 97 for Unit 1 and 110 for Unit 2) via the control structure corridor (fire area 7). Water discharged from a hose in one of these 4 kV switchgear compartments would flow through the open doorway to fire area 7 and then through the doorway to the equipment hatch corridor. The equipment hatch corridor is provided with floor drains to dispose of the fire fighting water. Since the control structure corridor does not contain any safe shutdown components, the drainage of fire fighting water through the corridor will not have an adverse effect on safe shutdown capability.

A fire hose can be used in the Unit 1 static inverter compartment (fire area 20) only by bringing the hose in from the Unit 1 cable spreading room through an open doorway. Although the Unit 2 static inverter compartment (fire area 21) contains a manual hose station, the fire brigade would fight a fire in this compartment using a hose brought in from the generator equipment area (fire zone 113B) through an open doorway. For both the Unit 1 and Unit 2 static inverter compartments, the doorway that is used for access will remain open during fire fighting activities within the compartment. Water discharged from a hose in the Unit 1 static inverter compartment would flow through the open doorway to the Unit 1 cable spreading room, whereas water discharged from a hose in the Unit 2 static inverter compartment would flow to the generator equipment area. The

cable spreading rooms and the generator equipment area are each provided with floor drains to dispose of the fire fighting water. Since the cable spreading room does not contain any safe shutdown components, the drainage of fire fighting water into the spreading room from the static inverter compartment will not have an adverse effect on safe shutdown capability.

A fire hose can be used in the remote shutdown room (fire area 26) only by bringing the hose in from the control structure stairwell through an open doorway. This stairwell hose reel is the only hose reel available to fight a fire in this area so the door will remain open during fire fighting activities within the room. Water discharged from the hose in the remote shutdown room would flow through the open doorway into the stairwell, which does not contain any safe shutdown components.

A fire hose can be used in the auxiliary equipment room (fire area 25) only by bringing the hose in from the control structure stairwell through an open doorway. This stairwell hose reel is the only hose reel available to fight a fire in this area from the primary attack route so the door will remain open during fire fighting activities within the room. Water discharged from the hose in the auxiliary equipment room would flow through the open doorway into the stairwell, which does not contain any safe shutdown components. The secondary attack route for this area is from fire area 111 through an open door on the east wall of the auxiliary equipment room. Water discharged from the hose in the auxiliary equipment room would flow through the open doorway into the fire area 111, which does not contain any safe shutdown components.

Nonsafety-related areas of the plant that adjoin safety-related areas are provided with floor drains. As a result, fire fighting water that is discharged into the nonsafety-related areas will be disposed of through the floor drains, so that water will not accumulate on the floor and create a potential for inadvertent flooding of the adjoining safety-related areas.

Item 69

BTP Guideline

Where gas suppression systems are installed, the drains should be provided with adequate seals, or the gas suppression system should be sized to compensate for the loss of the suppression agent through the drains.

LGS Design

Gas suppression systems are provided for the remote shutdown room (Halon 1301), and the raised flooring in the auxiliary equipment room (Halon 1301). Loss of Halon 1301 through floor drains is not possible, since the auxiliary equipment and remote shutdown rooms do not have floor drains.

Item 70

BTP Guideline

Drains in areas containing combustible liquids should have provisions for preventing the backflow of combustible liquids to safety-related areas through the interconnected drain systems.

LGS Design

For the safety-related pump compartments at el 177' of the reactor enclosure, floor drains leading to the reactor enclosure floor drain sump are each provided with backflow prevention devices. The only other safety-related areas of the plant that contain significant quantities of combustible liquids are the diesel generator cells. The drains from the diesel generator cells are not interconnected with drains from other safety-related areas of the plant. The drains from each diesel generator cell are provided with traps upstream of their connection to an oil separator receiver.

The turbine enclosure contains several oil storage tanks, but the floor drains from the turbine enclosure are not interconnected with drains from safety-related areas of the plant.

Item 78

BTP Guideline

Bulk gas storage (either compressed or cryogenic), should not be permitted inside structures housing safety-related equipment. Storage of flammable gas such as hydrogen should be located outdoors or in separate detached buildings so that a fire or explosion will not adversely affect any safety-related systems or equipment.

LGS Design

Compressed gases are stored either outdoors or in nonsafety-related structures whenever possible. Compressed gas cylinders used for welding are stored in the construction shop (during periods of usage only) and the machine shop. Hydrogen used in cooling of the main generators is provided from the HWC system tube trailer facility located outside the protected area.

Compressed gas cylinders are stored in safety-related areas of the plant for use with three different systems: PCIG, containment combustible gas monitoring, and offgas hydrogen monitoring. The PCIG system includes compressed gas cylinders located at el 217' in the reactor enclosure. These cylinders contain nitrogen only, and therefore do not constitute a hazard with respect to fire protection. The containment combustible gas monitoring system includes compressed gas cylinders located at el 253' and el 283' in the reactor enclosure. These cylinders contain oxygen and oxygen/nitrogen mixtures, which also do not constitute a hazard with respect to fire protection, since oxygen is not a fuel gas.

The span and reagent gas bottles for the containment combustible gas monitoring systems are located outside the south wall of the Reactor Enclosures. These bottles of high purity oxygen, high purity hydrogen, 7% oxygen and 7% hydrogen are considered transportable, not bulk. The bottles are oriented with the long axis parallel to the Reactor Enclosure walls, minimizing the impact of a bottle failure when combined with the robust design of the Reactor Enclosure.

The offgas hydrogen monitoring system includes two compressed gas cylinders located at el 200' in the control structure. One of these cylinders contains nitrogen and the other contains a nitrogen/hydrogen mixture with a hydrogen content of 7%. An inadvertent release of the nitrogen/hydrogen mixture into the control structure air volume would result in immediate dilution of the hydrogen concentration to less than 4%. Since a hydrogen concentration of less than 4% in air is not combustible, the nitrogen/hydrogen mixture does not constitute a hazard with respect to fire protection.

Item 79

BTP Guideline

High pressure gas storage containers should be located with the long axis parallel to building walls.

LGS Design

High pressure gas storage cylinders are stored vertically with their long axis parallel to turbine enclosure walls.

Item 80

BTP Guideline

Use of compressed gases (especially flammable and fuel gases) inside buildings should be controlled.

LGS Design

The usage of compressed gases for cutting and welding is limited to those activities authorized as to be outlined in the administrative procedures.

The usage of compressed fuel gases for laboratory and shop use is limited to a low pressure supply system for Bunsen burners in the radioactive chemistry laboratory in the radwaste enclosure and the instrument repair shop on the 269 foot level of the control structure. Compressed fuel gas cylinders and gas pressure- reducing stations are installed outside of the building at a location that does not expose nuclear safety-related structures, systems, and equipment to potential damage from fire at the storage location.

Item 81

BTP Guideline

The use of plastic materials should be minimized. In particular, halogenated plastics such as PVC and neoprene should be used only when substitute noncombustible materials are not available.

LGS Design

The use of plastic materials within the plant has been minimized to the greatest extent practicable. However, alternatives to plastic or elastomeric materials for electrical cable insulating systems, with an optimum balance of electrical, physical, and environmental characteristics, are not available. Cable insulation and jacketing materials are chosen for their fire-retardant and self-extinguishing properties, such that fuel contribution to a cable fire is minimized and propagation of a fire along cables is self-limiting in the absence of an external fire hazard. The types of electrical cable insulation and jacketing used in the plant are listed in Table 9A-3.

Electrical components located throughout the plant, such as control panels, relay panels, motor control centers, and power distribution panels, contain relatively small amounts of plastic in the form of terminal blocks, relay cases, circuit breaker cases, and other small items. The use of plastic in these applications is necessary because of its electrically insulating properties.

Plastic materials are also used for electrical conduit, but only when embedded within poured concrete walls and floor slabs.

Item 85

BTP Guideline

Only metallic tubing should be used for conduit. Thin-wall metallic tubing should not be used.

LGS Design

Exposed conduit used for the routing of safety-related cables is rigid steel conduit. Conduit embedded in poured concrete walls and slabs may be either rigid steel or PVC. Conduits used for the routing of exposed nonsafety-related cables may be either rigid steel or EMT.

Item 88

BTP Guideline

Redundant safety-related cable systems outside the cable spreading room should be separated from each other and from potential fire exposure hazards in nonsafety-related areas by fire barriers with a minimum fire rating of 3 hours.

LGS Design

Fire exposure hazards in nonsafety-related areas are separated from safety-related areas by 3 hour rated fire barriers. Separation by distance or by fire barriers between redundant divisions of electrical cabling is provided as necessary to ensure safe shutdown capability in the event of a fire.

Item 89

BTP Guideline

These cable trays should be provided with continuous line-type heat detectors.

LGS Design

Fire detection capability for safety-related cables routed in cable trays is provided by smoke detectors (either ionization or photoelectric-type) in lieu of line-type heat detectors. The detection system is discussed in Section 9A.2.12, and the types and locations of detectors are listed in Table 9A-1. The determination of locations for early warning smoke detectors was performed under the direction of a registered fire protection engineer. Where the intent is to protect against postulated fires involving specific fire hazards, the detectors are installed closer to the hazard in a position where the detectors will readily intercept the products of combustion.

Ionization and photoelectric detectors are the preferred means of detecting both incipient cable tray fires and exposure fires involving other hazards. Line-type heat detectors are not the preferred means of detecting cable tray fires because they will not initiate an alarm until the fire is beyond the incipient stage. This conclusion is supported by studies performed at Sandia Laboratories and reported in NUREG/CR-0488, "Nuclear Power Plant Fire Protection, Fire Detection." Table IV of the report states that ionization or photoelectric detectors are the detection method of choice for the

[redacted]

[redacted]

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
	Water Supplies for Fire Suppression Systems			
1.	Two separate water supplies shall be provided to furnish necessary water volume and pressure to the fire main loop.	A	C	
2.	Each supply shall consist of a storage tank, pump, piping, and appropriate isolation and control valves.	A	AC	In lieu of storage tanks, the cooling tower basins of the Unit 1 and Unit 2 circulating water systems are used as the two sources of water for the fire main loop.
3.	These supplies shall be separated so that a failure of one supply will not result in a failure of the other supply.	A	C	See Section 9A.3.2.2.
4.	Each supply of the fire water distribution system shall be capable of providing the maximum expected water demands for a period of 2 hours.	A	C	The storage capacity of each cooling tower is 7,200,000 gallons, which is well in excess of the 387,000 gallon volume required for two hour operation of the largest sprinkler system concurrent with hose stream operation at 500 gpm.
5.	Requirements for ensuring minimum water volume when storage tanks are used for combined service water/fire water uses.	A	NA	See Section 9A.3.2.2.
6.	Requirements for other water systems used as sources of fire protection water.	A	AC	See Section 9A.3.2.2
	Sectional Isolation Valves			
7.	Sectional isolation valves such as postindicator 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.	B	C	

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
	Hydrant Isolation Valves			
8.	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.	C	C	
	Manual Fire Suppression			
9.	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.	D	AC	See Section 9A.3.2.2
10.	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.	D	C	
11.	Standpipe and hose stations shall be inside PWR containments and BWR containments that are not inerted.	D	NA	The primary containment is inerted with nitrogen during reactor operation.
12.	For BWR drywells, standpipe and hose stations shall be placed outside the drywell with adequate lengths of hose to reach any location inside the drywell with an effective hose stream.	D	C	The hose reels located nearest the drywell entrances are equipped with a 100 foot length of fire hose. To supplement this hose length, a hose station equipped with enough hose to reach any location within the drywell is located near each drywell entrance.

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
	Hydrostatic Hose Tests			
13.	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 three years.	E	C	
	Automatic Fire Detection			
14.	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.	F	AC	See Item 112 of Section 9A.3.1.2
	Fire Protection of Safe Shutdown Capability			
15.	Fire damage shall be limited so that one train of systems necessary to achieve and maintain hot shutdown conditions from either the control room or emergency control station is free of fire damage.	G.1.a	C	
16.	Fire damage shall be limited so that systems necessary to achieve and maintain cold shutdown from either the control room or emergency control station can be repaired within 72 hours.	G.1.b	C	
17.	Consideration of associated nonsafety circuits as requiring protection to ensure freedom from fire damage.	G.2 (part of first paragraph)	C	See Section 9A.6.1
18.	Alternative means of ensuring that one train of systems necessary to achieve and maintain hot shutdown is free of fire damage (where cables or equipment of redundant trains are located in the same fire area).	G.2.a G.2.b G.2.c	AC	See Section 9A.3.2.2

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
19.	Alternative means of providing fire protection inside noninerted containments.	G.2.d G.2.e G.2.f	NA	The primary containment is inerted with nitrogen during reactor operation.
20.	Provision of alternative or dedicated shutdown capability in certain fire areas.	G.3	NC	See Section 9A.3.2.2
	<u>Fire Brigade</u>			
21.	Requirements for the onsite fire brigade.	H	C	
	<u>Fire Brigade Training</u>			
22.	Requirements for training of fire brigade members.	I	AC	See Section 9A.3.2.2.
	<u>Emergency Lighting</u>			
23.	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.	J	C	See Section 9A.3.2.2.
	<u>Administrative Controls</u>			
24.	Establishment of administrative controls to minimize fire hazards.	K	C	
	<u>Alternative and Dedicated Shutdown Capability</u>			
25.	The 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 shutdown conditions, achieve cold shutdown conditions within 72 hours, and maintain cold shutdown conditions thereafter.	L.1	C	

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
26.	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.	L.1	C	
27.	performance goals for the shutdown functions.	L.2	C	The systems and components relied on for hot shutdown and cold shutdown in the event of a fire have been selected so as to ensure that the listed goals are achieved.
28.	The alternative shutdown capability shall be independent of the specific fire areas.	L.3	C	
29.	The shutdown capability shall accommodate postfire conditions where offsite power is available and where offsite power is not available for 72 hours.	L.3	C	All systems and components relied on for hot shutdown and cold shutdown in the event of a fire are capable of being powered from the onsite power supplies, i.e., the station batteries and standby diesel generators.
30.	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 shutdown condition shall be capable of maintaining such conditions until cold shutdown can be achieved.	L.4	C	
31.	If the equipment and systems comprising the means to achieve and maintain hot shutdown conditions 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.	L.4	NA	See Section 9A.3.2.2

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
32.	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 can be achieved within 72 hours.	L.5	C	
33.	Materials for such repairs shall be readily available onsite and procedures shall be in effect to implement such repairs.	L.5	C	See Section 9A.3.2.2.
34.	If the equipment and systems comprising the means to achieve and maintain cold shutdown conditions (and which are used prior to 72 hours after the fire) will not be capable of being powered by both offsite and onsite power systems because of fire damage, and independent onsite power system shall be provided.	L.5	NA	See Section 9A.3.2.2.
35.	Shutdown systems installed to ensure positive shutdown capability need not be designed to meet seismic Category I criteria, single failure criteria, or other design basis accident criteria, except where required for other reasons.	L.6	C	
36.	Isolation of safe shutdown equipment and systems from associated nonsafety circuits.	L.7	C	See Section 9A.6.1
	<u>Fire Barrier Cable Penetration Seal Qualification</u>			
37.	Requirement Deleted	M	N/A	The non-combustibility requirement for fire barrier penetration seals was deleted from 10 CFR 50 Appendix R as documented in the Federal Register, volume 65, No. 119, Tuesday June 20, 2000 (Doc. 00-15544).
38.	Penetration seal designs shall be qualified by tests that are comparable to tests used to rate fire barriers.	M	C	See Section 9A.3.2.2

NO.	APPENDIX R GUIDELINE	APPENDIX R ITEM NO.	COMPARISON	REMARKS
	Fire Doors			
39.	Acceptance criteria for tests of penetration seal designs.	M.1 M.2 M.3	C	The listed criteria are included in documents discussed under item 38.
40.	Fire doors shall be self-closing or provided with closing mechanisms.	N	AC	See Section 9A.3.2.2
41.	Fire doors shall be inspected semiannually to verify that automatic hold open, release, and closing mechanisms and latches are operable.	N	AC	Fire doors that are not electrically supervised will be inspected semiannually. For doors that are electrically supervised, this supervision provides continual verification that the doors are in the closed position.
42.	Alternative means for ensuring that fire doors protect the door opening as required in case of fire.	N.1 N.2 N.3 N.4	C	See Section 9A.3.2.2
43.	The fire brigade Leader shall have ready access to keys for any locked fire doors.	N	C	
44.	Areas protected by automatic total flooding gas suppression systems shall have electrically supervised self-closing fire doors or shall satisfy option 1 above.	N	C	The only automatic total flooding gas suppression systems are the halon systems in the areas under the raised floor of the auxiliary equipment room and the remote shutdown room. There are no fire doors into these areas.
	Oil Collection System for Reactor Coolant Pump			
45.	The reactor coolant pump shall be equipped with an oil collection system if the containment is not inerted during normal operation.	0	NA	The primary containment is inerted with nitrogen during normal reactor operation.

9A.3.2.2 Explanatory Notes for Appendix R Comparison

Item 3

Appendix R Guideline

These supplies shall be separated so that a failure of one supply will not result in a failure of the other supply.

LGS Design

The Unit 1 and Unit 2 circulating water systems are completely separate, so that any failures occurring in one system will not affect the other system. The two fire pumps are located in separate compartments within the circulating water pump structure. The connections of the fire pump discharge lines to the fire main loop are located underground to minimize the potential for damage to the piping.

Item 5

Appendix R Guideline

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.

LGS Design

Storage tanks are not used as the sources of fire protection water. As noted in items 2 and 4 of Section 9A.3.2.1, fire protection water is obtained from the cooling tower basins of the Unit 1 and Unit 2 circulating water systems, each of which has a storage capacity of 7,200,000 gallons. Although the cooling tower basins also serve as the water sources for the service water systems, the storage capacity of the cooling tower basins is sufficient to ensure an adequate water supply for both systems (service water and fire protection water) without dedicating a certain volume of water to either system.

One of the two cooling tower basins will become unavailable as a source of fire protection water if the basin is drained to allow maintenance of it, or if the stop logs are inserted in the 96 inch circulating water lines from the cooling tower to allow work on some portion of the circulating water system. In this situation, the fire pump suction valves from the affected circulating water line will be closed in order to avoid jeopardizing the operability of the fire pumps. The unaffected circulating water lines and cooling tower will remain available to provide fire protection water to both the fire pumps.

Item 6

Appendix R Guideline

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.

LGS Design

The suction piping of the fire pumps is permanently connected to the 96 inch circulating water lines that supply water from the cooling towers to the main condensers. Since there are no pumps or valves located in the circulating water lines between the cooling tower basins and the connection points of the fire pump suction lines, no realignments are necessary to make the circulating water system available to provide water to the fire pumps. Therefore, there are no active failures of the circulating water system that could degrade the fire main system, and no special requirements are needed for the circulating water pumps or their associated power supplies and controls.

Item 9

Appendix R Guideline

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.

LGS Design

Hose reels are located throughout the plant in areas that either contain systems and components important to safety or present an exposure fire hazard to such areas, with the exception of the spray pond pump structure. Fire suppression capability for the spray pond pump structure is provided by portable fire extinguishers.

As shown in Table 9A-1, the combustible loading in the various compartments of the spray pond pump structure is low enough that portable fire extinguishers are sufficient to extinguish any postulated fire. Those compartments that contain combustible materials are provided with fire detectors that annunciate in the control room. In addition, the spray pond pump structure is divided into two separate fire areas by a 3 hour rated fire wall along the centerline of the structure. A postulated fire in either fire area will leave at least one method available to safely shut the plant down.

Item 18

Appendix R Guideline

Except as provided for in paragraph G.3 of this section, where cables or equipment, including associated nonsafety circuits that could prevent operation or cause maloperation due to hot shorts, open circuits, or shorts to ground, of 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; or

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.

LGS Design

To the greatest extent practical, redundant trains of systems necessary to achieve and maintain hot shutdown are located in different fire areas, so that the redundant trains are separated by 3 hour fire barriers. In fire areas where this is not possible due to restrictions on equipment location and electrical cable routing, the capability to achieve hot shutdown is maintained by one of the following alternate means:

a. Enclosing the equipment and cabling of one redundant train in a 3 hour rated fire barrier.

b. Enclosing the equipment and cabling of one redundant train in a 1 hour rated fire barrier, and providing fire detection and automatic fire suppression in the fire area.

c. Dividing a fire area into two portions so that a fire is postulated to occur in only one portion at a time. Division of a fire area is accomplished by establishing a 20 foot wide zone that is free of combustible materials, and providing a water curtain suppression system within the combustible free zone. Components and equipment of redundant trains of systems that are necessary to achieve hot shutdown are located on opposite sides of the combustible free zone. Cables that are needed for operation of one redundant train and are routed through the portion of the fire area that contains equipment of the other redundant train are enclosed in a 3 hour rated fire barrier. Fire detection capability is provided on both sides of the combustible free zone.

d. Methods alternative to the foregoing are utilized in certain fire areas; these individual fire areas are discussed in Sections 9A.5.3, 9A.5.4, and 9A.5.5.

Item 20

Appendix R Guideline

Alternative or dedicated shutdown capability and its associated circuits, 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.

LGS Design

Systems whose function is required for hot shutdown are provided with protection against fire-caused damage in order to ensure that at least one of the redundant trains of these systems remains available in the event of a postulated fire and/or operation of a fire suppression system in any fire area or an alternative shutdown capability is provided to ensure that hot shutdown can be achieved. Alternative methods of shutdown are identified for fires which may occur in the control complex as discussed in Section 9A.5.3.

Components required for hot shutdown are designed so that rupture or inadvertent operation of fire suppression systems will not adversely affect the operability of these components. Where necessary, appropriate protection is provided to prevent impingement of water spray on components required for hot shutdown.

Alternative shutdown capability has been identified for fires that may occur in the control complex. However, a fixed fire suppression system may not be provided in the area, room, or zone under consideration. Compliance with Position C.5.c of BTP CMEB 9.5-1 is discussed in Section 9A.3.1.1, Item 76.

Item 22

Appendix R Guideline

Requirements for training of fire brigade members.

LGS Design

Fire Protection program objectives for training fire brigade members is accomplished by using a combination of in plant areas and an off-site training facility that simulates plant physical conditions. Drills are conducted in conformance with plant fire drill procedures.

An off-site facility enables drills to include the use of live fire conditions. These elements plus the use of breathing apparatus and full protective clothing create actual conditions that would be encountered during a real plant fire emergency. Additional drills, including backshift unannounced drills are conducted in plant areas throughout the year.

Item 23

Appendix R Guideline

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.

LGS Design

Fixed self-contained lighting units with individual 8 hour battery power supplies are provided in all areas to which access may be needed for manual actuation of safe shutdown of equipment, and in access and egress routes thereto. The locations where remote actions are required for achieving safe shutdown in the event of a postulated fire are listed in Table 9A-14. Self-contained battery powered lighting units will maintain a lighting level of at least nominal 0.5 footcandle in the listed areas and in access and egress paths thereto.

In addition to the self-contained individual battery powered lighting units, there is an emergency lighting system consisting of an ac subsystem and an ac/dc subsystem. The emergency ac lighting is powered from Class IE buses which automatically transfer to the standby diesel generators upon loss of the normal power source. Emergency ac lighting is provided throughout the plant to maintain minimum lighting levels necessary for access to and operation of equipment for a period greater than 24 hours. The general location of the emergency ac lighting and the associated lighting levels are shown on Table 9.5-12.

The emergency ac/dc lighting is normally powered from the Class IE buses. In the event of loss of the Class IE ac source, an automatic transfer switch immediately transfers this lighting to the 125 V dc non-Class IE station battery source. This power source will sustain the ac/dc lighting load on battery power for some period of time and could sustain the lights indefinitely if the diesel generator feeding the battery charger is available. All emergency ac/dc lighting fixtures are of the incandescent type. Emergency ac/dc lighting is provided throughout the plant to maintain minimum lighting levels necessary for access to and operation of equipment. The general location of the ac/dc lighting and the associated lighting levels are shown on Table 9.5-12.

The cables for both emergency lighting subsystems are routed exclusively in conduit, most of which is embedded in concrete. The locations of the power distribution buses and the cable routing for the two emergency lighting subsystems are separated to the extent practical such that a fire in any given area is not likely to cause the loss of both lighting subsystems in areas to which access is needed for the operation of safe shutdown equipment.

Item 31

Appendix R Guideline

If the equipment and systems comprising the means to achieve and maintain hot shutdown conditions 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.

LGS Design

There is no postulated fire in any given fire area that could cause the simultaneous loss of both the offsite and onsite power supplies. Therefore, an additional redundant onsite power supply is not needed to ensure that safe shutdown can be achieved.

Item 33

Appendix R Guideline

Materials for such repairs shall be readily available onsite and procedures shall be in effect to implement such repairs.

LGS Design

A total of six different types of repair actions may be needed in order to compensate for the effects of fire-caused damage to equipment and systems involved in achieving and maintaining cold shutdown conditions. The six types of repair actions are described below.

a. It may be necessary to install a temporary cable in order to provide power to the ADS valves or the MSRVs and monitoring instruments at the Remote Shutdown Panel. The repair action is intended to ensure continued availability of electrical power to the ADS valves or MSRVs so that the valves can be opened by operators at the Control Room, PGCC, or Remote Shutdown Panel as necessary. In the case of power for the operation of the MSRVs from the Remote Shutdown Panel, power is also provided for the continued operation of Reactor Vessel and Suppression Pool instrumentation at the RSP. This repair action is only needed in the event of a loss of the ac power supplies to the battery chargers associated with the normal dc battery power supply. The temporary cable will be used to supply power from the Division 2 dc distribution panel to either the Division 1 or Division 3 circuit that provides power to the ADS valves or the MSRVs/RSP instruments.

b. The design of the ESW system includes intertie lines with both the Unit 1 service water system and the Unit 2 service water system. The intertie lines that allow water in the ESW piping to return to the service water system are each provided with two redundant air-operated isolation valves in series. When a given loop of the ESW system is placed in operation, the intertie lines associated with that particular loop need to be isolated in order to prevent long-term diversion of water from the ESW system to the service water system. It may be necessary to remove the air supply tubing for individual isolation valves to ensure that at least one valve in each intertie line closes and remains closed. This action is needed only if both isolation valves in a given intertie line remain open and cannot be reclosed during the first 24 hours of ESW system operation. The isolation valves affected are HV-011-043, HV-011-048, HV-011-121, HV-011-124, HV-011-125, HV-011-221, and HV-011-225.

c. A source of compressed gas may be required to support ADS valve or MSRV operation. The gas is required to allow opening of the valves as required for depressurization and shutdown. An air jumper will be used to connect the tank of a diesel generator air start system to the primary containment instrument gas system. Another air jumper will be connected to open valve HV-059-1(2)29B and leads to valve SV-059-1(2)52A or B may be cut to open it and allow the compressed gas system to function. This repair is only required if the primary containment instrument gas system does not operate.

d. If the Control Room or Auxiliary Equipment Room HVAC system becomes unavailable due to fire damage, it may be necessary to provide a temporary means of ventilating the affected rooms. Ventilation for the control room will need to be re-established no earlier than nine hours after the loss of HVAC. Ventilation of the auxiliary equipment room and remote shutdown panel room will need to be re-established no earlier than seven hours after the loss of HVAC. Ventilation of the 4

kV switchgear rooms and static inverter rooms via natural convection will need to be re-established no earlier than four hours after the loss of HVAC. If necessary, a temporary ventilation capability will be established for the main control room, auxiliary equipment room and remote shutdown panel area by setting up portable fans and flexible duct-work and by opening doors to create an air flow pathway. The portable fans will be powered from either an onsite power source or a mobile diesel generator. A diesel generator that is dedicated to this service is stored onsite in a readily accessible location. Operability of the diesel generator will be ensured by a surveillance and maintenance program. This repair is only required if the normal HVAC fails as a result of the fire.

e. If the Spray Pond Pump Structure HVAC becomes unavailable due to fire damage, it may be necessary to provide a temporary means of ventilating the structure. Ventilation of the structure needs to be re-established no earlier than four and a half hours after the loss of HVAC. If necessary, a repair will be performed to establish a flow path for natural convection through the structure. In addition to opening doors in the spray pond pump structure, it will be necessary to partially disassemble a damper mechanism in order to permit the damper to be opened manually. This repair is only required if the normal HVAC fails as a result of the fire.

f. It may be necessary to utilize existing station procedures for "Loss of Shutdown Cooling" to establish a flow path for RHR shutdown cooling. Permissives to open the shutdown cooling suction line inboard and outboard isolation valves and the shutdown cooling return line outboard isolation valves are not included in the FSSD model and may not be available post-fire. Existing station procedures provide direction to Operations to establish the shutdown cooling flow path. Repair actions will operate the valves at the MCC via the use of jumpers.

For all six types of repairs described above, the tools and materials needed to perform the repairs are stored in readily accessible locations on site. Procedures governing the implementation of the repairs are in effect.

Item 34

Appendix R Guideline

If the equipment and systems comprising the means to achieve and maintain cold shutdown conditions (and which are used prior to 72 hours after the fire) will not be capable of being powered by both onsite and offsite power systems because of fire damage, an independent onsite power system shall be provided.

LGS Design

There is no postulated fire in any given fire area that could cause the simultaneous loss of both the offsite and onsite power supplies. Therefore, an additional redundant onsite power supply is not needed for permanent plant equipment to ensure that safe shutdown can be achieved. A mobile diesel generator is stored onsite for use in providing power to temporary fans that may be needed to provide ventilation for the control room, auxiliary equipment room, and remote shutdown room.

Item 38

Appendix R Guideline

Penetration seal designs shall be qualified by tests that are comparable to tests used to rate fire barriers.

LGS Design

The designs of penetration seals in fire-rated barriers are tested to verify that the penetration seals are adequate to provide a specific degree of protection against the propagation of fire through the barriers. These tests are performed in accordance with the guidelines provided in the following documents:

a. Institute of Electrical and Electronics Engineers, IEEE 634 (1978), "IEEE Standard Cable Penetration Fire Stop Qualification Test".

b. NRC, Draft Regulatory Guide, "Qualification Test for Cable Penetration Fire Stops for Use in Nuclear Power Plants", (July 1979).

c. NEL-PIA/MAERP, "Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops", (February 1976).

d. American Nuclear Insurers, "ANI Position on Fire Stop Test Standards", (September 1979).

Item 40

Appendix R Guideline

Fire doors shall be self-closing or provided with closing mechanisms.

LGS Design

With the exception of watertight doors, all fire doors are provided with one of the following two features:

a. A self-closer to ensure that a normally closed door returns to the closed position after someone passes through it.

b. An automatic closing mechanism to ensure that a normally open door will close if there is a fire in the vicinity of the door.

Watertight doors that also serve as fire doors cannot be provided with self-closers or automatic closing mechanisms, due to the inherent restrictions of their design and function. These watertight doors are electrically supervised or inspected daily.

Item 42

Appendix R Guideline

One of the following measures shall be provided to ensure they will protect the opening as required in case of fire:

a. Fire doors shall be kept closed and electrically supervised at a continuously manned location;

b. Fire doors shall be locked and inspected weekly to verify that the doors are in the closed position;

c. Fire doors shall be provided with automatic hold open and release mechanisms and inspected daily to verify that doorways are free of obstructions; or

d. Fire doors shall be kept closed and inspected daily to verify that they are in the closed position.

LGS Design

Appropriate steps are taken to ensure that safe shutdown fire doors either are closed or will close when required in the event of a fire. One of the four measures listed above is followed for each safe shutdown fire door .

9A.4 EVALUATION OF POTENTIAL FIRE HAZARDS

9A.4.1 SCOPE OF EVALUATION

This chapter provides an evaluation of the potential for occurrence of fires within the plant and a summary of the capabilities of the existing fire protection program. This evaluation was performed for all structures that contain safety-related equipment or could affect safety-related structures by virtue of the fire hazards present.

A review of the plant was made to identify the combustible materials present, quantify the fire hazard in terms of combustible loading, and relate the potential hazard to the capabilities of the existing fire barriers and fire suppression systems. This information is presented in Table 9A-1 which lists the type of combustible materials present in each fire zone, the corresponding combustible loading, and the availability of detection and suppression equipment. Figures 9A-4 through 9A-12 show the locations of the fire zones, fire barriers, and fire suppression coverage.

9A.4.2 PROCEDURE

The evaluation of fire hazards was performed using a procedure that is summarized by the following steps:

a. For identification purposes, the various structures of the plant were divided into specific fire areas. A fire area is defined as that portion of a structure that is separated from other areas by boundaries (walls, floors, and ceilings) which are of a type of construction which is sufficient to prevent the spread of fire across the boundary, considering the combustible loading in the area. Many fire areas were further subdivided into fire zones to permit more precise identification of the locations of combustible materials, fire detection and suppression systems, and components associated with safety-related systems. The breakdown into fire zones was based on the locations of interior walls and slabs within each fire area. Fire areas are identified by a unique number, and fire zones within the same fire area are identified by a subletter. The fire area and fire zone designations are listed in Table 9A-1 "AREA-ZONE".

b. Each fire zone was surveyed to determine the type, quantity, and distribution of combustible materials present.

c. The combustible loading for each fire zone is determined based on the quantity of combustible materials present and the heat of combustion of each type of combustible material. The heat of combustion values used in this analysis are listed in Table 9A-2. The quantity of each type of combustible material (UNIT) is multiplied by the appropriate heat of combustion (BTU/UNIT) to determine the heat release (BTU) of each type of combustible material. The total heat release of all combustibles in the fire zone was then calculated by adding the heat release of each combustible material. To obtain the combustible loading (in BTU/ft^2) for each fire zone, the total heat release (in BTU) was divided by floor area of the fire zone.

d. The methodology for calculating fire severity (hours) is based on information presented in the 17^{th} edition of the NFPA Handbook. The methodology uses the relationship between the calculated fire load in an area and an exposure to a fire severity which is equivalent to the standard time-temperature curve which is used

as the exposure fire in the fire resistance rating tests (ASTM E-119). The steps involved in calculating fire severity are as follows:

1. Calculate the fire load (BTU/ft^2) for an area as stated within the methodology.

2. Divide the calculated fire load by 80,000 BTU/ft ^{2}hr to obtain fire severity:

$$\text{Fire Severity} = \frac{\text{Fire Load BTU / ft}^2}{\text{80,000 BTU / ft}^2\text{ hr}}$$

e. The clarification of the fire loading in a zone is based on the results of fire loading studies performed by the British (contained in the 17 ^{h} edition of the Fire Protection Handbook). The results of the study show that the loading in an occupancy can be classified as low, moderate, or high, defined by the fire loading (BTU/ft^2) of the occupancy. The classifications are defined as follows:

Low - The fire load of a zone is classified as low if it does not exceed an average of 60,000 BTU/ft^2 of floor area. This loading corresponds to a fire severity of 45 minutes using the standard time temperature curve (ASTM E-119). Classification of fire load in a fire zone or area as low identifies the zone as having a fire severity below that which could be expected to be contained within a 1-hr fire rated enclosure.

Moderate - The fire load of a zone is classified as moderate if it exceeds an average of 60,000 BTU/ft^2 but does not exceed an average of 140,000 BTU/ft^2 of floor area. This loading corresponds to a fire severity of 1 hour, 45 minutes using the standard time temperature curve. Classification of fire load in fire zone or area as moderate identifies the zone as having a fire severity below that which could be expected to be contained within a 2-hr fire rated enclosure.

High - The fire load of a zone is classified as high if it exceeds an average of 140,000 BTU/ft^2 of floor area. This loading corresponds to a fire severity in excess of 1 hour, 45 minutes using the standard time temperature curve. Classification of fire zone or area as high identifies the zone as having a fire severity which could be expected to be contained within a 3-hour fire rated enclosure provided the defense in depth concept has been provided for high hazard concentrations of combustibles.

No Combustibles Allowed - Item 112 of Section 9A.3.1.2, Explanatory Notes for Comparison to Branch Technical Position CMEB 9.5-1 address a deviation from the installation of automatic fire detection in certain fire zones based on the lack of combustible material located in these

areas. Therefore, in order to comply with the commitments identified in item 112 no combustible materials are allowed.

Control of Combustibles - The NRC granted a deviation on separation requirements based on fire protection defense-in-depth features and low combustible loading. In order to maintain the basis for the deviation from separation requirements, the combustible loading in these areas shall be controlled. Any increase in combustible loading shall be reviewed and approved by the licensee's fire protection engineer.

9A.5 ANALYSIS OF CAPABILITY TO ACHIEVE SAFE SHUTDOWN

9A.5.1 METHODOLOGY

This chapter provides an evaluation of the effects of postulated fires in each fire area on the ability of the operator to achieve a safe shutdown of the plant. Of the numerous possible combinations of equipment that could be used to effect a safe shutdown, four specific combinations were selected for detailed study for the purposes of this evaluation. These four shutdown methods are described in Section 9A.5.2.

In performing the safe shutdown analysis, the four shutdown methods were examined to determine the minimum equipment, control, and power requirements for operability of each method. The locations of the equipment itself and the cabling associated with the required equipment were identified with respect to the various fire areas.

Each fire area was then examined to determine which components associated with the shutdown methods, if any, would be rendered inoperable by the occurrence of a fire within the fire area. The results of the safe shutdown analysis are summarized in Sections 9A.5.3 through 9A.5.9 for each fire area.

The following assumptions were used in performing the safe shutdown analysis:

a. No credit is taken for manual fire fighting efforts or the operation of automatic fire suppression systems. The fire is assumed to disable all equipment and electrical cabling located in the fire area, unless the fire hazard analysis demonstrates otherwise. An electrical cable tray fire is assumed not to propagate from one tray to another, since separation is provided in accordance with Regulatory Guide 1.75.

b. Plant accidents and severe natural phenomena are not considered to occur concurrently with the postulated fire.

c. A single active component failure is not assumed to occur concurrently with the fire.

d. Credit is taken for reactor trip. Any fire affecting the RPS or the CRD circuitry will not prevent the reactor from being tripped. A reactor trip can be performed manually (in the control room), automatically (by the RPS logic), or by tripping the RPS power supplies (in the auxiliary equipment room).

e. No credit is taken for proper operation or proper positioning of equipment which is not separated or protected in accordance with the guidelines of 10CFR50, Appendix R, unless the safe shutdown analyses presented in Sections 9A.5.3 and 9A.5.4 demonstrate the adequacy of the existing design. For such equipment, loss of operability or spurious operation is assumed, whichever is more conservative. This assumption provides a worst case analysis regarding spurious signals associated with cabling failures in a fire area.

f. For Alternative or Dedicated Shutdown Capability as defined in Chemical Mechanical Engineering Branch Technical Position (CMEBTP) 9.5-1, "Fire Protection Program", and 10CFR50, Appendix R, III, L, offsite power is assumed to be unavailable during the first 72 hours after the onset of the fire. However, no

credit is taken for loss of offsite power in situations for which a loss of offsite power would be advantageous.

g. For Safe Shutdown, as defined in Chemical Mechanical Engineering Branch Technical Position 9.5-1, (CMEBTP) "Fire Protection Program", and 10CFR50, Appendix R, III, offsite power is assumed to be available: except if the fire would cause a loss of offsite power.

One single spurious operation of a non-high/low pressure interface FSSD component is postulated to occur for a fire event. Any number of hot shorts, open circuits, or shorts to ground may occur, but they will result in only one single spurious actuation. Three phase hot shorts of the proper voltage and phase sequence capable of spuriously operating a device are not postulated.

In the discussions of individual fire areas contained in Sections 9A.5.3 through 9A.5.9, paragraph (c) addresses the nature of the fire that is postulated to occur in each fire area. Paragraph (c) relates to potential fires involving in situ combustible materials, and does not preclude the postulation of fires involving transient combustibles. In all cases, the safe shutdown analysis and the resulting fire protection features for each fire area are based on the potential for an exposure fire to affect all components and cables within the fire area.

Those floor slabs identified by an asterisk following the indicated fire rating in the fire area discussions contained in Sections 9A.5.3 through 9A.5.9 are discussed in Item 37 of Section 9A.3.1. Those fire doors identified in Sections 9A.5.3 through 9A.5.9 by a double asterisk (**) following the indicated fire rating are discussed in Item 48 of Section 9A.3.1.

9A.5.2 DESCRIPTION OF REACTOR SHUTDOWN METHODS

The following sections provide descriptions of methods that can be used for reactor shutdown and cooldown. Each of these methods includes a system by which makeup water can be added to the reactor vessel, a system by which energy can be removed from the reactor vessel, and any support systems needed to accommodate energy removal to an ultimate heat sink or to return water to its supply source.

Although the safe shutdown analysis for the various fire areas places primary emphasis on achievement of reactor shutdown using the methods described below, many alternative shutdown methods would be available. Use of safety-related and nonsafety-related systems not addressed in the safe shutdown analysis, plus manual operation of certain equipment and controls, would provide numerous combinations of systems with adequate capability to safely shut the plant down.

9A.5.2.1 Reactor Shutdown With Balance of Plant Cooling Systems Available

After the turbine-generator has been tripped and all control rods inserted into the reactor core during the course of a normal shutdown and cooldown, reactor decay heat and sensible heat is removed by bypassing main steam to the condenser. Heat is removed from the condenser by the circulating water system and rejected to the atmosphere by the cooling tower. Makeup water is supplied to the reactor vessel by the condensate and feedwater system, taking suction on the condenser hotwell. When the reactor has been depressurized below a nominal 75 psig, the RHR system is initiated in the shutdown cooling mode of operation. In this mode, reactor water is circulated through the RHR heat exchangers, where it is cooled by the RHRSW system. Heat is rejected from the RHRSW system to the atmosphere by using either the cooling tower or the spray pond. The reactor vent valves are opened when reactor pressure reaches atmospheric.

9A.5.2.2 Reactor Shutdown Without Balance of Plant Cooling Systems Available

Four specific methods of achieving cold shutdown and maintaining the plant in that condition have been defined for use in analyzing the capability to safely shut the plant down in the event of a fire. Three of the specific shutdown methods (designated as methods A, B and C) are directed from the Main Control Room and may be supplemented by local operator actions, including actions at the Remote Shutdown Panel (RSP). The fourth shutdown method (designated as method R) is directed from the RSP and may be supplemented by local operator actions. Shutdown methods A, B, C and R each include systems and components necessary to accomplish the major functions of (a) providing makeup water to the reactor vessel, (b) depressurizing the reactor vessel, and (c) removing decay heat and sensible heat from the primary containment. The systems in each shutdown method that are directly relied on for accomplishing these functions are as follows:

Shutdown Method	Pressure Control	Inventory Control	Decay Heat Removal (Vessel)	Decay Heat Removal (Pool)
A	ADS or MSRV	RCIC	RHR in Shutdown Cooling Mode or Alternate Shutdown Cooling Mode	RHR in the Suppression Pool Cooling Mode
B	ADS or MSRV	HPCI	RHR in Shutdown Cooling Mode or Alternate Shutdown Cooling Mode	RHR in the Suppression Pool Cooling Mode
C	ADS or MSRV	RHR in the LPCI Mode	RHR in Shutdown Cooling Mode or Alternate Shutdown Cooling Mode	RHR in the Suppression Pool Cooling Mode
R	MSRV	RCIC	RHR (Loop A) in Shutdown Cooling Mode	RHR (Loop A) in the Suppression Pool Cooling Mode

The main safe shutdown components that may be relied upon to achieve safe shutdown using these methods are listed in Table 9A-4.

Method A

After closure of the Main Steam Isolation Valves (MSIVs), the RCIC system is used to supply makeup water to the reactor vessel from the suppression chamber. The operation of the RCIC system also removes energy from the reactor in the form of steam to drive the RCIC turbine. During the period in which steam is generated at a rate greater than the consumption of the RCIC system, steam is relieved to the suppression pool by automatic actuation of the Main Steam Relief Valves (MSRV's), which open when reactor pressure reaches the valve setpoint. Heat is removed from the suppression pool by operating a loop of the RHR system in the suppression pool cooling mode. In this mode, water from the suppression pool is circulated through the RHR heat exchanger and then returned to the suppression pool. In order to initiate

operation of the shutdown cooling mode of the RHR system, it is necessary to depressurize the reactor below a nominal pressure of 75 psig. This is accomplished by using the ADS valves or MSRV's to discharge steam to the suppression pool. When the reactor has been depressurized below 75 psig, operation of the RCIC system is terminated and the RHR system is switched from the suppression pool cooling mode to the shutdown cooling mode. An alternate shutdown cooling mode has been defined and may be used with Method A instead of the standard shutdown cooling mode. This involves using the RHR pump to circulate water from the suppression pool through the RHR heat exchanger and discharge it into the reactor vessel through the LPCI injection line or through the shutdown cooling return line to the reactor recirculation loop. Water from the reactor vessel is returned to the suppression pool by opening one or more of the ADS valves or MSRVs. The water level in the reactor vessel rises to the main steam line nozzles , allowing water to partially fill the main steam lines and then flow through the open relief valve and down the MSRV discharge line to the suppression pool.

In the suppression pool cooling mode and the shutdown cooling modes, heat is removed from the RHR heat exchanger by the RHRSW system, which in turn dissipates heat at the spray pond. The shutdown cooling or alternate shutdown cooling mode of RHR will maintain the reactor in a cold shutdown condition.

Depending on the location of a fire within the plant, certain operations that are used in this shutdown method may need to be performed manually from outside the control room. The specific operations are identified in Table 9A-14.

Method B

After closure of the Main Steam Isolation Valves (MSIVs), the HPCI system is used to supply makeup water to the reactor vessel from the suppression chamber. The operation of the HPCI system also removes energy from the reactor in the form of steam to drive the HPCI turbine. During the period in which steam is generated at a rate greater than the consumption of the HPCI system, steam is relieved to the suppression pool by automatic actuation of the Main Steam Relief Valves (MSRV's), which open when reactor pressure reaches the valve setpoint. Heat is removed from the suppression pool by operating a loop of the RHR system in the suppression pool cooling mode. In this mode, water from the suppression pool is circulated through the RHR heat exchanger and then returned to the suppression pool. In order to initiate operation of the shutdown cooling mode of the RHR system, it is necessary to depressurize the reactor below a nominal pressure of 75 psig. This is accomplished by using the ADS valves or MSRV's to discharge steam to the suppression pool. When the reactor has been depressurized below 75 psig, operation of the HPCI system is terminated and the RHR system is switched from the suppression pool cooling mode to the shutdown cooling mode. An alternate shutdown cooling mode has been defined and may be used with Method B instead of the standard shutdown cooling mode. This involves using the RHR pump to circulate water from the suppression pool through the RHR heat exchanger and discharge it into the reactor vessel through the LPCI injection line or through the shutdown cooling return line to the reactor recirculation loop. Water from the reactor vessel is returned to the suppression pool by opening one or more of the ADS valves or MSRVs. The water level in the reactor vessel rises to the main steam line nozzles , allowing water to partially fill the main steam lines and then flow through the open relief valve and down the MSRV discharge line to the suppression pool.

In the suppression pool cooling mode and the shutdown cooling modes, heat is removed from the RHR heat exchanger by the RHRSW system, which in turn dissipates heat at the spray

pond. The shutdown cooling or alternate shutdown cooling mode of RHR will maintain the reactor in a cold shutdown condition.

Depending on the location of a fire within the plant, certain operations that are used in this shutdown method may need to be performed manually from outside the control room. The specific operations are identified in Table 9A-14.

Method C

After closure of the MSIVs, the reactor is depressurized by manually controlling the valves of the ADS or three or more MSRVs. The opening of these valves allows reactor steam to be discharged to the suppression pool. Makeup water is supplied to the reactor vessel from the suppression pool by operating a loop of the RHR system in the LPCI mode after reactor pressure has decreased to a nominal 295 psig. When the reactor has been depressurized below 75 psig, the RHR system is switched from the suppression pool cooling mode to the shutdown cooling mode. An alternate shutdown cooling mode has been defined and may be used with method C instead of the standard shutdown cooling mode. This involves using the RHR pump to circulate water from the suppression pool through the RHR heat exchanger and discharge it into the reactor vessel through the LPCI injection line or through the shutdown cooling return line to the reactor recirculation loop. Water from the reactor vessel is returned to the suppression pool by opening one or more of the ADS valves or MSRVs. The water level in the reactor vessel rises to the main steam line nozzles , allowing water to partially fill the main steam lines and then flow through the open relief valve and down the MSRV discharge line to the suppression pool.

In the suppression pool cooling mode and the shutdown cooling modes, heat is removed from the RHR heat exchanger by the RHRSW system, which in turn dissipates heat at the spray pond. The shutdown cooling or alternate shutdown cooling mode of RHR will maintain the reactor in a cold shutdown condition.

Depending on the location of a fire within the plant, certain operations that are used in this shutdown method may need to be performed manually from outside the control room. The specific operations are identified in Table 9A-14.

Method R - Reactor Shutdown from Outside the Control Room

In the unlikely event that a fire disables or requires evacuation of the Control Room, an alternative shutdown capability is provided compliant with Position C.5.c of BTP CMEB 9.5-1. The capability is designated as shutdown method R and is used to effect a plant shutdown directed from the Remote Shutdown Panel (RSP).

The shutdown sequence is similar to Shutdown Method A except that the methodology is centered around equipment that may be controlled from the RSP. After closure of the Main Steam Isolation Valves (MSIVs), the RCIC system is used to supply makeup water to the reactor vessel from the suppression chamber. The operation of the RCIC system also removes energy from the reactor in the form of steam to drive the RCIC turbine. During the period in which steam is generated at a rate greater than the consumption of the RCIC system, steam is relieved to the suppression pool by automatic actuation of the Main Steam Relief Valves (MSRVs), which open when reactor pressure reaches the valve setpoint. Heat is removed from the suppression pool by operating the A loop of the RHR system in the suppression pool cooling mode. In this mode, water from the suppression pool is circulated through the RHR heat

exchanger and then returned to the suppression pool. In order to initiate operation of the shutdown cooling mode of the RHR system, it is necessary to depressurize the reactor below a nominal pressure of 75 psig. This is accomplished by using the MSRVs A, C, and N to discharge steam to the suppression pool. When the reactor has been depressurized below 75 psig, operation of the RCIC system is terminated and the A loop of the RHR system is switched from the suppression pool cooling mode to the shutdown cooling mode. In the suppression pool cooling mode and the shutdown cooling modes, heat is removed from the RHR heat exchanger by the RHRSW system, which in turn dissipates heat at the spray pond. The shutdown cooling mode of RHR will maintain the reactor in a cold shutdown condition.

Depending on the location of a fire within the plant, certain operations that are used in this shutdown method may need to be performed manually from outside the control room. The specific operations are identified in Table 9A-14.

9A.5.3 SAFE SHUTDOWN ANALYSIS - CONTROL STRUCTURE

9A.5.3.1 Fire Area 1: Recombiner Compartments, Condensate Backwash Compartments, and Control Structure Water Chiller Areas (el 180'-0" and 200'-0")

a. Structural and architectural design features of fire area (Figures 9A-4 and 9A-5):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	N - Reinforced concrete (part; contains 5 ft^2 of unrated metal blowout panels)	3 hr
	N - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part below el 200'-0")	3 hr
	S - Concrete masonry unit (part above el 200'-0", eastern half)	3 hr
	S - Concrete masonry unit (part above el 200'-0", western half, contains two HVAC penetrations without fire dampers)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Steamtight door connecting to stairwell no. 7	1.5 hr
	Double steamtight doors connecting to areas 89 and 102	3 hr**

b. Major safety-related components in fire area:

1. Control structure water chillers 0AK112 and 0BK112

2. Control structure chilled water circulation pumps 0AP162 and 0BP162

c. Postulated fire in area:

1. Ignition of electrical cabling in cable trays. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of oil in a waste oil collection drum associated with the floor drain sump oil removal belt.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 1 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are either: encapsulated by qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

9A.5.3.2 <u>Fire Area 2: 13 kV Switchgear Area (el 217'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Concrete masonry unit - (part adjacent to battery rooms)	3 hr
	E -	Reinforced concrete - (remainder)	3 hr
	S -	Reinforced concrete	3 hr
	W -	Reinforced concrete (part)	3 hr
	W -	Concrete masonry unit (part adjacent to battery rooms)	3 hr
	W -	Reinforced concrete (part adjacent to stairwell no. 7)	2 hr

Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Door connecting to stairwell no. 7	1.5 hr
	Doors connecting to areas 3, 4, 5, and 6	3 hr
	Double steamtight doors connecting to areas 94, 107, and 113	3 hr**

b. Major safety-related components in fire area:

1. Emergency switchgear and battery room fan cabinets OAV118 and OBV118 and associated ventilation dampers

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to the area.

A localized sprinkler system is provided in the area adjacent to the Column Line “J” wall, to provide protection for 1-hour encapsulated safe shutdown cables. When the temperature in the area reaches a nominal 200°F, combined with a smoke detection signal, the sprinklers will open to control the fire.

e. Effect of fire on safe shutdown:

Fire area 2 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Units 1 and 2 are either: encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, method C will be available to shutdown Units 1 and 2.

9A.5.3.3 <u>Fire Area 3: Unit 1 Class 1E Battery Room (el 217'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	2 hr
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (See Section 9A.3.1.2, Item 46)	3 hr*
Access:	Door connecting to area 2	3 hr

b. Major safety-related components in fire area:

1. Class 1E battery 1DD101 (Div. 4)

2. Battery charger 1DD103

3. Fuse box 1DD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detector, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 3 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.3.4 Fire Area 4: Unit 1 Class 1E Battery Room (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (See Section 9A.3.1.2, Item 46)	3 hr*
Access:	Door connecting to area 2	3 hr

b. Major safety-related components in fire area:

1. Class 1E battery 1CD101 (Div. 3)

2. Battery charger 1CD103

3. Fuse box 1CD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detector, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 4 contains safe shutdown cables and equipment.

Cables associated with shutdown method A for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method A for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.3.5 Fire Area 5: Unit 2 Class 1E Battery Room (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete E - Reinforced concrete S - Concrete masonry unit W - Concrete masonry unit	3 hr 3 hr 3 hr 3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (See Section 9A.3.1.2, Item 46)	3 hr*
Access:	Door connecting to area 2	3 hr

b. Major safety-related components in fire area:

1. Class 1E battery 2DD101 (Div. 4)

2. Battery charger 2DD103

3. Fuse box 2DD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detector, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 5 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1

and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.3.6 Fire Area 6: Unit 2 Class 1E Battery Room (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete	3 hr
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (See Section 9A.3.1.2, Item 46)	3 hr*
Access:	Door connecting to area 2	3 hr

b. Major safety-related components in fire area:

1. Class 1E battery 2CD101 (Div. 3)
2. Battery charger 2CD103
3. Fuse box 2CD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 6 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1

and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.3.7 Fire Area 7: Corridor (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Doors connecting to areas 9, 11, 13, 15, 17, and 19	3 hr
	Steamtight doors connecting to areas 97 and 110	3 hr**

b. Major safety-related components in fire area: None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. When the temperature in the area reaches a nominal 200°F, the sprinkler will open to control the fire. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to the area.

e. Effect of fire on safe shutdown:

Fire area 7 contains safe shutdown cables but does not contain safe shutdown equipment.

Cables required to support shutdown methods A and C for Units 1 and 2 are either: encapsulated by a qualified fire barrier, associated with equipment that have redundant

components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

9A.5.3.8 Fire Area 8: Unit 1 Class 1E Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 9	3 hr
	Steamtight door connecting to area 113	3 hr

b. Major safety-related components in fire area:

1. Class 1E batteries 1B1D101 and 1B2D101 (Div. 2)
2. Battery chargers 1B1D103 and 1B2D103
3. Fuse box 1BD105
4. Class 1E dc distribution panels 1BD162 (Div. 2) and 1DD162 (Div. 4)

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 8 contains safe shutdown cables and equipment.

Cables associated with shutdown methods A and C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 1 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

9A.5.3.9 Fire Area 9: Unit 1 Class 1E Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Doors connecting to areas 7 and 8	3 hr

b. Major safety-related components in fire area:

1. Class 1E batteries 1A1D101 and 1A2D101 (Div. 1)

2. Battery chargers 1A1D103 and 1A2D103

3. Fuse box 1AD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors which will cause an audible/visual annunciation to register on the fire protection panels in the control

room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 9 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

9A.5.3.10 Fire Area 10: Unit 2 Class 1E Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 11	3 hr
	Steamtight door connecting to area 113	3 hr

b. Major safety-related components in fire area:

1. Class 1E batteries 2B1D101 and 2B2D101 (Div. 2)
2. Battery chargers 2B1D103 and 2B2D103
3. Fuse box 2BD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control

room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 10 contains safe shutdown cables and equipment.

Cables associated with shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 1 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area. The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2.

9A.5.3.11 Fire Area 11: Unit 2 Class 1E Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete	3 hr
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Doors connecting to areas 7 and 10	3 hr

b. Major safety-related components in fire area:

1. Class 1E batteries 2A1D101 and 2A2D101 (Div. 1)
2. Battery chargers 2A1D103 and 2A2D103
3. Fuse box 2AD105

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 11 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.

9A.5.3.12 Fire Area 12: Unit 1 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr§
	E - Concrete masonry unit	3 hr§
	S - Concrete masonry unit	3 hr§
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 13	3 hr
	Steamtight door connecting to area 113	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 12 from fire areas 13, 14, and 113.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 10A117 (Div. 3)

2. Class 1E dc distribution panels 1CD102 and 1CD162 (Div. 3)
3. Class 1E instrument ac distribution panel 10Y103 (Div. 3)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 12 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions may be taken to recover any functions that could be lost. Equipment associated with shutdown methods A, B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.13 Fire Area 13: Unit 1 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

		Construction	Rating
Walls:	N -	Concrete masonry unit	3 hr§
	E -	Concrete masonry unit	3 hr§

S - Concrete masonry unit 3 hr
W - Concrete masonry unit 3 hr

Floor: Reinforced concrete 3 hr*

Ceiling: Reinforced concrete 3 hr

Access: Doors connecting to areas 7 and 12 3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 13 from fire areas 12 and 15.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 10A115 (Div. 1)
2. Class 1E dc distribution panels 1AD102 and 1AD162 (Div. 1)
3. Class 1E instrument ac distribution panel 10Y101 (Div. 1)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 13 contains safe shutdown cables and equipment.

Cables associated with shutdown methods B and C for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Units 1 & 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.14 Fire Area 14: Unit 1 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Concrete masonry unit	3 hr§
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 15	3 hr
	Steamtight door connecting to area 113	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 14 from fire areas 12 and 16.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 10A118 (Div. 4)

2. Class 1E instrument ac distribution panel 10Y104 (Div. 4)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 14 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.15 Fire Area 15: Unit 1 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Concrete masonry unit	3 hr§
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Doors connecting to areas 7 and 14	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 15 from fire areas 13 and 17.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 10A116 (Div. 2)
2. Class 1E instrument ac distribution panel 10Y102 (Div. 2)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 15 contains safe shutdown cables and equipment.

Cables associated with shutdown methods A and C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 1 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.16 Fire Area 16: Unit 2 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Concrete masonry unit	3 hr§
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*

Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 17	3 hr
	Steamtight door connecting to area 113	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 16 from fire areas 14 and 18.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 20A118 (Div. 4)

2. Class 1E instrument ac distribution panel 20Y104 (Div. 4)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 16 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.17 Fire Area 17: Unit 2 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Concrete masonry unit	3 hr§
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Doors connecting to areas 7 and 16	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 17 from fire areas 15 and 19.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 20A116 (Div. 2)

2. Class 1E instrument ac distribution panel 20Y102 (Div. 2)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 17 contains safe shutdown cables and equipment.

Cables associated with shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C

for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.18 Fire Area 18: Unit 2 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr§
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr§
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 19	3 hr
	Steamtight door connecting to area 113	3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 18 from fire areas 16, 19, and 113.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 20A117 (Div. 3)

2. Class 1E dc distribution panel 2CD102 (Div. 3)

3. Class 1E instrument ac distribution panel 20Y103 (Div. 3)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 18 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.19 Fire Area 19: Unit 2 4 kV Switchgear Compartment (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr§
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr§
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr

Access: Doors connecting to areas 7 and 18 3 hr

Walls denoted above by the "§" symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4 kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in each of the walls indicated above. These walls separate fire area 19 from fire areas 17 and 18.

b. Major safety-related components in fire area:

1. Class 1E 4 kV switchgear 20A115 (Div. 1)

2. Class 1E dc distribution panel 2AD102 (Div. 1)

3. Class 1E instrument ac distribution panel 20Y101 (Div. 1)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 19 contains safe shutdown cables and equipment.

Cables associated with shutdown methods B and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.

f. Deviations:

The unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts are a deviation from the requirements of CMEB 9.5-1, C.5.b. See section 9A.6.3.

9A.5.3.20 Fire Area 20: Unit 1 Static Inverter Compartment (el 254'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	2 hr
	E - Concrete masonry unit	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Two doors connecting to area 22	3 hr
	Door providing access to panel 1BD102	3 hr

b. Major safety-related components in fire area:

1. 125 V dc power distribution panels 1BD102 (Div. 2) and 1DD102 (Div. 4)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, and excessive heat in the enclosure around 1BD102 will activate the heat detector, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 20 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area may have redundant

components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Panel 1BD102 is enclosed by a 3-hour rated enclosure and is available for dsafe shutdown.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

9A.5.3.21 Fire Area 21: Unit 2 Static Inverter Compartment (el 254'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Two doors connecting to area 23	3 hr
	Steamtight door connecting to area 113	3 hr

b. Major safety-related components in fire area:

1. 125 V dc power distribution panels 2BD102 (Div. 2) and 2DD102 (Div. 4)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 21 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2.

9A.5.3.22 Fire Area 22: Unit 1 Cable Spreading Room (el 254'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Concrete masonry unit	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Concrete masonry unit (part)	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Two doors connecting to area 20	3 hr
	Doors connecting to area 23 and stairwell no. 7	3 hr

b. Major safety-related components in fire area:

1. Cabling for Division 1, 2, 3, and 4 safeguard equipment (in cable tray, gutter, and conduit)

2. Cabling for Division A1, A2, B1, and B2 of the RPS (in cable tray)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. If the compartment temperature rises to 212°F, individual sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 22, the Unit 1 cable spreading room, contains safe shutdown cables associated with shutdown methods A, B, and C for Units 1 and 2 but does not contain safe shutdown equipment.

Alternative shutdown capabilities are available via the use of transfer/isolation and control switches on the remote shutdown panel and other local control stations as well as manual operator actions.

Offsite power cannot be credited for alternative shutdown.

Therefore, method R will be available to shutdown Units 1 and 2.

9A.5.3.23 Fire Area 23: Unit 2 Cable Spreading Room (el 254'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Concrete masonry unit	3 hr
	S - Reinforced concrete	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Two doors connecting to area 21	3 hr
	Door connecting to area 23	3 hr

b. Major safety-related components in fire area:

1. Cabling for Division 1, 2, 3, and 4 safeguard equipment (in cable tray, gutter, and conduit)

2. Cabling for Division A1, A2, B1, and B2 of the RPS (in cable tray)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. If the compartment temperature rises to 212°F, individual sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 23, the Unit 2 cable spreading room, contains safe shutdown cables associated with shutdown methods A, B, and C for Units 1 and 2 but does not contain safe shutdown equipment.

Alternative shutdown capabilities are available via the use of transfer/isolation and control switches on the remote shutdown panel and other local control stations as well as manual operator actions.

Offsite power cannot be credited for alternative shutdown.

Therefore, method R will be available to shutdown Units 1 and 2.

9A.5.3.24 Fire Area 24: Control Room and Peripheral Rooms (el 269'-0")

a. Structural and architectural design features of fire area (Figure 9A-8):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Two steamtight doors connecting to area 114	3 hr**

b. Safety-related components in fire area:

Safety-related control panels as listed below are located in the control room.

Unit 1 Panels

10C600	Radiation monitoring Containment combustible gas analyzer (Div. 3 & 4)
10C601	RHR (Div. 1, 2, 3, 4) CS (Div. 1, 2, 3, 4) MSIVs (Div. 1, 2, 3, 4) Reactor pressure and level (Div. 1 & 2) CAC system (Div. 1, 2, 3, 4)
10C602	RWCU (Div. 1 & 2) Reactor recirculation system Reactor head vent valves Drywell floor and equipment drain sumps
10C603	Reactor control (Div. 1, 2, 3, 4)
10C614	NSSS temperature recorder and leak detection
10C626	ADS (Div. 1 & 3) Suppression pool temperature monitoring (Div. 1 & 2)
10C647	HPCI (Div. 2 & 4)
10C648	RCIC (Div. 1 & 3)
10C651	Feedwater, condensate, and turbine (Div. 1, 2, 3)
10C668	Feedwater (Div. 1)
10C669	Condensate (Div. 1)
10C681	Reactor enclosure HVAC (Div. 1 & 2)
1AC661	Safeguard ac power supply (Div. 1)
1BC661	Safeguard ac power supply (Div. 2)
1CC661	Safeguard ac power supply (Div. 3)
1DC661	Safeguard ac power supply (Div. 4)
1AC696	Containment hydrogen recombiner package "A" (Div. 1)

1BC696	Containment hydrogen recombiner package "B" (Div. 2)

Unit 2 Panels

20C600	Radiation monitoring Containment combustible gas analyzer (Div. 3 & 4)
20C601	RHR (Div. 1, 2, 3, 4) CS (Div. 1, 2, 3, 4) MSIVs (Div. 1, 2, 3, 4) Reactor pressure and level (Div. 1 & 2) CAC system (Div. 1, 2, 3, 4)
20C602	RWCU (Div. 1 & 2) Reactor recirculation system Reactor head vent valves Drywell floor and equipment drain sumps
20C603	Reactor control (Div. 1, 2, 3, 4)
20C614	NSSS temperature recorder and leak detection
20C626	ADS (Div. 1 & 3) Suppression pool temperature monitoring (Div. 1 & 2)
20C647	HPCI (Div. 2 & 4)
20C648	RCIC (Div. 1 & 3)
20C651	Feedwater, condensate, and turbine (Div. 1, 2, 3)
20C668	Feedwater (Div. 1)
20C669	Condensate (Div. 1)
20C681	Reactor enclosure HVAC (Div. 1 & 2)
2AC661	Safeguard ac power supply (Div. 1)
2BC661	Safeguard ac power supply (Div. 2)
2CC661	Safeguard ac power supply (Div. 3)
2DC661	Safeguard ac power supply (Div. 4)
2AC696	Containment hydrogen recombiner package "A" (Div. 1)
2BC696	Containment hydrogen recombiner package "B"

(Div. 2)

Common Panels

0AC667	ESW and RHRSW (Div. 1)
0BC667	ESW and RHRSW (Div. 2)
0CC667	ESW and RHRSW (Div. 3)
0DC667	ESW and RHRSW (Div. 4)
00C681	Control structure HVAC (Div. 3 & 4) Spray pond pump structure HVAC (Div. 1, 2, 3, 4)
00C691	Control room normal fresh air radiation monitoring (Div. 3 & 4) Control room emergency fresh air radiation monitoring (Div. 3 & 4) Containment area radiation monitoring (Div. 2 & 3)
00C692	Suppression pool temperature monitoring (Div. 1 & 2)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray, gutter, or control panels. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The raceways and control panels in the control room have been designed to incorporate divisional separation in order to maintain the independence of redundant divisions of safety-related cables and electrical devices. Considering the absence of combustibles which could contribute to an exposure fire in this area, the separation is adequate to prevent an electrical fire in one division of cabling from propagating and affecting a redundant division.

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. The operator will then bring the plant fire brigade to manually extinguish the fire. An electrical fire occurring in any of the control room panels will generate substantial quantities of smoke with an acrid odor, thereby ensuring immediate detection and location of such a panel fire.

e. Effect of fire on safe shutdown:

Fire area 24, the main control room, contains safe shutdown cables and equipment associated with shutdown methods A, B, and C for Units 1 and 2.

Alternative shutdown capabilities are available via the use of transfer/isolation and control switches on the remote shutdown panel and other local control stations as well as manual operator actions.

Offsite power cannot be credited for alternative shutdown.

Therefore, method R will be available to shutdown Units 1 and 2.

f. Deviations:

Carpeting installed in the Main Control Room that has been tested in accordance with NFPA or ASTM standards to assure minimum critical radiant heat flux values does not create a fire hazard in the area. See Section 9A.3.1.2, Item 190.

The peripheral rooms in the control room complex do not have automatic water suppression; however, incipient detection is provided and manual fire fighting capabilities are provided. Additionally, the entrance doors to the main control room peripheral rooms are kept open as it has been shown that they do not perform any credited barrier function. See Section 9A3,1.2, Item 179.

9A.5.3.25 Fire Area 25: Auxiliary Equipment Room (el 289'-0")

a. Structural and architectural design features of fire area (Figure 9A-8):

	Construction	Rating
Walls:	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
	W - Gypsum board (part adjacent to fire area 26)	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to stairwell no. 7	1.5 hr
	Steamtight door connecting to area 111	3 hr
	Door connecting to area 26	3 hr **

b. Major safety-related components in fire area:

Figure 9A-21 shows the locations of all panels, consoles, and vertical boards in the auxiliary equipment room. Those panels that are associated with the shutdown methods described in Section 9A.5.2.2 are identified in the figure.

The safety-related components located in the auxiliary equipment room consist mainly of the PGCC for Unit 1 and Unit 2. The PGCC for each unit consists of vertical boards mounted on raised floor sections, with a termination cabinet located at one end of each floor section. The safety-related portions of the PGCC are identified in the following listing. The listing applies specifically to Unit 1, but the Unit 2 PGCC is identical.

Floor Section & Terminating Cabinet	Vertical Board	
10U791 & 10C791	10C617	RHR and CS (Div. 1)
	10C640	RHR and CS (Div. 3)
	10C621	RCIC
	10C628	ADS (Div. 1)
	10C631	ADS (Div. 3)
10U792 & 10C792	10C618	RHR and CS (Div. 2)
	10C641	RHR and CS (Div. 4)
	10C620	HPCI
	10C613	Process instrumentation (Div. 2 & 4)
10U786	10C634	RRCS logic cabinet (Div. 1)
	10C635	RRCS logic cabinet (Div. 2)
10U787 & 10C787	10C608	Power range neutron monitoring
10U788 & 10C788	10C619	Jet pump instrumentation
	10C623	Outboard containment isolation valves
10U789 & 10C789	10C606	Startup range neutron monitoring "A"
	10C609	RPS channel A
10U790 & 10C790	10C633	Startup range neutron monitoring "B"
	10C611	RPS channel B
	10C646	Nuclear boiler system
10U793 & 10C793	10C622	Inboard containment isolation valves
	10C612	Feedwater and reactor recirculation instrumentation (Div. 1 & 3)

The PGCC and the computer facilities, both of which are located in the auxiliary equipment room, utilize raised flooring approximately 1 foot high. The raised flooring is divided into sections typically 8 feet wide and approximately 20 feet long; PGCC panels or computer equipment are mounted near the center of each floor section. The floor sections are of all-steel construction (except for the floor plates, which are aluminum) and are each divided into four longitudinal raceways and numerous lateral raceways, each of which is totally enclosed and therefore physically isolated from adjacent raceways. To minimize the possibility of occurrence of a fire, the cabling routed in these raceways is provided with

flame retardant insulation, and no other combustible material exists in the floor sections. The highest voltages present within the floor sections are 125 V dc and 120 V ac. To prevent the spread of a postulated fire between different divisions of raceways within a floor section or between adjacent floor sections, fire stops are provided at the ends of the longitudinal raceways, at the ends of those lateral raceways which do not have end caps, in the lateral raceways where cables run from a longitudinal to a lateral raceway, and at the raceway openings at the bottom of the vertical panels. These fire stops consist of refractory material covered by silicone rubber.

The GE licensing topical report NEDO-10466-A, "Power Generation Control Complex Design Criteria and Safety Evaluation" (February 1979), describes the design concepts for the construction of the PGCC components, their arrangement within the PGCC, and the routing of interpanel cabling. The report includes test data that demonstrates the adequacy of the design with regard to fire protection. Additionally, a safety evaluation is provided which addresses NRC and industry safety guidelines and demonstrates design compliance.

A detailed comparison has been made between the design of the LGS PGCC and the design description of the generic PGCC contained in NEDO-10466-A. In all areas that could have an impact on fire protection capability (such as fire resistance, separation features, fire detection, and fire suppression), it was verified that the LGS design is either identical or equivalent to the design described in NEDO-10466-A.

The LGS design floor plates are constructed of aluminum honeycomb core bonded between aluminum sheet metal. The bottom skin is also covered by aluminum coated, steel sheet metal. This provides magnetic shielding and an optimum strength to weight ratio. The top surface of each plate is covered in an aesthetic tile that meets the following requirements:

- Flame spread rating < 25 per ASTM E84.
- Critical radiant flux > 0.45 watts /sq.cm. per NFPA 253.

Each individual floor plate is lightweight and can be easily removed by one person using the installed, recessed, quick-disconnect fasteners. The LGS design has been determined to be equivalent to the design described in NEDO-10466-A.

The RPS and UPS power distribution panels (1AY160 and 1BY160 for Unit 1; 2AY160 and 2BY160 for Unit 2), which are not safety-related, are also located in the auxiliary equipment room.

In addition to the cabling routed through the raised flooring of the auxiliary equipment room, cables associated with safety-related systems are routed in conduits, gutter, and cable tray through the space above the raised flooring.

c. Postulated fire in area:

Ignition of electrical cabling in cable tray, termination cabinets, raised flooring, or vertical boards. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.) An electrical fire occurring within any of these enclosures or raceways is precluded from affecting two redundant shutdown

methods simultaneously, through implementation of the electrical separation criteria presented in Section 8.1.6.1.14.

An exposure fire due to transient combustibles in the auxiliary equipment room would not prevent safe shutdown from being achieved for both units of the plant. A liquid combustible spilled onto the surface of the raised floor sections would flow through the cracks between adjacent floor plates, down into the longitudinal raceways of the floor sections. The heat detectors in the floor sections would detect the fire and initiate operation of the Halon suppression system, thereby extinguishing the fire promptly.

An exposure fire involving solid transient combustibles would be extremely limited in scope and confined to a small area due to the lack of available floor space in the auxiliary equipment room. The smoke detectors below the ceiling would detect the fire promptly and annunciate in the control room. The fire brigade would then be dispatched to extinguish the fire.

d. Consequences of fire with active fire suppression:

The raceways, raised flooring, termination cabinets, and vertical boards in the auxiliary equipment room have been designed to incorporate divisional separation in order to maintain the independence of redundant divisions of safety- related cables and electrical devices. The only fire potential in this area is ignition of cable insulation due to electrical faulting. Since the majority of the cables in the area involve low voltage instrument and control circuits, overload protection is provided, and cable insulation is flame retardant, this potential source of fire is minimal.

Particular attention has been given to minimizing the potential for fire and maximizing divisional separation in the PGCC and associated facilities. Considering the absence of combustibles which could contribute to an electrical fire in this area, the separation is adequate to prevent a fire in one division of cabling from propagating and affecting a redundant division.

Smoke detectors are located inside each of the termination cabinets and floor sections in the auxiliary equipment room to provide early warning of fires originating in these components. Additional fire detectors are located near the ceiling, to provide early warning of fires originating outside the termination cabinets and floor sections. Activation of any of the above smoke detectors will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. A local panel is provided to identify the floor section in which smoke has been detected. In the event that a fire in the floor sections is not extinguished by fire brigade response, heat detectors in the floor sections will activate the Halon extinguishing system. The Halon system is described in Section 9A.2.9.

e. Effect of fire on safe shutdown:

Fire area 25 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Units 1 and 2 are either:
encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for

which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, method C will be available to shutdown Units 1 and 2.

For a fire in the auxiliary equipment room, manual operator actions at the remote shutdown panel may be required. Ventilation air for the remote shutdown room is provided by duct-work that passes through the auxiliary equipment room. The air supply duct for the remote shutdown room does not contain any diffusers within the auxiliary equipment room. However, the air exhaust duct from the remote shutdown room includes two registers that exhaust air from the auxiliary equipment room. The auxiliary equipment room HVAC system, which serves the remote shutdown room as well as the auxiliary equipment room, normally operates in the recirculation mode. When a fire in the auxiliary equipment room is confirmed, the HVAC supply and exhaust smoke dampers for the remote shutdown room are closed minimizing the leakage of smoke into the remote shutdown room. In addition, special features of the walls between the remote shutdown room and the auxiliary equipment room will minimize the infiltration of smoke into the remote shutdown room. The potential smoke infiltration paths in those walls have been sealed, including installation of gaskets on both of the access doors into the remote shutdown room.

During initial plant licensing, the NRC had a concern that a fire in the auxiliary equipment room (AER) could affect plant safe shutdown actions and habitability in the remote shutdown panel room due to smoke infiltration through the HVAC ductwork. In Limerick SER, Supplement 2, Section 9.5.1.4.2 titled "Safe Shutdown Capability," PECO committed to modify the HVAC system so that the remote shutdown panel (RSP) room is maintained at a positive pressure, thereby preventing the infiltration of smoke.

In 1989, it was determined that the AER HVAC may be disabled during the postulated AER fire, and therefore could not maintain the RSP room at a positive pressure to prevent smoke infiltration.

To address this concern and commitment to minimize smoke infiltration into the RSP room, qualified manually operated smoke dampers were installed in the HVAC ductwork and all potential smoke infiltration paths in the RSP room walls have been sealed, including installation of gaskets on both of the access doors into the remote shutdown room. The fire brigade will manually isolate the dampers after verification of a fire in the AER. The dampers can also be manually isolated during plant remote shutdown if smoke is entering the RSP room through ventilation ducts due to a fire. The NRC reviewed the final configuration prior to Unit 2 fuel loading and found it acceptable. Reference Bechtel Letter to PECO #47554, NRC Inspection Report 50-352/89-12 and 50-353/89-19, LER 1-89-039, Letter from PECO to NRC dated June 30, 1989, Letter from PECO to NRC dated June 2, 1989, and NRC Inspection Report 50-352/90-04.

9A.5.3.26 Fire Area 26: Remote Shutdown Room (el 289'-0")

a. Structural and architectural design features of fire area (Figure 9A-8):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 7)	3 hr
	E - Gypsum board	3 hr
	S - Gypsum board	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to stairwell no. 7	3 hr
	Door connecting to area 25	3 hr **

b. Major safety-related components in fire area:

1. Remote shutdown panel 10C201 (for Unit 1)

2. Remote shutdown panel 20C201 (for Unit 2)

c. Postulated fire in area:

Ignition of electrical cabling in raceways, raised flooring, or the remote shutdown panels. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.) An electrical fire occurring within these raceways or enclosures is precluded from affecting two redundant divisions of circuitry simultaneously, through implementation of the electrical separation criteria presented in Section 8.1.6.1.14.

An exposure fire due to transient combustibles in the remote shutdown room would not prevent safe shutdown from being achieved for both units of the plant. Damage to the remote shutdown panels due to an exposure fire would be either extremely limited or nonexistent because of the provisions described below.

Access to the remote shutdown panels is restricted by a woven wire partition that divides the remote shutdown room into two portions, as shown in Figure 9A-21. Access to the aisle-ways at the front and back sides of the remote shutdown panels can be gained only through locked doorways in the woven wire partition. The portion of the remote shutdown room that is outside the partition consists of only a short corridor that leads from stairwell no. 7 to fire area 25 (the auxiliary equipment room). This partition will prevent transient combustibles from being stored or transported in close proximity to the remote shutdown panels. The only portion of fire area 26 in which transient combustibles can be assumed to exist is the portion outside the partition. Any liquid combustible spilled onto the surface of the raised floor sections would flow through the cracks between adjacent floor plates, down into the raised flooring. The heat detectors in the raised flooring would detect the fire and initiate operation of the Halon suppression system, thereby extinguishing the fire promptly. Any solid combustible material would be located outside the woven wire partition and be of limited size due to the space constraints of the area.

d. Consequences of fire with active fire suppression:

Smoke detectors are located within the raised flooring of the remote shutdown room to provide early warning of fires originating in the raised flooring. Additional smoke detectors are located near the ceiling, to provide early warning of fires originating above the raised flooring. Activation of any of the above smoke detectors will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. A local panel is provided to identify the floor section in which smoke has been detected. In the event that a fire in the raised flooring is not extinguished by fire brigade response, heat detectors in the raised flooring will activate the Halon extinguishing system. The Halon system is described in Section 9A.2.9.

e. Effect of fire on safe shutdown:

Fire area 26 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods C will be available to shutdown Units 1 and 2.

9A.5.3.27 Fire Area 27: Control Structure Fan Room (el 304'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 7 and 8)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 8)	2 hr
	E - Reinforced concrete (part)	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
Floor:	Reinforced concrete	3 hr
Ceiling:	Reinforced concrete	3 hr*

Access:	Doors connecting to stairwell nos. 7 and 8	1.5 hr
	Double steamtight door connecting to area 99	3 hr**
	Steamtight doors connecting to areas 99 and 112	3 hr
	Equipment hatch in ceiling (filled with 95 ft^2 of steel plate)	None

b. Major safety-related components in fire area:

1. HVAC 120 V ac distribution panel 10Y206 (Div. 1), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 1AC563
   (b) RHRSW radiation monitor 0AS578
   (c) Control structure HVAC local panel 0CC101
   (d) SGTS control panel 0AC124
   (e) RERS control panel 10C207
   (f) Reactor enclosure differential pressure panel 1AC253
   (g) Refueling area differential pressure panel 0AC254

2. HVAC 120 V ac distribution panel 10Y207 (Div. 2), which serves the following components:
   (a) RHRSW radiation monitor 0BS578
   (b) Control structure HVAC local panel 0CC101
   (c) SGTS control panel 0BC124
   (d) RERS control panel 10C207
   (e) Reactor enclosure differential pressure panel 1BC253
   (f) Refueling area differential pressure panel 0BC254

3. HVAC 120 V ac distribution panel 10Y163 (Div. 3), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 1CC563
   (b) DELETED
   (c) Control structure HVAC local panel 0AC101
   (d) SGTS control panel 0CC124
   (e) Containment combustible gas analyzer package 10S206
   (f) ESW control valve XC-11-053A (for control structure chiller "A")
   (g) Control structure chilled water control valves XC-90-042A, XC-90-043A, and XC-90-044A
   (h) Containment combustible gas analyzer heat tracing panel 10C902

4. HVAC 120 V ac distribution panel 10Y164 (Div. 4), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 1DC563
   (b) DELETED
   (c) Control structure HVAC local panel 0BC101
   (d) SGTS control panel 0CC124
   (e) Containment combustible gas analyzer 10S205
   (f) ESW control valve XC-11-053B (for control structure chiller "B"

   (g) Control structure chilled water control valves XC-90-042B, XC-90-043B, and XC-90-044B
   (h) Containment combustible gas analyzer heat tracing panel 10C901

5. HVAC 120 V ac distribution panel 20Y207 (Div. 2), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 2BC563
   (b) Control structure HVAC local panel 0CC101
   (c) RERS control panel 20C207
   (d) Reactor enclosure differential pressure panel 2BC253

6. HVAC 120 V ac distribution panel 20Y164 (Div. 4), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 2DC563
   (b) Deleted
   (c) Containment combustible gas analyzer package 20S205
   (d) Containment combustible gas analyzer heat tracing panel 20C901

7. Motor control center 00B131 (Div. 3), which serves the following components:
   (a) HVAC 120 V ac distribution panel 10Y163
   (b) Control room emergency supply air fan (0AV127) and intake heater (0AE191)
   (c) Control room emergency air intake isolation valve HV-78-020C
   (d) Control room air supply fan cabinet (0AV116) and heater (0AE192)
   (e) Control room return air fan 0AV121
   (f) Auxiliary equipment room supply air fan cabinet (0AV114) and heater (0AE193)
   (g) Auxiliary equipment room return air fan 0AV120
   (h) Emergency switchgear and battery room supply air fan cabinet 0AV118
   (i) Control structure chilled water pump (0AP162), oil pump (0AP168), pump-out compressor (0AK114)

8. Motor control center 00B132 (Div. 4), which serves the following components:
   (a) HVAC 120 V ac distribution panel 10Y164
   (b) Control room emergency supply air fan (0BV127) and intake heater (0BE191)
   (c) Control room emergency air intake isolation valve HV-78-020D
   (d) Control room air supply fan cabinet (0BV116) and heater (0BE192)
   (e) Control room return air fan 0BV121
   (f) Auxiliary equipment room supply air fan cabinet (0BV114) and heater (0BE193)
   (g) Auxiliary equipment room return air fan 0BV120
   (h) Emergency switchgear and battery room supply air fan cabinet 0BV118
   (i) Control structure chilled water pump (0BP162), oil pump (0BP168), and pump-out compressor (0BK114)

9. Control structure HVAC local panels 0AC101, 0BC101, 0CC101, and 0DC101

10. Auxiliary equipment room supply air fan cabinets OAV114 and OBV114

11. Control room supply air fan cabinets OAV116 and OBV116

12. Auxiliary equipment room return air fans OAV120 and OBV120

13. Control room return air fans OAV121 and OBV121 (14) Control room emergency fresh air supply fans and filter trains OAV127 and OBV127

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished. In the event of a fire in one of the control room emergency fresh air filters, a heat detector inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

The preaction sprinkler system in this area has been installed to provide protection against an exposure fire hazard. Other than the charcoal filters, which have their own water spray systems, electrical cable insulation and jacketing constitutes the only in situ combustible material in the fire area. The insulation and jacketing is qualified in accordance with the IEEE 383 flame test requirements, and is present in such a small quantity that it constitutes a low combustible loading. The cable trays in this area are located at approximately the same elevation as the sprinkler heads. The sprinkler heads are provided with heat collecting shields to ensure prompt actuation in the event of a fire.

e. Effect of fire on safe shutdown:

Fire area 27 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 1 and shutdown method C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 and shutdown method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2.

f. Deviations

The existence of an equipment hatch with unrated steel panels in the ceiling of this fire area is acceptable because of the low combustible loadings in the areas above and below the equipment hatch, the low potential for transient combustibles in these areas, and the height of the equipment hatch above the floor (28 feet). These factors minimize the possibility of fire propagating through the equipment hatch. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the equipment hatch in the slab at elevation 332’, safe shutdown capability would still be assured. Fire area 27 and fire area 28 both credit methods A and C for safe shutdown of Unit 1. Fire area 27 and fire area 28 both credit method C for safe shutdown of Unit 2.

The equipment hatch with unrated steel panels is a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the steel panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

The existence of an equipment hatch with unrated steel panels in the floor of this fire area is acceptable because of the low combustible loadings in the areas above and below the equipment hatch, the low potential for transient combustibles in these areas, and the height of the equipment hatch above the floor (28 feet) of the fire area below. These factors minimize the possibility of fire propagating through the equipment hatch. Penetrations of piping and electrical raceway through the floor are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the equipment hatch in the slab at elevation 332', safe shutdown capability would still be assured. Fire area 27 and fire area 28 both credit methods A and C for safe shutdown of Unit 1. Fire area 27 and fire area 28 both credit method C for safe shutdown of Unit 2.

The equipment hatch with unrated steel panels is a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the steel panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.3.28 Fire Area 28: SGTS Filter Compartments and Access Area (el 332'-0")

a. Structural and architectural design features of fire area (Figure 9A-10):

	Construction	Rating
Walls:	N - Reinforced concrete (exterior wall, also contains louver openings)	None
	N - Reinforced concrete (parts adjacent to stairwell nos. 7 and 8)	2 hr
	E - Reinforced concrete (part adjacent to stairwell no. 8)	2 hr
	E - Reinforced concrete (part adjacent to fire area 69)	3 hr

	E - Reinforced concrete (part, exterior wall)	None
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (part adjacent to fire area 46)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 7)	2 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (roof slab)	None
Access:	Two doors connecting to stairwell no. 7	1.5 hr
	Door connecting to stairwell no. 8	1.5 hr
	Steamtight doors connecting to areas 46 and 69	3 hr
	Equipment hatch in floor (filled with 95 ft^2 of steel plate)	None

b. Major safety-related components in fire area:

1. SGTS filters
   Train A: 0AF169, 0AF170, 0AF183
   Train B: 0BF169, 0BF170, 0BF183

2. SGTS exhaust fans 0AV109 and 0BV109

3. SGTS local control panels 0AC124, 0BC124, 0CC124, 0DC124

4. HVAC 120 V ac distribution panel 20Y206 (Div. 1), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 2AC563
   (b) Control structure HVAC local panel 0CC101
   (c) RERS control panel 20C207
   (d) Reactor enclosure differential pressure panel 2AC253

5. HVAC 120 V ac distribution panel 20Y163 (Div. 3), which serves the following components:
   (a) Diesel generator enclosure HVAC control panel 2CC563
   (b) DELETED
   (c) Containment combustible gas analyzer package 20S206
   (d) Containment combustible gas analyzer heat tracing panel 20C902

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the SGTS filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

e. Effect of fire on safe shutdown:

Fire area 28 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A , B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4 SAFE SHUTDOWN ANALYSIS - UNIT 1 REACTOR ENCLOSURE

9A.5.4.1 Fire Area 29: Suppression Chamber (el 181'-11")

a. Structural and architectural design features of fire area (Figures 9A-4, 9A-5, and 9A-6):

	Construction	Rating
Walls:	All around - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (diaphragm slab)	None
Access:	Two access hatches connecting to area 44	None

b. Major safety-related components in fire area:

1. Primary containment vacuum relief valve assemblies PSV-57-137 A, B, C & D

c. Postulated fire in area:

Since there are no combustible materials located in this area, no fire is postulated to occur.

d. Consequences of fire with active fire suppression:

Not applicable (see item (c)).

e. Effect of fire on safe shutdown:

Fire area 29 contains safe shutdown cables and equipment.

During normal operation, primary containment is inerted. Since containment is inerted no fire is postulated.

9A.5.4.2 Fire Area 30: Drywell (el 237'-11")

a. Structural and architectural design features of fire area (Figures 9A-7, 9A-8, and 9A-9):

	Construction	Rating
Walls:	All around - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete (diaphragm slab)	None
Ceiling:	Steel dome (drywell head)	None
Access:	Equipment hatch connecting to area 45	None
	Equipment hatch with personnel lock connecting to area 45	None

b. Major safety-related components in fire area:

1. CRDM (total of 185)
2. MSIV (inboard, one per steam line)
3. MSRV (total of 14)
4. Drywell unit coolers (total of 8)
5. Inboard containment isolation valves for HPCI steam supply line, RCIC steam supply line, RWCU letdown line, and RHR shutdown cooling suction line

c. Postulated fire in area:

1. Leakage of lube oil from a recirculation pump motor onto the diaphragm slab, with subsequent ignition of the oil.
2. Ignition of electrical cabling in cable tray, gutter or direct supported metal clad cable.
3. Ingnition of non-scheduled electrical cabling.

d. Consequences of fire with active fire suppression:

The possibility of a fire in the drywell is limited to periods when the reactor is shut down. This is because the primary containment is inerted with nitrogen during reactor operation, so that the oxygen concentration is maintained below 4% by volume. This inert atmosphere will prevent fires from occurring in the primary containment during reactor operation.

In the event of a fire in the drywell while the reactor is shut down and the drywell deinerted, the operator will dispatch the plant fire brigade to el 253' in the reactor enclosure. The fire brigade will enter the drywell through the personnel airlock and will ensure extinguishment of the fire through the use of portable fire extinguishers or hoses from hose reels located outside the entrances to the drywell.

e. Effect of fire on safe shutdown:

Fire area 30 contains safe shutdown cables and equipment.

During normal operation, primary containment is inerted. Since containment is inerted, no fire is postulated.

9A.5.4.3 Fire Area 31: Residual Heat Removal Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	NW - Reinforced concrete (primary containment wall)	None
	N - Reinforced concrete	3 hr
	E - Reinforced concrete (part below el 201', exterior wall)	None
	E - Reinforced concrete (part above el 201')	3 hr
	S - Reinforced concrete (part below el 198', exterior wall)	None
	S - Reinforced concrete (part above el 198')	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 115 ft^2 of unrated metal blowout panels leading to area 43)	None
Access:	Watertight doors connecting to areas 32 and 39	3 hr**
	Steamtight doors (el 201') connecting to areas 32 and 41	3 hr

b. Major safety-related components in fire area:

1. RHR pumps 1BP202 and 1DP202

2. RHR heat exchanger 1BE205

3. RHR compartment unit coolers 1BV210, 1DV210, 1FV210, and 1HV210

c. Postulated fire in area:

Leakage of lube oil from both RHR pump motors onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 31 contains safe shutdown cables and equipment.

Cables required to support shutdown method B for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method B for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217’, safe shutdown capability would still be assured. Fire area 31 and the eastern portion of fire area 43 both credit method C for safe

shutdown of Unit 1. The only exception is the need in the eastern portion of fire area 43 to use the Remote Shutdown Panel suppression pool temperature indicator TI-41-102. Although main control room indication is credited for a fire which is contained within fire area 31, the RSP indicator would also be available. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 2.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.4.4 Fire Area 32: Residual Heat Removal Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	NW - Reinforced concrete	3 hr
	NE - Reinforced concrete (primary containment wall)	None
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part below el 198', exterior wall)	None
	S - Reinforced concrete (part above el 198')	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 150 ft^2 of unrated metal blowout panels leading to area 43)	None
Access:	Watertight doors connecting to areas 31 and 33	3 hr**
	Steamtight doors (el 201') connecting to areas 31 and 42	3 hr

b. Major safety-related components in fire area:

1. RHR pumps 1AP202 and 1CP202
2. RHR heat exchanger 1AE205
3. RHR compartment unit coolers 1AV210, 1CV210, 1EV210, and 1GV210
4. ESW loop "A" valves (HV-11-041, HV-11-071, HV-11-121, and HV-11-123)

c. Postulated fire in area:

Leakage of lube oil from both RHR pump motors onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 32 contains safe shutdown cables and equipment.

Cables required to support shutdown method A for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method A for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217’, safe shutdown capability would still be assured. Fire area 32 and the western portion of fire area 43 both credit method C for safe shutdown of Unit 1. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 2.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.4.5 <u>Fire Area 33: Reactor Core Isolation Cooling Compartment (el 177'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	NW - Reinforced concrete	3 hr
	NE - Reinforced concrete (primary containment wall)	None
	SE - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	S - Reinforced concrete (part, exterior wall below el 198')	None
	S - Reinforced concrete (part, exterior wall above el 198')	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 25 ft^2 of unrated metal blowout panels leading to area 43)	None
Access:	Watertight doors connecting to areas 32 and 34	3 hr**
	Door connecting to stairwell no. 3	1.5 hr

b. Major safety-related components in fire area:

1. RCIC pump 10P203

2. RCIC turbine 10S212

3. RCIC compartment unit coolers 1AV208 and 1BV208

c. Postulated fire in area:

Leakage of lube oil from RCIC turbine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 33 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217’, safe shutdown capability would still be assured. Fire area 33 and the western portion of fire area 43 both credit method C for safe shutdown of Unit 1. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 2.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.4.6 <u>Fire Area 34: High Pressure Coolant Injection Compartment (el 177'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	E - Reinforced concrete (primary containment wall)	None
	SE - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None

Ceiling:	Reinforced concrete (ceiling contains 160 ft^2 of unrated metal blowout panels leading to area 43)	None
Access:	Watertight doors connecting to areas 33 and 40	3 hr**

b. Major safety-related components in fire area:

1. HPCI pump 10P204

2. HPCI turbine 10S211

3. HPCI compartment unit coolers 1AV209 and 1BV209

4. Instrument rack 10C014 (HPCI)

c. Postulated fire in area:

Leakage of lube oil from HPCI turbine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 34 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the

panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217', safe shutdown capability would still be assured. Fire area 34 and the western portion of fire area 43 both credit method C for safe shutdown of Unit 1. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 2.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.4.7 Fire Area 35: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

		Construction	Rating
Walls:	W -	Reinforced concrete	3 hr
	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete (primary containment wall)	None
	S -	Reinforced concrete	3 hr
Floor:		Reinforced concrete foundation mat	None
Ceiling:		Reinforced concrete	3 hr*
Access:		Watertight door connecting to area 40	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 1AP206

2. Core spray compartment unit coolers 1AV211 and 1EV211

3. Safeguard piping fill pump 1AP256

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 35 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.8 Fire Area 36: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	SE - Reinforced concrete (primary containment wall)	None
	S - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 40	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 1CP206

2. Core spray compartment unit coolers 1CV211 and 1GV211

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 36 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.9 Fire Area 37: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	W - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	SW - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 39	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 1DP206

2. Core spray compartment unit coolers 1DV211 and 1HV211

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 37 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.10 Fire Area 38: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N -Reinforced concrete	3 hr
	E -Reinforced concrete	3 hr
	S -Reinforced concrete	3 hr
	W -Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 39	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 1BP206

2. Core spray compartment unit coolers 1BV211 and 1FV211

3. Safeguard piping fill pump 1BP256

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 38 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.11 Fire Area 39: Sump Room and Passageway (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 1)	2 hr
	E - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to unexcavated area),	None
	S - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part, primary containment wall)	None
	W - Reinforced concrete (part)	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight doors connecting to areas 31, 37 and 38	3 hr**
	Door connecting to stairwell no. 1	1.5 hr

b. Major safety-related components in fire area:

1. Containment isolation valves (HV-52-127 and HV-52-128) for suppression pool cleanup pump suction line

2. Instrument rack 10C076 (RHR pump "B" discharge pressure)

3. Instrument rack 10C078 (RHR pump "D" discharge pressure)

c. Postulated fire in area:

1. Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of oil in a waste oil collection drum associated with the floor drain sump oil removal belt

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 39 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

9A.5.4.12 Fire Area 40: Corridor (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight doors connecting to areas 34, 35 and 36	3 hr**
	Door connecting to stairwell no. 4	1.5 hr
	Elevator door	0.75 hr

b. Major safety-related components in fire area:

1. HPCI pump discharge flow transmitters (FT-55-1N008 and FT-55-1N051)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 40 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

9A.5.4.13 Fire Area 41: Reactor Enclosure Cooling Water Equipment Area (el 201'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 1)	2 hr
	E - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part adjacent to unexcavated area)	None
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (one portion of the ceiling slab, covering an area of 10 ft^2, has a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Access:	Door connecting to stairwell no. 1	1.5 hr
	Door connecting to area 31	3 hr

b. Major safety-related components in fire area:

1. Instrument rack 10C021 (Div. 2 RHR and Div. 2 RHRSW)

2. Suppression chamber pressure transmitter (PT-57-101)

3. ESW loop "B" valves (HV-11-044, HV-11-074, HV-11-124, HV-11-125, HV-11-126, HV-11-127 and HV-11-128)

4. HVAC unit cooler control panels 1BC208 and 1DC208

5. Motor control center 10B218, which serves the following components:
   (a) RHR loop "D" valves
   (b) RHR compartment unit coolers 1DV210 and 1HV210
   (c) Core spray loop "B" valves
   (d) Core spray compartment unit coolers 1DV211 and 1HV211
   (e) RHRSW outlet valve from RHR "B" heat exchanger (HV-51-1F068B)
   (f) Drywell unit cooler fans 1D2V212 and 1F2V212
   (g) Containment hydrogen recombiner 1BS403 and associated valves

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 41 contains safe shutdown cables and equipment.

Cables required to support shutdown method B for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method B for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

9A.5.4.14 <u>Fire Area 42: Safeguard System Access Area (el 201'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-5):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete	3 hr
	SE - Reinforced concrete (primary containment wall)	None
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	S - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (One portion of the ceiling slab, covering an area the ceiling slab, covering an area of 10 ft^2, has a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Access:	Elevator door	0.75 hr
	Doors connecting to stairwell nos. 3 and 4	1.5 hr
	Door connecting to area 32	3 hr
	Watertight door connecting to area 75	3 hr**

b. Major safety-related components in fire area:

1. HPCI valves HV-55-1F007 (pump discharge) and HV-55-1F008 (pump discharge recirculation to CST)

2. RCIC valves HV-49-1F012 (pump discharge) and HV-49-1F022 (pump discharge recirculation to CST)

3. HPCI level transmitters (LT-55-IN061B&F) and turbine exhaust pressure transmitters (PT-56- 1N055D&H)

4. Instrument rack 10C017 (RCIC)

5. RCIC turbine exhaust pressure transmitters (PT-50-1N055C&G)

6. Instrument rack 10C018 (Div. 1 RHR and Div. 1 RHRSW)

7. Instrument rack 10C075 (RHR pump "A" discharge pressure)

8. Instrument rack 10C077 (RHR pump "C" discharge pressure)

9. HVAC unit cooler control panels 1AC208 and 1CC208

10. Motor control center 10B217, which serves the following components:
    (a) RHR loop "C" valves
    (b) RHR compartment unit coolers 1CV210 and 1GV210
    (c) Core spray pump suction valve (HV-52-1F001C)
    (d) Core spray compartment unit coolers 1CV211 and 1GV211
    (e) RHRSW outlet valve from RHR "A" heat exchanger (HV-51-1F068A)
    (f) Drywell unit cooler fans 1C2V212 and 1G2V212
    (g) Containment hydrogen recombiner 1AS403 and associated valves

c. Postulated fire in Area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 42 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown method C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, method C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

9A.5.4.15 Fire Area 43: Safeguard System Isolation Valve Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (exterior wall, contains 150 ft^2 of unrated blowout panels)	None
	W - Concrete masonry unit	3 hr
	Interior boundary – Reinforced concrete (primary containment wall	None
Floor:	Reinforced concrete (contains 450 ft^2 of unrated metal blowout panels from areas 31, 32, 33, and 34)	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Two steamtight doors connecting to area 44	3 hr

b. Major safety-related components in fire area:

1. HPCI steam line containment isolation valves (HV-55-1F003 and HV-55-1F100)

2. RCIC steam line containment isolation valves (HV-49-1F008 and HV-49-1F076)

3. RHR system valves:
   (a) HV-51-1F008 (shutdown cooling suction containment isolation)
   (b) HV-51-1F015A&B (shutdown cooling return containment isolation)
   (c) HV-51-1F047A&B (heat exchanger inlet)
   (d) HV-C-51-1F048A&B (heat exchanger bypass)
   (e) HV-51-1F023 (head spray containment isolation)

4. CAC containment isolation valves (HV-57-109, HV-57-121, HV-57-123, HV-57-124, HV-57-131, HV-57-135, HV-57-147, HV-57-163, and HV-57-164)

5. PCIG containment isolation valves (HV-59-102, HV-59-129A, HV-59-129B, HV-59-131, HV-59-135, HV-59-151A, and HV-59-151B)

6. HPCI system leakage detection temperature elements

7. RCIC system leakage detection temperature elements

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 43 is divided into an eastern (43E) and a western (43W) portion through the establishment of a 20 foot wide zone that is free of combustible materials.

43E

The eastern portion of fire area 43 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 43.

43W

The western portion of fire area 43 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 1 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that

are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, method C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2, for a fire in the western half of fire area 43.

f. Deviations:

Fire area 43 is divided into a western portion and an eastern portion through the establishment of a 20 foot wide zone that is free of combustible materials. This combustible-free zone was created by using 1 hour rated fire barriers to enclose the cable trays that pass through the zone.

Several valves associated with the credited safe shutdown methods are located in fire area 43. Valves performing active, credited, redundant functions are located on opposite sides of fire area 43 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray. The fire barriers that enclose the portions of the cable trays that are within the combustible-free zone, eliminate the potential for a postulated fire to propagate through the combustible-free zone within the cable trays. The in situ combustible loading in fire area 43 is low. The potential for transient combustibles to exist in the space between credited, redundant valves is severely restricted by the arrangement of fire area 43 and the locations of commodities within it. The space between the credited, redundant equipment is relatively narrow and contains a high concentration of pipes and pipe supports. These obstructions effectively prevent the introduction of significant quantities of combustible materials into this space. The factors discussed above preclude the occurrence of a fire, involving either in situ combustibles or transient combustibles, that could simultaneously affect credited, redundant equipment.

The measures described above for physical separation and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 43.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

The existence of unrated metal panels in the floor of this fire area is acceptable because the low combustible loadings in the areas above and below the panels. Penetrations of piping and electrical raceway through the floor are provided with 3- hour rated seals. Unrated blowout panels exist in the south wall of the fire area that release to the outside of the reactor enclosure, which has no adjoining tire area impacts.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the floor at elevation 217’, safe shutdown capability would still be assured. Fire area 43, 31, 32, 33, and 34 all credit method C for safe shutdown of Unit 1. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 2.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.4.16 Fire Area 44: Safeguard System Access Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 1 and 4)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 1)	2 hr
	E - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	S - Reinforced concrete (part adjacent to fire area 124)	3 hr
	S - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (part adjacent to stairwell nos. 3 and 4)	2 hr
	W - Reinforced concrete (part)	3 hr
	Interior boundary (part) - Reinforced concrete and concrete masonry unit walls	3 hr
	Interior boundary (part) - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete (Two portions of the floor slab, each of which covers an area of 10 ft^2, have a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 1, 3, and 4	1.5 hr
	Two steamtight doors connecting to area 43	3 hr
	Missile-resistant door connecting to area 76	3 hr**
	Equipment airlock door	None
	Elevator door	0.75 hr
	Suppression chamber access hatches	None
	Equipment hatchway in ceiling (200 ft^2 opening; protected by water curtain suppression system)	None

b. Major safety-related components in fire area:

1. Core spray full flow test recirculation valves (HV-52-1F015A&B)

2. CAC containment isolation valves (HV-57-104, HV-57-105, HV-57-112, HV-57-118, and HV-57-162)

3. RHR system valves:
   (a) HV-51-125A&B (containment isolation for recirculation to suppression chamber)
   (b) HV-51-1F027A&B (containment isolation for suppression chamber spray)
   (c) HV-51-1F010A&B (loops C and D recirculation to suppression chamber)
   (d) HV-51-1F024A&B (loops A and B recirculation to suppression chamber)

4. Instrument racks 10C001 (core spray loop A) and 10C019 (core spray loop B)

5. Instrument racks 10C015, 10C025, 10C041, and 10C042 (main steam and reactor recirculation flow)

6. Instrument racks 10C016 and 10C036 (HPCI)

7. Instrument racks 10C035 and 10C038 (RCIC)

8. Instrument racks 10C006, 10C009, 10C010, and 10C022 (reactor recirculation system pressure and jet pump flow)

9. RHR flow transmitters (FT-51-1N015A,B,C&D and FT-51-1N052A,B,C&D)

10. Motor control center 10B211, which serves the following components:
    (a) RHR loop "A" valves
    (b) RHR compartment unit coolers 1AV210 and 1EV210
    (c) Core spray loop "A" valves
    (d) Core spray compartment unit coolers 1AV211 and 1EV211
    (e) RHRSW inlet valve to RHR "A" heat exchanger (HV-51-1F014A)
    (f) RHR shutdown cooling suction inboard isolation valve (HV-51-1F009)
    (g) RCIC compartment unit coolers 1AV208 and 1BV208
    (h) RWCU inboard isolation valve (HV-44-1F001)
    (i) Main steam drain line inboard isolation valve (HV-41-1F016)
    (j) Drywell unit cooler fans 1A1V212, 1C1V212, 1E1V212, and 1G1V212

11. Motor control center 10B212, which serves the following components:
    (a) RHR loop "B" valves
    (b) RHR compartment unit coolers 1BV210 and 1FV210
    (c) Core spray loop "B" valves
    (d) Core spray compartment unit coolers 1BV211 and 1FV211
    (e) RHRSW inlet valve to RHR "B" heat exchanger (HV-51-1F014B)
    (f) RHR shutdown cooling return isolation valve (HV-51-1F015A)
    (g) Reactor recirculation pump suction valve (HV-43-1F023B)
    (h) HPCI compartment unit coolers 1AV209 and 1BV209
    (i) Drywell unit cooler fans 1B1V212, 1D1V212, 1F1V212, and 1H1V212

12. Motor control center 10B215, which serves the following components:
    (a) RHR loop "A" valves
    (b) RCIC system valves
    (c) Deleted
    (d) Suppression pool cleanup pump suction isolation valve (HV-52-127)
    (e) Drywell pressure tap isolation valve (HV-42-147A)

(f) Drywell floor drain and equipment drain containment isolation valves (HV-61-112 and HV-61-132)

13. Motor control center 10B216, which serves the following components:
    (a) RHR loop "B" valves
    (b) HPCI system valves
    (c) Deleted
    (d) Suppression pool cleanup pump isolation valve (HV-52-128)
    (e) Drywell pressure tap isolation valve (HV-42-147B)
    (f) Suppression pool level tap isolation valves (HV-55-120 and HV-55-121)
    (g) RHR shutdown cooling suction outboard isolation valve (HV-51-1F008)
    (h) RWCU outboard isolation valve (HV-44-1F004)
    (i) Main steam drain line outboard isolation valve (HV-41-1F019)

14. Dc motor control center 10D201, which serves the following components:
    (a) RCIC system
    (b) Div. 1 RPS and UPS static inverter

15. Dc motor control center 10D202, which serves the HPCI system

16. Dc motor control center 10D203, which serves the following components:
    (a) HPCI system
    (b) Div. 2 RPS and UPS static inverter

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of one of the two preaction sprinkler systems in this fire area, the system will provide automatic suppression of the fire. When the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 44 is divided into an eastern (44E) and a western (44W) portion through the establishment of two 20 foot wide zones.

<u>44E</u>

The eastern portion of fire area 44 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Units 1 and 2 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2, for a fire in the eastern half of fire area 44.

<u>44W</u>

The western portion of fire area 44 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, method C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2, for a fire in the western half of fire area 44.

f. Deviation:

A 20 foot wide zone that is free of combustibles was created at two locations in fire area 44 by using a galvanized steel cable tray enclosure system to cover the cable trays that pass through the zone. This non-combustible configuration together with the enclosure end seals will prevent fire propagation across the combustible free zone. A fixed suppression system of the water curtain-type is located within each combustible-free zone to provide assurance that a postulated fire due to transient combustibles can be prevented from propagating through the combustible-free zones. The two combustible-free zones, one located in the southwest quadrant of the fire area and one located in the northeast quadrant of the fire area, divide fire area 44 into a western portion and an eastern portion.

Several components associated with the credited safe shutdown methods are located in fire area 44. Components performing active, credited, redundant functions are located on opposite sides of fire area 44 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone.

The locations of preaction sprinkler systems and water curtain suppression systems in fire area 44 are shown in Figure 9A-6.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 44.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.5.7.

9A.5.4.17 Fire Area 45: CRD Hydraulic Equipment Area and Neutron Monitoring System Area (el 253'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 1 2 hr and 4)	
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 1)	2 hr
	E - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	S - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (parts adjacent to stairwell nos. 3 and 4)	2 hr
	W - Reinforced concrete (part)	3 hr
	Interior boundary (part adjacent to main steam tunnel) – Reinforced concrete	3 hr
	Interior boundary (part) – Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 1, 3, and 4	1.5 hr
	Elevator door	0.75 hr
	Drywell access hatches	None
	Watertight door connecting to area 46	3 hr**
	Equipment hatchways in floor and protected by water curtain suppression systems)	None

b. Major safety-related components in fire area:

1. DCWS valves HV-87-122, HV-87-123, HV-87-128, and HV-87-129 (supply and return line containment isolation)

2. CRD master control station

3. CRD hydraulic control units

4. Containment combustible gas analyzer sample package 10S206

5. Load center 10B203 (Div. 3)

6. Deleted

7. Instrument racks 10C004, 10C005, 10C026, and 10C027 (RPV instrumentation and LPCI injection valve ΔP transmitters)

8. SLCS injection line containment isolation valves (HV-48-1F006A&B)

9. Motor control center 10B223, which serves the following components:
   (a) LPCI injection containment isolation valve (HV-51-1F017C)
   (b) RHR loop "C" minimum flow recirculation isolation valve (HV-51-105A)
   (c) RCIC system valves
   (d) SLCS pump 1AP208
   (e) SLCS injection outboard isolation valve (HV-48-1F006)
   (f) Drywell pressure tap isolation valve (HV-42-147C)
   (g) Drywell unit cooler fans 1A2V212 and 1E2V212
   (h) Reactor recirculation pump cooling water isolation valves (HV-13-106 and HV-13-107)

10. Motor control center 10B224, which serves the following components:
    (a) LPCI injection containment isolation valve (HV-51-1F017D)
    (b) RHR loop "D" minimum flow recirculation isolation valve (HV-51-105B)
    (c) HPCI system valves
    (d) SLCS pump 1BP208
    (e) Drywell pressure tap isolation valve (HV-42-147D)
    (f) Reactor recirculation pump cooling water source select valves (HV-13-108, HV-13-109, HV-13-110, and HV-13-111)
    (g) Drywell unit cooler fans 1B2V212 and 1H2V212

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of the preaction sprinkler system in this fire area, the system will provide automatic suppression of the fire. When the compartment

temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 45 is divided into an eastern (45E) and a western (45W) portion through the establishment of a 20 foot wide zone that is free of combustible materials.

45E

The eastern portion of fire area 45 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 1 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods B and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, method C will be available to shutdown Unit 1 and methods B and C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 45.

45W

The western portion of fire area 45 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2, for a fire in the western half of fire area 45.

A postulated fire in the vicinity of the reactor vessel instrumentation reference leg backfill system could adversely affect reactor vessel water level indication due to reference leg density changes caused by an increase in water temperature. Since there are no fire initiators in close proximity to the backfill system tubing, administratively controlled combustible free zones, throughout the locations of the backfill system will preclude any adverse effect on level indication, due to fire, prior to annunciation in the main control room. Following annunciation in the main control room, the backfill system will be administratively isolated from the reference legs.

f. Deviation

A 20 foot wide zone that is free of combustibles was created by ensuring, by analysis, that there are no intervening combustibles which could provide a path for fire propagation through the combustible-free zone. A fixed suppression system of the water curtain-type is located within the combustible-free zone to provide assurance that a postulated fire due to transient combustibles can be prevented from propagating through the combustible-free zone. The combustible-free zone divides the fire area into a western portion and an eastern portion.

Several components associated with the credited safe shutdown methods are located in fire area 45. Components performing active, credited, redundant functions are located on opposite sides of fire area 45 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone. The locations of the preaction sprinkler system and the water curtain suppression system in fire area 45 are shown in Figure 9A-7.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 45.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

If the fire occurs within the coverage area of the wet pipe sprinkler systems in this fire area, the systems will provide automatic suppression of the fire. When the compartment temperature rises to 212°F, individual fusible link sprinklers will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

9A.5.4.18 Fire Area 46: Main Steam Tunnel (el 253'-0")

a. Structural and architectural design features of fire area (Figures 9A-7, 9A-8, 9A-9, and 9A-10):

	Construction	Rating
Walls:	N - Reinforced concrete (contains 188 ft^2 of unrated metal blowout panels)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part , primary containment wall)	None
	S - Reinforced concrete (part)	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (part at el 295'-3")	3 hr*
	Reinforced concrete (part at el 365' roof slab)	None
Access:	Watertight door connecting to area 45	3 hr**
	Steamtight doors connecting to areas 28 and 47	3 hr

b. Major safety-related components in fire area:

1. Main steam line outboard containment isolation valves (HV-41-1F028 A,B,C&D)
2. Feedwater line outboard containment isolation valves (HV-41-1F032A&B and HV-41-1F074A&B)
3. Main steam drain line outboard containment isolation valve (HV-41-1F019)
4. RCIC injection valve (HV-49-1F013)
5. Steam line radiation sensors (RE-41-1N006A,B,C&D)

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the plant fire brigade will be dispatched to el 253' and/or el 283' in the reactor enclosure and will enter the main steam tunnel through doors at those elevations. The fire brigade will extinguish the fire using portable fire extinguishers or hoses from hose stations located outside the entrances to the main steam tunnel.

e. Effect of fire on safe shutdown:

Fire area 46 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Unit 1 and shutdown methods A, B, and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 1 and shutdown methods A, B, and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Unit 1, and methods A, B, and C will be available to shutdown Unit 2.

9A.5.4.19 Fire Area 47: RWCU Compartments, FPCC Compartment, and General Equipment Area (el 283'-0" and el 295'-3")

a. Structural and architectural design features of fire area (Figure 9A-8):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 1 and 4)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part adjacent to stairwell no. 1)	2 hr
	E - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	S - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (parts adjacent to stairwell nos. 3 and 4)	2 hr
	W - Reinforced concrete (part)	3 hr
	Interior boundary (east and west walls of area 46) – Reinforced concrete	3 hr
	Interior boundary (primary containment wall) – Reinforced concrete	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 1, 3, and 4	1.5 hr
	Steamtight door connecting to area 46	3 hr
	Elevator door	0.75 hr
	Equipment hatchways in floor and ceiling (200 ft^2 openings; protected by water curtain suppression systems)	None

b. Major safety-related components in fire area:

1. Containment hydrogen recombiner packages 1AS403 and 1BS403

2. SLCS components:

Storage tank 10T204
Injection pumps 1AP208, 1BP208, and 1CP208
Explosive valves XV-48-1F004A,B&C

3. Core spray loop "A" injection valves (HV-52-1F004A and HV-52-1F005)

4. Core spray loop "B" injection valves (HV-52-1F004B, HV-52-1F037, and HV-52-108)

5. RHR system valves:
   HV-51-1F017A,B,C&D (LPCI injection line containment isolation)
   HV-51-1F021A&B (drywell spray line containment isolation)
   HV-51-1F016A&B (drywell spray line shutoff)

6. HPCI system injection valve (HV-55-1F006)

7. RWCU supply line containment isolation valve (HV-44-1F004)

8. CAC purge line containment isolation valves (HV-57-111, HV-57-115, HV-57-114, and HV-57-161)

9. Containment combustible gas analyzer sample cabinet 10S205

10. Load center 10B204 (Div. 4)

11. Motor control center 10B213, which serves the following components:
   (a) RHR loop "A" valves
   (b) Core spray loop "A" valves
   (c) Feedwater startup recirculation valves (HV-41-109A&B)
   (d) Shutoff valves for main steam to miscellaneous steam-driven components (HV-01-108, HV-01-109, HV-01-111, and HV-01-150)
   (e) Drywell chilled water source select valves
   (f) SGTS heater 0AE188
   (g) SGTS exhaust fan 0AV109

12. Motor control center 10B214, which serves the following components:
   (a) RHR loop "B" valves
   (b) Core spray loop "B" valves
   (c) Drywell cooling water containment isolation valves
   (d) SGTS heater 0BE188
   (e) SGTS exhaust fan 0BV109

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of the preaction sprinkler system in this fire area, the system will provide automatic suppression of the fire. When the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 47 is divided into an eastern (47E) and a western (47W) portion through the establishment of a 20 foot wide zone that is free of combustible materials; no cable trays are located within this combustible-free zone.

<u>47E</u>

The eastern portion of fire area 47 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 1 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods B and C for Unit 2 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost.

Equipment associated with shutdown methods B and C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, method C will be available to shutdown Unit 1 and methods B and C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 47.

<u>47W</u>

The western portion of fire area 47 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Unit 1 are either encapsulated by a qualified barrier, associated with equipment that have redundant

components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods B and C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2, for a fire in the western half of fire area 47.

A postulated fire in the vicinity of the reactor vessel instrumentation reference leg backfill system could adversely affect reactor vessel water level indication due to reference leg density changes caused by an increase in water temperature. Since there are no fire initiators in close proximity to the backfill system tubing, administratively controlled combustible free zones, throughout the locations of the backfill system will preclude any adverse effect on level indication, due to fire, prior to annunciation in the main control room. Following annunciation in the main control room, the backfill system will be administratively isolated from the reference legs.

f. Deviations:

A 20 foot wide zone that is free of combustible materials is maintained; no cable trays are located within this combustible-free zone. The combustible-free zone divides fire area 47 into a western portion and an eastern portion.

Several components associated with the credited safe shutdown methods are located in the eastern half of fire area 47. Components and cables performing active, credited, redundant functions are located on opposite sides of fire area 47 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone. The location of the precaution sprinkler system on fire area 47 is shown in Figure 9A-8.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 47.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.4.20 <u>Fire Area 48: RWCU Holding Pump Compartments, RERS Fan Area, and Corridors (el 313'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
	N - Reinforced concrete (part)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	W - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (part adjacent to stairwell no. 4)	2 hr
	Interior boundary - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 3 and 4	1.5 hr
	Airlock door connecting to area 49	3 hr
	Double airlock door connecting to area 49	3 hr**
	Elevator door	0.75 hr
	Equipment hatchway in floor ($200\ ft^2$ opening; protected by water curtain suppression system)	None

b. Major safety-related components in fire area:

1. RERS fans (1AV213 and 1BV213)

2. Load center 10B201 (Div. 1)

3. Load center 10B202 (Div. 2)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control

room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 48 is divided into an eastern (48E) and a western (48W) portion through the establishment of a 20 foot wide zone that is free of combustible materials.

<u>48E</u>

The eastern portion of fire area 48 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 1 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2, for a fire in the eastern half of fire area 48.

<u>48W</u>

The western portion of fire area 48 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2, for a fire in the western half of fire area 48.

f. Deviations:

Load centers 10B201 and 10B202 and their associated transformers are the only components credited for safe shutdown which are located in fire area 48. The horizontal separation between the two load centers is greater than 35 feet, and the only combustible materials in the intervening space are electrical cables in a cable tray. A 20 foot wide zone that is free of combustibles was created between the two load centers by using a galvanized steel cable tray enclosure system to cover the cable trays that pass through the zone. This non-combustible configuration together with the enclosure and seals will prevent fire propagation across the combustible zone. A fixed suppression system of the water curtain-type is located within the combustible-free zone to provide assurance that a postulated fire due to transient combustibles can be prevented from propagating through the combustible-free zone. To preclude the possibility of a spilled combustible liquid spreading across the area between the two load centers, a concrete curb is provided between the load centers, spanning the full width of the corridor in which the load centers are located. The curb is located within the coverage area of the water curtain system. To protect the load centers from radiant heat that could be generated by a postulated fire occurring in the area between the load centers, each load center is provided with a radiant heat shield. The heat shields are constructed of Marinite sheet and are located adjacent to the side of each load center that faces the concrete curb.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 48.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.4.21 Fire Area 49: Reactor Enclosure Lower Fan Room (el 313'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part, exterior wall)	None
	S - Louvers open to outside atmosphere (part)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (part below fire area 50)	None
	Reinforced concrete (part below fire area 51)	3 hr*
Access:	Airlock door connecting to area 48	3 hr
	Double airlock door connecting	3 hr**

	to area 48	
	Emergency exit in ceiling (6.25 ft^2 opening)	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Once the control room operators have been notified that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 49 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.22 Fire Area 50: Reactor Enclosure Upper Fan Room and Equipment Compartment Exhaust Filter Rooms (el 331'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete (part adjacent to stairwell no. 3)	2 hr
	W - Reinforced concrete (part)	3 hr
Floor:	Reinforced concrete	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Door connecting to stairwell no. 3	1.5 hr
	Two doors connecting to area 51	3 hr
	Emergency exit in floor	None

(6.25 ft^2 opening)

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the reactor enclosure equipment compartment exhaust filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the affected ventilation system will be shut down and the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

e. Effect of fire on safe shutdown:

Fire area 50 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.23 <u>Fire Area 51: RERS Filter Compartments (el 331'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Two doors connecting to area 50	3 hr

b. Major safety-related components in fire area:

1. RERS filter assemblies (1AS297 and 1BS297)

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the RERS filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

e. Effect of fire on safe shutdown:

Fire area 51 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.24 Fire Area 75: Service Water Pipe Tunnel (el 198'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	None
	S - Reinforced concrete (part adjacent to diesel generator enclosures)	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation	None
Ceiling:	Reinforced concrete (portion below fire areas 44, 67, and 79 through 86)	3 hr*
	Reinforced concrete (portion below fire areas 76, 124, and 125)	None
Access:	Watertight doors connecting to areas 42 and 65	3 hr**

b. Major safety-related components in fire area:

1. ESW discharge header isolation valves (HV-11-011A&B and HV-11-015A&B)

2. Flow transmitters FT-11-011A&B, FT-11-013A&B, and FT-11-015A&B for ESW supply and return headers

3. Pressure switches PSL-12-102A&B and PSL-12-202A&B for RHRSW supply to the RHR heat exchangers

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire. Depending on the severity and location of the fire, certain components in the ESW and/or RHRSW systems may be affected.

e. Effect of fire on safe shutdown:

Fire area 75 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

f. Deviations:

The existence of an unrated ceiling for this fire area is acceptable because of the low combustible loadings in the pipe tunnel (fire area 75) below the ceiling and in the corridors and condensate pump rooms (fire areas 124 and 125) above the ceiling. In the highly unlikely event that a fire in this area should propagate through the unrated ceiling, safe shutdown capability would still be assured. Fire area 75 and fire areas 124 and 125 all credit methods A, B, and C for safe shutdown of both Units 1 and 2.

The unrated steel ceiling is a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the ceiling is unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barrier.

9A.5.4.25 <u>Fire Area 76: Refueling Hoist-way (el 217'-0")</u>

a. Structural and architectural design features of fire area (Figures 9A-6, 9A-7, 9A-8, and 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation	None
Ceiling:	Concrete hatch plugs connecting to area 78	None
Access:	Missile-resistant doors connecting to areas 44 and 67	3 hr**
	Railroad car airlock doors	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 76 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.26 Fire Area 77: South Ventilation Exhaust Stack

a. Structural and architectural design features of fire area (Figures 9A-7, 9A-8, 9A-9, and 9A-10):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Precast concrete panels	None
	S - Precast concrete panels	None
	W - Precast concrete panels	None

Floor:	None (open to outside)	
Ceiling:	None (open to outside)	
Access:	Door connecting to area 78	3 hr

b. Major safety-related components located in fire area:

None

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 77 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.27 Fire Area 78: Refueling Area (el 352'-0")

a. Structural and architectural design features of fire area (Figure 9A-10):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell nos. 4 and 6)	2 hr
	N - Reinforced concrete (part adjacent to fire areas 28, 46, and 69)	3 hr
	N - Reinforced concrete (part, exterior wall)	None
	E - Reinforced concrete (part adjacent to stairwell nos. 5 and 6)	2 hr
	E - Reinforced concrete (part)	None
	S - Reinforced concrete (part adjacent to stairwell nos. 3 and 5)	2 hr

	S - Reinforced concrete (part, exterior wall)	None
	W - Reinforced concrete (part adjacent to stairwell nos. 3 and 4)	2 hr
	W - Reinforced concrete (part, exterior wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Doors to stairwell nos. 3, 4, 5, and 6	1.5 hr
	Two doors to area 77	3 hr

b. Major safety-related components in fire area:

1. Reactor enclosure crane

2. Refueling platforms for Units 1 and 2

3. Gate seals, stop seals, and reactor well seals

c. Postulated fire in area:

Ignition of stored materials as a result of an exposure fire. An exposure fire involving stored combustible materials in this fire area would be extremely limited in scope and confined to a small area due to the sparsely distributed combustibles within the refueling area. Ignition of the stored combustible materials is extremely unlikely in the absence of a fire source external to the materials.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire. No effect on safety related systems will result from a fire in the fire area.

e. Effect of fire on safe shutdown:

Fire area 78 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.28 Fire Area 126: North Stack Instrument Room and Vestibule (el 411'-9")

a. Structural and architectural design features of fire area (Figure 9A-10):

	Construction	Rating
Walls:	N - Precast concrete panels	2 hr
	E - Insulated metal siding	None
	S - Insulated metal siding	None
	W - Insulated metal siding	None
Floor:	Reinforced concrete	None
Ceiling:	Built-up roofing	UL Class A
Access:	Door connecting to north stack	1.5 hr
	Two doors to outside	None

b. Major safety-related components in fire area:

1. Wide range accident monitors 01S908 and 02S908

2. Wide range accident monitor microprocessor (RY-26-076)

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 126 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.4.29 Fire Area 127: South Stack Instrument Room (el 411'-9")

a. Structural and architectural design features of fire area (Figure 9A-10):

	Construction	Rating
Walls:	N - Insulated metal siding	None
	E - Insulated metal siding	None
	S - Precast concrete panels	2 hr

	W - Insulated metal siding	None
Floor:	Reinforced concrete	None
Ceiling:	Built-up roofing	UL Class A
Access:	Door connecting to south stack Two doors to outside	1.5 hr None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 127 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5 SAFE SHUTDOWN ANALYSIS - UNIT 2 REACTOR ENCLOSURE

9A.5.5.1 Fire Area 52: Suppression Chamber (el 181'-11")

a. Structural and architectural design features of fire area (Figures 9A-4, 9A-5, and 9A-6):

	Construction	Rating
Walls:	All around - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (diaphragm slab)	None

Access:	Two access hatches connecting to area 67	None

b. Major safety-related components in fire area:

1. Primary containment vacuum relief valve assemblies (PSV-57-237A,B,C&D)

c. Postulated fire in area:

Since there are no combustible materials located in this area, no fire is postulated to occur.

d. Consequences of fire with active fire suppression:

Not applicable (see item (c)).

e. Effect of fire on safe shutdown:

Fire area 52 contains safe shutdown cables and equipment.

During normal operation, primary containment is inerted. Since containment is inerted no fire is postulated.

9A.5.5.2 Fire Area 53: Drywell (el 237'-11")

a. Structural and architectural design features of fire area (Figures 9A-7, 9A-8, and 9A-9):

	Construction	Rating
Walls:	All around - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete (diaphragm slab)	None
Ceiling:	Steel dome (drywell head)	None
Access:	Equipment hatch connecting to area 68	None
	Equipment hatch with personnel lock connecting to area 68	None

b. Major safety-related components in fire area:

1. Control rod drive mechanisms (total of 185)

2. Main steam isolation valves (inboard, one per steam line)

3. Main steam relief valves (total of 14)

4. Drywell unit coolers (total of 8)

5. Inboard containment isolation valves for HPCI steam supply line, RCIC steam supply line, RWCU letdown line, and RHR shutdown cooling suction line

c. Postulated fire in area:

1. Leakage of lube oil from a recirculation pump motor onto the diaphragm slab, with subsequent ignition of the oil.

2. Ignition of electrical cabling in cable tray or direct supported metal clad cable.

d. Consequences of fire with active fire suppression:

The possibility of a fire in the drywell is limited to periods when the reactor is shut down. This is because the primary containment is inerted with nitrogen during reactor operation, so that the oxygen concentration is maintained below 4% by volume. This inert atmosphere will prevent fires from occurring in the primary containment during reactor operation.

In the event of a fire in the drywell while the reactor is shut down and the drywell deinerted, the operator will dispatch the plant fire brigade to el 253' in the reactor enclosure. The fire brigade will enter the drywell through the personnel airlock and will ensure extinguishment of the fire through the use of portable fire extinguishers or hoses from hose reels located outside the entrances to the drywell.

e. Effect of fire on safe shutdown:

Fire area 53 contains safe shutdown cables and equipment.

During normal operation, primary containment is inerted. Since containment is inerted no fire is postulated.

9A.5.5.3 <u>Fire Area 54: Residual Heat Removal Compartment (el 177'-0")</u>

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	NE - Reinforced concrete (primary containment wall)	None
	N - Reinforced concrete	3 hr
	W - Reinforced concrete (part below el 201', exterior wall)	None
	W - Reinforced concrete (part above el 201')	3 hr
	S - Reinforced concrete (part below el 198', exterior wall)	None
	S - Reinforced concrete (part above el 198')	3 hr
	E - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None

Ceiling:	Reinforced concrete (ceiling contains 115 ft^2 of unrated metal blowout panels leading to area 66)	None
Access:	Watertight doors connecting to areas 55 and 62	3 hr**
	Steamtight doors (at el 201') connecting to areas 55 and 64	3 hr

b. Major safety-related components in fire area:

1. RHR pumps 2AP202 and 2CP202

2. RHR heat exchanger 2AE205

3. RHR compartment unit coolers 2AV210, 2CV210, 2EV210, and 2GV210

c. Postulated fire in area:

Leakage of lube oil from both RHR pump motors onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 54 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B and C will be available to shutdown Unit 1 and methods B and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the

panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217', safe shutdown capability would still be assured. Fire area 54 and the western portion of fire area 66 both credit method C for safe shutdown of Unit 2. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 1.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.5.4 Fire Area 55: Residual Heat Removal Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete	3 hr
	NE - Reinforced concrete	3 hr
	NW - Reinforced concrete (primary containment wall)	None
	W - Reinforced concrete	3 hr
	S - Reinforced concrete (part below el 198', exterior wall)	None
	S - Reinforced concrete (part above el 198')	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 150 ft^2 of unrated metal blowout panels leading to area 66)	None
Access:	Watertight doors connecting to areas 54 and 56	3 hr**
	Steamtight doors (at el 201') connecting to areas 54 and 65	3 hr

b. Major safety-related components in fire area:

1. RHR pumps 2BP202 and 2DP202

2. RHR heat exchanger 2BE205

3. RHR compartment unit coolers 2BV210, 2DV210, 2FV210, and 2HV210

4. RCIC turbine exhaust line vacuum breaker valves HV-49-2F080 and HV-49-2F084

5. ESW loop "B" valves (HV-11-047, HV-11-077, HV-11-225, and HV-11-226)

c. Postulated fire in area:

Leakage of lube oil from both RHR pump motors onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 55 contains safe shutdown cables and equipment.

Cables required to support shutdown method B for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method B for Unit 1 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Unit 1 and method C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 and method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217', safe shutdown capability would still be assured. Fire area 55 and the eastern portion of fire area 66 both credit method C for safe shutdown of Unit 2. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 1.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.5.5 Fire Area 56: Reactor Core Isolation Cooling Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete (exterior wall)	None
	N - Reinforced concrete	3 hr
	NE - Reinforced concrete	3 hr
	NW - Reinforced concrete (primary containment wall)	None
	SW - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	S - Reinforced concrete (part, exterior wall below el 198')	None
	S - Reinforced concrete (part, exterior wall above el 198')	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 25 ft^2 of unrated metal blowout panels leading to area 66)	None
Access:	Watertight doors connecting to areas 55 and 57	3 hr**
	Door connecting to stairwell no. 5	1.5 hr

b. Major safety-related components in fire area:

1. RCIC pump 20P203
2. RCIC turbine 20S212
3. RCIC compartment unit coolers 2AV208 and 2BV208

c. Postulated fire in area:

Leakage of lube oil from RCIC turbine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control

room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 56 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217’, safe shutdown capability would still be assured. Fire area 56 and the eastern portion of fire area 66 both credit method C for safe shutdown of Unit 2. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 1.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers

9A.5.5.6 Fire Area 57: High Pressure Coolant Injection Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete (exterior wall)	None
	N - Reinforced concrete	3 hr
	W - Reinforced concrete (primary containment wall)	None
	SW - Reinforced concrete	3 hr

	S - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (ceiling contains 160 ft^2 of unrated metal blowout panels leading to area 66)	None
Access:	Watertight doors connecting to areas 56 and 63	3 hr**

b. Major safety-related components in fire area:

1. HPCI pump 20P204

2. HPCI turbine 20S211

3. HPCI compartment unit coolers 2AV209 and 2BV209

4. Instrument rack 20C014 (HPCI)

c. Postulated fire in area:

Leakage of lube oil from HPCI turbine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible-visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 57 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2.

f. Deviations:

The existence of unrated metal panels in the ceiling of this fire area is acceptable because the low combustible loadings in the areas above and below the panels and the height of the panels above the floor (40 feet) minimize the possibility of fire propagating through the panels. Penetrations of piping and electrical raceway through the ceiling are provided with 3 hour rated seals.

In the highly unlikely event that a fire in this area should propagate through the metal panels in the ceiling at elevation 217', safe shutdown capability would still be assured. Fire area 57 and the eastern portion of fire area 66 both credit method C for safe shutdown of Unit 2. The unlikely propagation of a fire through the metal panels does not impact safe shutdown of Unit 1.

The unrated metal panels are a deviation from the requirements of CMEB 9.5-1, C.5.b. Although the metal panels are unrated, safe shutdown requirements are met in that safe shutdown can be achieved even with the unlikely failure of the unrated barriers.

9A.5.5.7 Fire Area 58: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	W - Reinforced concrete (primary containment wall)	None
	S - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 63	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 2BP206

2. Core spray compartment unit coolers 2BV211 and 2FV211

3. Safeguard piping fill pump 2BP256

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control

room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 58 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.8 Fire Area 59: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete	3 hr
	N - Reinforced concrete (part adjacent to fire areas 102 and 115)	3 hr
	N - Reinforced concrete (part adjacent to unexcavated area)	None
	W - Reinforced concrete	3 hr
	SW - Reinforced concrete (primary containment wall)	None
	S - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 63	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 2DP206

2. Core spray compartment unit coolers 2DV211 and 2HV211

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 59 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.9 Fire Area 60: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	E - Reinforced concrete	3 hr
	N - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	SE - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 62	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 2CP206

2. Core spray compartment unit coolers 2CV211 and 2GV211

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 60 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.

9A.5.5.10 Fire Area 61: Core Spray Compartment (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	E - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight door connecting to area 62	3 hr**

b. Major safety-related components in fire area:

1. Core spray pump 2AP206
2. Core spray compartment unit coolers 2AV211 and 2EV211
3. Safeguard piping fill pump 2AP256

c. Postulated fire in area:

Leakage of lube oil from core spray pump motor onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire will activate the smoke detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 61 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.11 Fire Area 62: Sump Room and Passageway (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 2)	2 hr
	W - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to unexcavated area)	None
	S - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (part, primary containment wall)	None
	E - Reinforced concrete (part)	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight doors connecting to areas 54, 60, and 61	3 hr**
	Door connecting to stairwell no. 2	1.5 hr

b. Major safety-related components in fire area:

1. Containment isolation valves (HV-52-227 and HV-52-228) for suppression pool cleanup pump suction line.

2. Instrument rack 20C075 (RHR pump "A" discharge pressure)

3. Instrument rack 20C077 (RHR pump "C" discharge pressure)

4. Instrument rack 20C018 (Div. 1 RHR and Div. 1 RHRSW)

c. Postulated fire in area:

1. Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of oil in waste oil collection drum associated with the floor drain sump oil removal belt.

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 62 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.12 Fire Area 63: Corridor (el 177'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
	N - Reinforced concrete (part adjacent to	None

	unexcavated area)	
	W - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	E - Reinforced concrete (part adjacent to unexcavated area)	None
	E - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Watertight doors connecting to areas 57, 58, and 59	3 hr**
	Door connecting to stairwell no. 6	1.5 hr
	Elevator door	0.75 hr

b. Major safety-related components in fire area:

1. HPCI pump discharge flow transmitters (FT-55-2N008 and FT-55-2N051)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 63 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1 and methods A and C will be available to shutdown Unit 2.

9A.5.5.13 Fire Area 64: Reactor Enclosure Cooling Water Equipment Area (el 201'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 2)	2 hr
	W - Reinforced concrete (part adjacent to fire area 41)	3 hr
	W - Reinforced concrete (part adjacent to unexcavated area)	None
	S - Reinforced concrete	3 hr
	E - Reinforced concrete (part)	3 hr
	E - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (One portion of the ceiling slab, covering an area of 10 ft^2, has a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Access:	Door connecting to stairwell no. 2	1.5 hr
	Door connecting to area 54	3 hr

b. Major safety-related components in fire area:

1. Core spray loop "A" minimum flow recirculation valve (HV-52-2F031A)

2. Containment atmosphere sample return line isolation valves (SV-57-290 and SV-57-291)

3. ESW loop "A" valves (HV-11-046, HV-11-076, HV-11-221, HV-11-223, HV-11-224, HV-11-227 and HV-11-228)

4. HVAC unit cooler control panels 2AC208 and 2CC208

5. Motor control center 20B217, which serves the following components:
   (a) RHR loop "C" valves
   (b) RHR compartment unit coolers 2CV210 and 2GV210
   (c) Core spray loop "A" valves
   (d) Core spray compartment unit coolers 2CV211 and 2GV211
   (e) RHRSW outlet valve from RHR "A" heat exchanger (HV-51-2F068A)
   (f) Drywell unit cooler fans 2C2V212 and 2G2V212
   (g) Containment hydrogen recombiner 2AS403 and associated valves
   (h) HVAC 120 V ac transformer 20X283
   (i) PCIG supply header containment isolation valve (HV-59-251A)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 64 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods B and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2.

9A.5.5.14 Fire Area 65: Safeguard System Access Area (el 201'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

	Construction	Rating
Walls:	N - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
	N - Reinforced concrete (part)	3 hr
	W - Reinforced concrete	3 hr
	SW - Reinforced concrete (primary containment wall)	None
	S - Reinforced concrete (part	2 hr

		adjacent to stairwell no. 5)	
		S - Reinforced concrete (part)	3 hr
		E - Reinforced concrete (part adjacent to unexcavated area)	None
		E - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
		E - Reinforced concrete (part adjacent to auxiliary boiler pipe tunnel)	3 hr
	Floor:	Reinforced concrete	3 hr*
	Ceiling:	Reinforced concrete (One portion of the ceiling slab, covering an area of 10 ft^2, has a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Access:		Elevator door	0.75 hr
		Doors connecting to stairwell nos. 5 and 6	1.5 hr
		Door connecting to area 55	3 hr
		Watertight door connecting to area 75	3 hr**

b. Major safety-related components in fire area:

1. HPCI valves HV-55-2F007 (pump discharge) and HV-55-2F008 (pump discharge recirculation to CST)

2. RCIC valves HV-49-2F012 (pump discharge) and HV-49-2F022 (pump discharge recirculation to CST)

3. HPCI level transmitters (LT-55-2N061B&F) and turbine exhaust pressure transmitters (PT-56-2N055D&H)

4. RCIC pump suction line level transmitters (LT-49-2N035A&E)

5. ESW loop "B" valves (HV-11-048, HV-11-049, HV-11-078, and HV-11-079)

6. Suppression chamber pressure transmitter (PT-57-201)

7. Instrument rack 20C017 (RCIC)

8. Instrument rack 20C021 (Div. 2 RHR and Div. 2 RHRSW)

9. Instrument rack 20C076 (RHR pump "B" discharge pressure)

10. Instrument rack 20C078 (RHR pump "D" discharge pressure)

11. HVAC unit cooler control panels 2BC208 and 2DC208

12. Motor control center 20B218, which serves the following components:

(a) RHR loop "D" valves
(b) RHR compartment unit coolers 2DV210 and 2HV210
(c) Core spray pump suction valve (HV-52-2F001D)
(d) Core spray compartment unit coolers 2DV211 and 2HV211
(e) RHRSW outlet valve from RHR "B" heat exchanger (HV-51-2F068B)
(f) Drywell unit cooler fans 2D2V212 and 2F2V212
(g) Containment hydrogen recombiner 2BS403 and associated valves
(h) HVAC 120 V ac transformer 20X284
(i) PCIG supply header containment isolation valve (HV-59-251B)

c. Postulated fire in Area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 65 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2.

9A.5.5.15 Fire Area 66: Safeguard System Isolation Valve Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (exterior wall, contains 150 ft^2 of unrated blowout panels)	None
	W - Reinforced concrete	3 hr
	Interior boundary - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete (contains 450 ft^2 of unrated metal blowout panels from areas 54, 55, 56, and 57)	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Two steamtight doors connecting to area 67	3 hr

b. Major safety-related components in fire area:

1. HPCI steam line containment isolation valves (HV-55-2F003 and HV-55-2F100)

2. RCIC steam line containment isolation valves (HV-49-2F008 and HV-49-2F076)

3. RHR system valves:
   (a) HV-51-2F008 (shutdown cooling suction containment isolation)
   (b) HV-51-2F015A&B (shutdown cooling return containment isolation)
   (c) HV-51-2F047A&B (heat exchanger inlet)
   (d) HV-C-51-2F048A&B (heat exchanger bypass)

4. CAC system containment isolation valves (HV-57-209, HV-57-221, HV-57-223, HV-57-224, HV-57-231, HV-57-235, HV-57-247, HV-57-263, and HV-57-264)

5. PCIG system containment isolation valves (HV-59-202, HV-59-229A, HV-59-229B, HV-59-235, HV-59-251A, and HV-59-251B)

6. HPCI system leakage detection temperature elements

7. RCIC system leakage detection temperature elements

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 66 is divided into an eastern (66E) and a western (66W) portion through the establishment of a 20 foot wide zone that is free of combustible materials; no cable trays are located within this combustible-free zone.

66E

The eastern portion of fire area 66 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 66.

66W

The western portion of fire area 66 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either encapsulated by a qualified fire barrier, or associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the western half of fire area 66.

f. Deviations:

Fire area 66 is divided into a western portion and an eastern portion through the establishment of a 20 foot wide zone that is free of combustible materials. No cable trays are located within this combustible-free zone.

Several valves associated with the credited safe shutdown methods are located in fire area 66. Valves performing active, credited, redundant functions are located on opposite sides of fire area 66 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable trays, and none of these cable trays are located within the combustible-free zone. The in situ combustible loading in fire area 66 is relatively light, with an equivalent severity of only 13 minutes. The potential for transient combustibles to exist in the space between credited, redundant valves is severely restricted by the arrangement of fire area 66 and the locations of commodities within it. The space between credited, redundant valves is relatively narrow and contains a high concentration of pipes and pipe supports. These obstructions effectively prevent the introduction of significant quantities of combustible materials into this space. The factors discussed above preclude the occurrence of a fire, involving either in situ combustibles or transient combustibles, that could simultaneously affect credited, redundant equipment.

The measures described above for physical separation and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or eastern portion of fire area 66.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.5.16 Fire Area 67: Safeguard System Access Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 2 and 6)	2 hr
	N - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 2)	2 hr
	W - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	S - Reinforced concrete (part adjacent to fire area 125)	3 hr

	S - Reinforced concrete (part, exterior wall)	None
	E - Reinforced concrete (part adjacent to stairwell nos. 5 and 6)	2 hr
	E - Reinforced concrete (part)	3 hr
	Interior boundary (part) - Reinforced concrete walls	3 hr
	Interior boundary (part) - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete (Two portions of the floor slab, each of which covers an area of 10 ft^2, have a reduced concrete thickness that varies between 4.5 inches and 9.0 inches.)	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 2, 5, and 6	1.5 hr
	Two steamtight doors connecting to area 66	3 hr
	Missile-resistant door connecting to area 76	3 hr**
	Equipment airlock door	None
	Elevator door	0.75 hr
	Suppression chamber access hatches	None
	Equipment hatchway in ceiling (200 ft^2 opening; protected by water curtain suppression system)	None

b. Major safety-related components in fire area:

1. Core spray full flow test recirculation valves (HV-52-2F015A&B)

2. CAC system containment isolation valves (HV-57-204, HV-57-205, HV-57-212, HV-57-218, and HV-57-262)

3. RHR system valves:
   (a) HV-51-225A&B (containment isolation for recirculation to suppression chamber)
   (b) HV-51-2F027A&B (containment isolation for suppression chamber spray)
   (c) HV-51-2F010A&B (loops C and D recirculation to suppression chamber)
   (d) HV-51-2F024A&B (loops A and B recirculation to suppression chamber)

4. Instrument racks 20C001 (core spray loop A) and 20C019 (core spray loop B)

5. Instrument racks 20C015, 20C025, 20C041, and 20C042 (main steam and reactor recirculation flow)

6. Instrument racks 20C016 and 20C036 (HPCI)

7. Instrument racks 20C035 and 20C038 (RCIC)

8. Instrument racks 20C006, 20C009, 20C010, and 20C022 (reactor recirculation system pressure and jet pump flow)

9. RHR flow transmitters (FT-51-2N015A,B,C&D and FT-51-2N052A,B,C&D)

10. Motor control center 20B211, which serves the following components:
    (a) RHR loop "A" valves
    (b) RHR compartment unit coolers 2AV210 and 2EV210
    (c) Core spray loop "A" valves
    (d) Core spray compartment unit coolers 2AV211 and 2EV211
    (e) RHRSW inlet valve to RHR "A" heat exchanger (HV-51-2F014A)
    (f) RHR shutdown cooling suction inboard isolation valve (HV-51-2F009)
    (g) RCIC compartment unit coolers 2AV208 and 2BV208
    (h) RWCU inboard isolation valve (HV-44-2F001)
    (i) Main steam drain line inboard isolation valve (HV-41-2F016)
    (j) Drywell unit cooler fans 2A1V212, 2C1V212, 2E1V212, and 2G1V212
    (k) Safeguard piping fill pump 2AP256
    (l) PCIG compressor suction line containment isolation valve (HV-59-201)
    (m) 120 V instrument ac distribution panel 20Y101
    (n) Battery chargers 2A1D103 and 2A2D103
    (o) Motor control center 20B215

11. Motor control center 20B212, which serves the following components:
    (a) RHR loop "B" valves
    (b) RHR compartment unit coolers 2BV210 and 2FV210
    (c) Core spray loop "B" valves
    (d) Core spray compartment unit coolers 2BV211 and 2FV211
    (e) RHRSW inlet valve to RHR "B" heat exchanger (HV-51-2F014B)
    (f) RHR shutdown cooling return isolation valve (HV-51-2F015A)
    (g) Reactor recirculation pump suction valve (HV-43-2F023B)
    (h) HPCI compartment unit coolers 2AV209 and 2BV209
    (i) Drywell unit cooler fans 2B1V212, 2D1V212, 2F1V212, and 2H1V212
    (j) Safeguard piping fill pump 2BP256
    (k) CAC system purge line isolation valve (HV-57-205)
    (l) 120 V instrument ac distribution panel 20Y102
    (m) Battery chargers 2B1D103 and 2B2D103
    (n) Motor control center 20B216

12. Motor control center 20B215, which serves the following components:
    (a) RHR loop "A" valves
    (b) RCIC system valves
    (c) Deleted.
    (d) Suppression pool cleanup pump suction isolation valve (HV-52-227)
    (e) Drywell pressure tap isolation valve (HV-42-247A)
    (f) Drywell floor drain and equipment drain containment isolation valves (HV-61-212 and HV-61-232)
    (g) Main steam drain line flow control valve (HV-C41-2F020)

13. Motor control center 20B216, which serves the following components:
    (a) RHR loop "B" valves
    (b) HPCI system valves
    (c) Deleted
    (d) Suppression pool cleanup pump isolation valve (HV-52-228)
    (e) Drywell pressure tap isolation valve (HV-42-247B)
    (f) Suppression pool level tap isolation valves (HV-55-220 and HV-55-221)
    (g) Reactor head spray outboard isolation valve (HV-51-2F023)
    (h) RHR shutdown cooling suction outboard isolation valve (HV-51-2F008)
    (i) RWCU outboard isolation valve (HV-44-2F004)
    (j) Main steam drain line outboard isolation valve (HV-41-2F019)
    (k) RHR to radwaste discharge line isolation valve (HV-51-2F049)

14. Dc motor control center 20D201, which serves the following components:
    (a) RCIC system
    (b) Div. 1 RPS and UPS static inverter

15. Dc motor control center 20D202, which serves the HPCI system

16. Dc motor control center 20D203, which serves the following components:
    (a) HPCI system
    (b) Div. 2 RPS and UPS static inverter

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of one of the three preaction sprinkler systems in this fire area, the system will provide automatic suppression of the fire. When the compartment temperature rises to 190ºF, the deluge valve will open and prime the preaction sprinkler system with water. At 212ºF, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 67 is divided into an eastern (67E) and a western (67W) portion through the establishment of a 20 foot wide zone that is free of combustible materials.

<u>67E</u>

The eastern portion of fire area 67 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 67.

<u>67W</u>

The western portion of fire area 67 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the western half of fire area 67.

f. Deviations:

Fire area 67 is divided into a western portion and an eastern portion through the establishment of a 20 foot wide zone that is free of combustible materials. All cable trays located within this combustible-free zone are enclosed by a galvanized steel cable tray enclosure system to cover the cable trays that pass through the zone. This non-combustible configuration together with the enclosure and seals will prevent fire propagation across the combustible zone. A fixed suppression system of the water curtain-type is located within the combustible-free zone to provide assurance that a postulated fire

due to transient combustibles can be prevented from propagating through the combustible-free zone.

Several components associated with the credited safe shutdown methods are located in fire area 67. Components performing active, credited, redundant functions are located on opposite sides of fire area 67 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone.

The locations of preaction sprinkler systems and water curtain suppression systems in fire area 67 are shown in Figure 9A-6.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 67.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.5.17 Fire Area 68: CRD Hydraulic Equipment Area and Neutron Monitoring System Area (el 253'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 2 and 6)	2 hr
	N - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 2)	2 hr
	W - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	S - Reinforced concrete (part, exterior wall)	None
	E - Reinforced concrete (parts adjacent to stairwell nos. 5 and 6)	2 hr
	E - Reinforced concrete (part, exterior wall)	None
	Interior boundary (part adjacent to main steam tunnel) - Reinforced concrete	3 hr
	Interior boundary (part) - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*

Access:	Doors connecting to stairwell nos. 2, 5, and 6	1.5 hr
	Elevator door	0.75 hr
	Drywell access hatches	None
	Watertight door connecting to area 69	3 hr**
	Equipment hatchways in floor and ceiling (200 ft^2 openings; protected by water curtain suppression systems)	None

b. Major safety-related components in fire area:

1. DCWS valves HV-87-222, HV-87-223, HV-87-228, and HV-87-229 (supply and return line containment isolation)

2. CRD system master control station

3. CRD system hydraulic control units

4. Containment combustible gas analyzer sample package 20S206

5. Load center 20B203 (Div. 3)

6. Deleted

7. Instrument racks 20C004, 20C005, 20C026, and 20C027 (RPV instrumentation and LPCI injection valve ΔP transmitters)

8. SLCS injection line containment isolation valves (HV-48-2F006A&B)

9. Reactor vessel pressure transmitters (PT-42-203A&B)

10. Reactor vessel water level transmitters (LT-42-215A&B)

11. Drywell pressure transmitters (PT-42-201 and PT-42-270)

12. PCIG supply line pressure monitoring instrumentation (PT-59-252A&B and PDS-59-206A&B)

13. Motor control center 20B223, which serves the following components:
    (a) LPCI injection containment isolation valve (HV-51-2F017C)
    (b) RHR loop "C" minimum flow recirculation isolation valve (HV-51-205A)
    (c) RCIC system valves (HV-49-2F007 and HV-49-2F084)
    (d) Standby liquid control pump 2CP208
    (e) Containment combustible gas analyzer sample package 20S206
    (f) Drywell pressure tap isolation valve (HV-42-247C)
    (g) Drywell unit cooler fans 2A2V212 and 2E2V212
    (h) Reactor recirculation pump cooling water isolation valves (HV-13-206 and HV-13-207)

(i) Battery charger 2CD103
(j) Instrument ac transformer 20X108
(k) Feedwater line inboard maintenance isolation valve (HV-41-2F011B)

14. Motor control center 20B224, which serves the following components:
(a) LPCI injection containment isolation valve (HV-51-2F017D)
(b) RHR loop "D" minimum flow recirculation isolation valve (HV-51-205B)
(c) HPCI system valves (HV-55-2F002 and HV-55-2F095)
(d) Containment combustible gas analyzer sample package 20S205
(e) Drywell pressure tap isolation valve (HV-42-247D)
(f) Reactor recirculation pump cooling water source select valves (HV-13-208 and HV-13-211)
(g) Drywell unit cooler fans 2B2V212 and 2H2V212
(h) Battery charger 2DD103
(i) Instrument ac transformer 20X109

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of one of the two preaction sprinkler systems in this fire area, the system will provide automatic suppression of the fire. When the compartment temperature rises to 190ºF, the deluge valve will open and prime the preaction sprinkler system with water. At 212ºF, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

If the fire occurs within the coverage area of the wet pipe sprinkler systems in this fire area, the systems will provide automatic suppression of the fire. When the compartment temperature rises to 200°F, individual fusible link sprinklers will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 68 is divided into an eastern (68E) and a western (68W) portion through the establishment of a 20 foot wide zone that is free of combustible materials; no cable trays are located within this combustible-free zone.

<u>68E</u>

The eastern portion of fire area 68 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 68.

68W

The western portion of fire area 68 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the western half of fire area 68.

A postulated fire in the vicinity of the reactor vessel instrumentation reference leg backfill system could adversely affect reactor vessel water level indication due to reference leg density changes caused by an increase in water temperature. Since there are no fire initiators in close proximity to the backfill system tubing, administratively controlled

combustible free zones, throughout the locations of the backfill system will preclude any adverse effect on level indication, due to fire, prior to annunciation in the main control room. Following annunciation in the main control room, the backfill system will be administratively isolated from the reference legs.

f. Deviations:

Fire area 68 is divided into a western portion and an eastern portion through the establishment of a 20 foot wide zone that is free of combustible materials. No cable trays are located within this combustible-free zone. A fixed suppression system of the water curtain-type is located within the combustible-free zone to provide assurance that a postulated fire due to transient combustibles can be prevented from propagating through the combustible-free zone.

Several components associated with the credited safe shutdown methods are located in fire area 68. Components performing active, credited, redundant functions are located on opposite sides of fire area 68 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone.

The locations of the preaction sprinkler systems and the water curtain suppression system in fire area 68 are shown in Figure 9A-7.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 68.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.5.18 Fire Area 69: Main Steam Tunnel (el 253'-0")

a. Structural and architectural design features of fire area (Figures 9A-7, 9A-8, 9A-9, and 9A-10):

	Construction	Rating
Walls:	N - Reinforced concrete (contains 233 ft^2 of unrated metal blowout panels)	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part, primary containment wall)	None
	S - Reinforced concrete (part)	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (part at el 295'-3")	3 hr*
	Reinforced concrete (part at el 365' roof slab)	None
Access:	Watertight door connecting to	3 hr**

area 68	
Steamtight doors connecting to areas 28 and 70	3 hr

b. Major safety-related components in fire area:

1. Main steam line outboard containment isolation valves (HV-41-2F028A,B,C&D)

2. Feedwater line outboard containment isolation valves (HV-41-2F032A&B and HV-41-2F074A&B)

3. Main steam drain line outboard containment isolation valve (HV-41-2F019)

4. Deleted
5. RCIC injection valve (HV-49-2F013)
6. Steam line radiation sensors (RE-41-2N006A,B,C&D)

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the plant fire brigade will be dispatched to el 253' and/or el 283' in the reactor enclosure and will enter the main steam tunnel through doors at those elevations. The fire brigade will extinguish the fire using portable fire extinguishers or hoses from hose stations located outside the entrances to the main steam tunnel.

e. Effect of fire on safe shutdown:

Fire area 69 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.

9A.5.5.19 <u>Fire Area 70: RWCU Compartments, FPCC Compartment, and General Equipment Area (el 283'-0" and el 295'-3")</u>

a. Structural and architectural design features of fire area (Figure 9A-8):

	Construction	Rating
Walls:	N - Reinforced concrete (parts adjacent to stairwell nos. 2 and 6)	2 hr
	N - Reinforced concrete (part)	3 hr
	W - Reinforced concrete (part adjacent to stairwell no. 2)	2 hr
	W - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	S - Reinforced concrete (part, exterior wall)	None
	E - Reinforced concrete (parts adjacent to stairwell nos. 5 and 6)	2 hr
	E - Reinforced concrete (part, exterior wall)	None
	Interior boundary (east and west walls of area 69) - Reinforced concrete	3 hr
	Interior boundary (primary containment wall) - Reinforced concrete	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	einforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 2, 5, and 6	1.5 hr
	Steamtight door connecting to area 69	3 hr
	Elevator door	0.75 hr
	Equipment hatchways in floor and ceiling (200 ft^2 openings; protected by water curtain suppression systems)	None

b. Major safety-related components in fire area:

1. Containment hydrogen recombiner packages 2AS403 and 2BS403

2. SLCS components:
   (a) Storage tank 20T204
   (b) Injection pumps 2AP208, 2BP208, and 2CP208
   (c) Explosive valves XV-48-2F004A,B&C

3. Core spray loop "A" injection valves (HV-52-2F004A and HV-52-2F005)

4. Core spray loop "B" injection valves (HV-52-2F004B, HV-52-2F037, and HV-52-208)

5. RHR system valves:
   (a) HV-51-2F017A,B,C&D (LPCI injection line containment isolation)
   (b) HV-51-2F021A&B (drywell spray line containment isolation)
   (c) HV-51-2F016A&B (drywell spray line shutoff)

6. HPCI system injection valve (HV-55-2F006)

7. RWCU supply line containment isolation valve (HV-44-2F004)

8. CAC system purge line containment isolation valves (HV-57-211, HV-57-215, HV-57-214, and HV-57-261)

9. Containment combustible gas analyzer sample package 20S205

10. Load center 20B204 (Div. 4)

11. Motor control center 20B213, which serves the following components:
   (a) RHR loop "A" valves
   (b) Core spray loop "A" valves
   (c) Feedwater startup recirculation valve (HV-41-209A)
   (d) Shutoff valves for main steam to miscellaneous steam-driven components (HV-01-208, HV-01-209, HV-01-211, and HV-01-250)
   (e) Drywell chilled water source select valves (HV-87-220A&B, HV-87-221A&B, HV-87-224A&B, and HV-87-225A&B)
   (f) Feedwater line outboard containment isolation valve (HV-41-2F032B)
   (g) Feedwater line inboard maintenance isolation valve (HV-41-2F011A)
   (h) SLCS pump 2AP208
   (i) SLCS injection line containment isolation valve (HV-48-2F006A)
   (j) RERS train "A" valves (HV-76-209, HV-76-284A, and HV-76-291A)
   (k) CAC system containment isolation valves (HV-57-212 and HV-57-215)
   (l) HVAC 120 V ac distribution panel 20X281

12. Motor control center 20B214, which serves the following components:
   (a) RHR loop "B" valves
   (b) Core spray loop "B" valves
   (c) Drywell cooling water containment isolation valves (HV-87-222, HV-87-223, HV-87-228, and HV-87-229)
   (d) Feedwater startup recirculation valve (HV-41-209B)
   (f) Feedwater line outboard containment isolation valve (HV-41-2F032A)
   (g) SLCS pump 2BP208
   (h) SLCS injection line containment isolation valve (HV-48-2F006B)
   (i) RERS train "B" valves (HV-76-210, HV-76-284B, and HV-76-291B)
   (j) CAC system containment isolation valve (HV-57-211)
   (k) HVAC 120 V ac distribution panel 20X282

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the fire occurs within the coverage area of the preaction sprinkler system in this fire area, the system will provide automatic suppression of the fire. When the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual fusible link sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 70 is divided into an eastern (70E) and a western (70W) portion through the establishment of a 20 foot wide zone that is free of combustible materials; no cable trays are located within this combustible-free zone.

<u>70E</u>

The eastern portion of fire area 70 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 70.

<u>70W</u>

The western portion of fire area 70 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either encapsulated by a qualified fire barrier, associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area have redundant

components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the western half of fire area 70.

A postulated fire in the vicinity of the reactor vessel instrumentation reference leg backfill system could adversely affect reactor vessel water level indication due to reference leg density changes caused by an increase in water temperature. Since there are no fire initiators in close proximity to the backfill system tubing, administratively controlled combustible free zones, throughout the locations of the backfill system will preclude any adverse effect on level indication, due to fire, prior to annunciation in the main control room. Following annunciation in the main control room, the backfill system will be administratively isolated from the reference legs.

f. Deviations:

Fire area 70 is divided into a western portion and an eastern portion through the establishment of a 20 foot wide zone that is free of combustible materials. No cable trays are located within this combustible-free zone.

Several components associated with the credited safe shutdown methods are located in fire area 70. Components performing active, credited, redundant functions are located on opposite sides of fire area 70 and are separated by the combustible free zone. The only combustible materials in the intervening space are electrical cables in cable tray up to the boundaries of the combustible free zone.

The location of the preaction sprinkler system in fire area 70 is shown in Figure 9A-8.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 70.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.5.20 Fire Area 71: RWCU Holding Pump Compartments, RERS Fan Area, and Corridors (el 313'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

Construction	Rating

Walls:	N - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
	N - Reinforced concrete (part)	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete (part)	3 hr
	S - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	E - Reinforced concrete (part, exterior wall)	None
	E - Reinforced concrete (part adjacent to stairwell no. 6)	2 hr
	Interior boundary - Reinforced concrete (primary containment wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Doors connecting to stairwell nos. 5 and 6	1.5 hr
	Airlock door connecting to area 72	3 hr
	Double airlock door connecting to area 72	3 hr**
	Elevator door	0.75 hr
	Equipment hatchway in floor (200 ft^2 opening; protected by water curtain suppression system)	None

b. Major safety-related components in fire area:

1. RERS fans (2AV213 and 2BV213)

2. Load center 20B201 (Div. 1)

3. Load center 20B202 (Div. 2)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

For the purposes of safe shutdown analyses, fire area 71 is divided into an eastern (71E) and a western (71W) portion through the establishment of a 20 foot wide zone that is free of combustible materials; no cable trays are located within this combustible-free zone.

<u>71E</u>

The eastern portion of fire area 71 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown methods A and C for Unit 2 located in this fire area either have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2, for a fire in the eastern half of fire area 71.

71W

The western portion of fire area 71 contains safe shutdown cables and equipment.

Cables required to support shutdown method C for Unit 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area, or can be credited for safe shutdown by manual operator actions to recover any functions that could be lost.

Cables required to support shutdown methods A, B, and C for Unit 1 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and method C will be available to shutdown Unit 2, for a fire in the western half of fire area 71.

f. Deviation:

Load centers 20B201 and 20B202 and their associated transformers are the only components credited for safe shutdown which are located in fire area 71. The horizontal separation between the two load centers is approximately 35 feet, and there are no cable trays located in the intervening space. A 20 foot wide zone that is free of combustible materials is maintained between the two load centers. A fixed suppression system of the

water curtain-type is located within the combustible-free zone to provide assurance that a postulated fire due to transient combustibles can be prevented from propagating through the combustible-free zone. To preclude the possibility of a spilled combustible liquid spreading across the area between the two load centers, a concrete curb is provided between the load centers, spanning the full width of the corridor in which the load centers are located. The curb is located within the coverage area of the water curtain system. To protect the load centers from radiant heat that could be generated by a postulated fire occurring in the area between the load centers, each load center is provided with a radiant heat shield. The heat shields are constructed of Marinite sheet and are located adjacent to the side of each load center that faces the concrete curb.

The measures described above for physical separation, fire suppression, and provision of fire barriers ensure that the plant can be safely shut down in the event of a fire in either the western portion or the eastern portion of fire area 48.

This is a deviation from the CMEB 9.5-1, C.5.b requirement for automatic suppression. This deviation is documented in reference 9A.7.5.

9A.5.5.21 Fire Area 72: Reactor Enclosure Lower Fan Room (el 313'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (part, exterior wall)	None
	S - Louvers open to outside atmosphere (part)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete (part below fire area 73)	None
	Reinforced concrete (part below fire area 74)	3 hr*
Access:	Airlock door connecting to area 71	3 hr
	Double airlock door connecting to area 71	3 hr**
	Emergency exit in ceiling (6.25 ft^2 opening)	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Once the control room operators have been notified that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect on fire safe shutdown:

Fire area 72 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.22 Fire Area 73: Reactor Enclosure Upper Fan Room and Equipment Compartment Exhaust Filter Rooms (el 331'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	E - Reinforced concrete (part adjacent to stairwell no. 5)	2 hr
	E - Reinforced concrete (part)	3 hr
Floor:	Reinforced concrete	None
Ceiling:	Reinforced concrete	3 hr*
Access:	Door connecting to stairwell no. 5	1.5 hr
	Two doors connecting to area 74	3 hr
	Emergency exit in floor (6.25 ft^2 opening)	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the reactor enclosure equipment compartment exhaust filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the affected ventilation system will be shut down and the plant fire brigade will be dispatched to extinguish the fire.

The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

e. Effect on fire safe shutdown:

Fire area 73 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.5.23 Fire Area 74: RERS Filter Compartments (el 331-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	E - Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete	3 hr*
Ceiling:	Reinforced concrete	3 hr*
Access:	Two doors connecting to area 73	3 hr

b. Major safety-related components in fire area:

1. RERS filter assemblies (2AS297 and 2BS297)

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the reactor enclosure recirculation system filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum.

e. Effect on fire safe shutdown:

Fire area 74 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6 SAFE SHUTDOWN ANALYSIS - DIESEL GENERATOR ENCLOSURES

9A.5.6.1 Fire Area 79: Diesel Generator Cell 1A (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 1A and auxiliaries

2. ESW supply and return shutoff valves (11-1131A, HV-11-132A, HV-11-133A, and HV-11-134A)

3. Diesel generator air exhaust fans 1AV512 and 1EV512

4. Diesel generator control board 1AC514

5. Dc distribution panel 1AD501 (serving diesel generator 1A and auxiliaries)

6. Motor control center 10B515, which serves the following components:
   (a) Auxiliaries of diesel generator 1A
   (b) ESW loop "A" discharge valve (HV-11-011A)

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 79 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

9A.5.6.2 Fire Area 80: Diesel Generator Cell 1C (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 1C and auxiliaries

2. ESW supply and return shutoff valves (11-1131C, HV-11-132C, HV-11-133C, and HV-11-134C)

3. Diesel generator air exhaust fans 1CV512 and 1GV512

4. Diesel generator control board 1CC514

5. Dc distribution panel 1CD501 (serving diesel generator 1C and auxiliaries)

6. Motor control center 10B517, which serves auxiliaries of diesel generator 1C

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190ºF, the deluge valve will open and prime the preaction sprinkler system with water. At 212ºF, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 80 contains safe shutdown cables and equipment.

Cables required to support shutdown method A for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method A for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6.3 Fire Area 81: Diesel Generator Cell 1B (el. 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 1B and auxiliaries

2. ESW supply and return shutoff valves (HV-11-131B, HV-11-132B, 11-1133B, and HV-11-134B)

3. Diesel generator air exhaust fans 1BV512 and 1FV512

4. Diesel generator control board 1BC514

5. Dc distribution panel 1BD501 (serving diesel generator 1B and auxiliaries)

6. Motor control center 10B516, which serves auxiliaries of diesel generator 1B

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 81 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

9A.5.6.4 Fire Area 82: Diesel Generator Cell 1D (el. 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete (part adjacent to equipment airlock)	3 hr
	E - Reinforced concrete (part, exterior wall)	None
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr

Floor:	Reinforced concrete (portion on foundation slab) Reinforced concrete (portion above fire area 75)	None 3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell Door at south side of cell	3 hr None

b. Major safety-related components in fire area:

1. Diesel generator 1D and auxiliaries

2. ESW supply and return shutoff valves (HV-11-131D, HV-11-132D, 11-1133D, and HV-11-134D)

3. Diesel generator air exhaust fans 1DV512 and 1HV512

4. Diesel generator control board 1DC514

5. Dc distribution panel 1DD501 (serving diesel generator 1D and auxiliaries)

6. Motor control center 10B518, which serves the following components:
   (a) Auxiliaries of diesel generator 1D
   (b) ESW loop "B" discharge valve (HV-11-015B)

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 82 contains safe shutdown cables and equipment.

Cables required to support shutdown method B for Units 1 and 2 are either associated with equipment that have redundant components that are not affected by a fire in this area, or associated with equipment for which manual operator actions can be taken to recover any functions that could be lost. Equipment associated with shutdown method B for Units 1 and 2 located in this fire area may have redundant components that are not affected by a fire in this area, or manual operator actions may be taken to recover any essential functions that could be lost.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6.5 Fire Area 83: Diesel Generator Cell 2A (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete (part adjacent to equipment airlock)	3 hr
	W - Reinforced concrete (part, exterior wall)	None
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 2A and auxiliaries

2. ESW supply and return shutoff valves (11-2231A, HV-11-232A, HV-11-233A, and HV-11-234A)

3. Diesel generator air exhaust fans 2AV512 and 2EV512

4. Diesel generator control board 2AC514

5. Dc distribution panel 2AD501 (serving diesel generator 2A and auxiliaries)

6. Motor control center 20B515, which serves auxiliaries of diesel generator 2A

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 83 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods B and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods B and C will be available to shutdown Unit 2.9A.5.6.6 Fire Area 84: Diesel Generator Cell 2C (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 2C and auxiliaries

2. ESW supply and return shutoff valves (11-2231C, HV-11-232C, HV-11-233C, and HV-11-234C)

3. Diesel generator air exhaust fans 2CV512 and 2GV512

4. Diesel generator control board 2CC514

5. Dc distribution panel 2CD501 (serving diesel generator 2C and auxiliaries)

6. Motor control center 20B517, which serves the following components:
   (a) Auxiliaries of diesel generator 2C
   (b) ESW loop "A" discharge valve (HV-11-015A)

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 84 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6.7 Fire Area 85: Diesel Generator Cell 2B (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (portion on foundation slab)	None

	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell Door at south side of cell	3 hr None

b. Major safety-related components in fire area:

1. Diesel generator 2B and auxiliaries

2. ESW supply and return shutoff valves (HV-11-231B, HV-11-232B, 11-2233B, and HV-11-234B)

3. Diesel generator air exhaust fans 2BV512 and 2FV512

4. Diesel generator control board 2BC514

5. Dc distribution panel 2BD501 (serving diesel generator 2B and auxiliaries)

6. Motor control center 20B516, which serves the following components:
   (a) Auxiliaries of diesel generator 2B
   (b) ESW loop "B" discharge valve (HV-11-011B)

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 85 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Unit 1 and methods A and C for Unit 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Unit 1, and methods A and C will be available to shutdown Unit 2.

9A.5.6.8 Fire Area 86: Diesel Generator Cell 2D (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete (exterior wall)	None
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (portion on foundation slab)	None
	Reinforced concrete (portion above fire area 75)	3 hr*
Ceiling:	Reinforced concrete roof slab	None
Access:	Door at north side of cell	3 hr
	Door at south side of cell	None

b. Major safety-related components in fire area:

1. Diesel generator 2D and auxiliaries
2. ESW supply and return shutoff valves (HV-11-231D, HV-11-232D, 11-2233D, and HV-11-234D)
3. Diesel generator air exhaust fans 2DV512 and 2HV512
4. Diesel generator control board 2DC514
5. Dc distribution panel 2DD501 (serving diesel generator 2D and auxiliaries)
6. Motor control center 20B518, which serves auxiliaries of diesel generator 2D

c. Postulated fire in area:

Leakage of fuel oil or lubricating oil from the diesel engine onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

A fire will activate the detectors in this area, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 86 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6.9 Fire Area 124: Diesel Generator Access Corridor for Unit 1 (el. 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete	3 hr
	S - Reinforced concrete	3 hr
	W - Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete	None
Ceiling:	Reinforced concrete roof slab	None
Access:	Door to outside at west end of corridor	None
	Four doors at south side of corridor, leading to diesel generator cells	3 hr

b. Major safety-related components in fire area:

1. RHRSW radiation monitors 0AS578 and 0BS578

2. Deleted

3. Primary containment post-LOCA radiation monitoring electronics (RY-26-191A,B,C,D)

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 124 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.6.10 Fire Area 125: Diesel Generator Access Corridor for Unit 2 (el. 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Reinforced concrete (exterior wall)	None
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete	None
Ceiling:	Reinforced concrete roof slab	None
Access:	Door to outside at east end of corridor	None
	Four doors at south side of corridor, leading to diesel generator cells	3 hr

b. Major safety-related components in fire area:

1. Deleted

2. Primary containment post-LOCA radiation monitoring electronics (RY-26-291A,B,C,D)

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receipt of notification in the control room that a fire has occurred in this area, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 125 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.7 SAFE SHUTDOWN ANALYSIS - SPRAY POND PUMP STRUCTURE

9A.5.7.1 Fire Area 122: Spray Pond Pump Structure, Western Half

a. Structural and architectural design features of fire area (Figures 9A-11 and 9A-12):

	Construction	Rating
Walls:	N - Reinforced concrete(exterior wall)	None
	E - Reinforced concrete	3 hr
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete foundation	None
Ceiling:	Reinforced concrete roof slab	None
Access:	Door connecting to area 123	3 hr
	Door connecting to outside	None
	Roll-up door connecting to outside	None

b. Major safety-related components in fire area:

1. ESW pumps OAP548 and OCP548

2. RHRSW pumps OAP506 and OCP506

3. Sluice gates HV-12-003A&C

4. RHRSW valves:
   (a) HV-12-031A&C (winter bypass line)
   (b) HV-12-032A&C (spray networks A and C)
   (c) HV-12-034A (spray network cross-connection)
   (d) HV-12-112 and HV-12-114 (inlet from the Unit 1 cooling tower)

5. Spray pond pump structure supply fans OAV543 and OCV543

6. Motor control centers OOB519 (Div. 1) and OOB521 (Div. 3), which serve the following components:
   (a) ESW loop "A" valves
   (b) RHRSW loop "A" valves
   (c) Spray pond pump structure supply fan OAV543 and associated heaters and dampers
   (d) Spray pond pump structure supply fan OCV543 and associated heaters and dampers

7. Class 1E instrument ac distribution panels 01Y501 (Div. 1) and 03Y501 (Div. 3)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 122 contains safe shutdown cables and equipment.

Cables required to support shutdown methods B and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods B and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods B and C will be available to shutdown Units 1 and 2.

9A.5.7.2 Fire Area 123: Spray Pond Pump Structure, Eastern Half

a. Structural and architectural design features of fire area (Figures 9A-11 and 9A-12):

	Construction	Rating
Walls:	N - Reinforced concrete(exterior wall)	None
	E - Reinforced concrete (exterior wall)	None
	S - Reinforced concrete (exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation	None
Ceiling:	Reinforced concrete roof slab	None
Access:	Door connecting to area 122	3 hr
	Door connecting to outside	None
	Roll-up door connecting to outside	None

b. Major safety-related components in fire area:

1. ESW pumps OBP548 and ODP548

2. RHRSW pumps OBP506 and ODP506

3. Sluice gates HV-12-003B&D

4. RHRSW valves:
   (a) HV-12-031B&D (winter bypass line)

(b) HV-12-032B&D (spray networks B and D)
(c) HV-12- (spray network cross-connection)
(d) HV-12-212 and HV-12-214 (inlet from the Unit 2 cooling tower)

5. Spray pond pump structure supply fans OBV543 and ODV543

6. Motor control centers OOB520 (Div. 2) and OOB522 (Div. 4), which serve the following components:
   (a) ESW loop "B" valves
   (b) RHRSW loop "B" valves
   (c) Spray pond pump structure supply fan OBV543 and associated heaters and dampers
   (d) Spray pond pump structure supply fan ODV543 and associated heaters and dampers

7. Class 1E instrument ac distribution panels 02Y501 (Div. 2) and 04Y501 (Div. 4)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 123 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A and C will be available to shutdown Units 1 and 2.

9A.5.8 SAFE SHUTDOWN ANALYSIS - TURBINE ENCLOSURE

9A.5.8.1 Fire Area 87: Condensate Pump-Room (el 189'-0")

a. Structural and architectural design features of fire area (Figures 9A-5 and 9A-6):

Construction	Rating

Walls:	N - Reinforced concrete(exterior wall)		None
	E - Reinforced concrete (below el 217 feet)		3 hr
	E - Concrete masonry unit (above el 217 feet)		2 hr
	S - Reinforced concrete (above el 217 feet)		3 hr
	W - Reinforced concrete		3 hr
	S- Reinforced concrete (below el 217 feet)		None
Floor:	Reinforced concrete foundation mat		None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)		None
Access:	Watertight door connecting to area 88		3 hr**
	Two doors connecting to area 113		1.5 hr
	Roll-up door connecting to area 113		2 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

1. Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of oil in a waste oil collection drum associated with the floor drain sump oil removal belt.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 87 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.2 Fire Area 88: Main Condenser Area and Feedwater Heater Rooms (el 200'-0" and el 239'-0")

a. Structural and architectural design features of fire area (Figures 9A-5, 9A-6, and 9A-7):

	Construction	Rating
Walls:	N - Reinforced concrete and concrete masonry unit	None

	(exterior wall, below el 217')	
	N - Reinforced concrete and precast concrete panels (exterior wall, above el 217')	None
	E - Reinforced concrete (below el 217'; contains 25 ft^2 of unrated steel plate as separation from area 115)	3 hr
	E - Reinforced concrete and concrete masonry unit (above el 217')	3 hr
	S - Reinforced concrete and concrete masonry unit (below el 217')	3 hr
	S - Reinforced concrete (between el 217' and el 239')	3 hr
	S - Reinforced concrete (above el 239', contains 188 ft^2 of unrated metal blowout panels)	3 hr
	W - Reinforced concrete (portion north of column line N)	3 hr
	W - Concrete masonry unit and precast concrete panels (exterior wall south of column line N)	None
Floor:	Reinforced concrete foundation mat (el 200' and el 217')	None
	Reinforced concrete (el 239' supported by structural steel ;members without fireproofing)	None
Ceiling:	Reinforced concrete	None
Access:	Watertight doors connecting to areas 87 and 94	3 hr**
	Three doors connecting to area 89	3 hr
	Five doors connecting to area 97	3 hr
	Doors connecting to areas 95 and 113	3 hr

b. Major safety-related components in fire area:

1. Main turbine stop valve position switches (ZS-01-104A,B,C&D)

2. Turbine control valve fast closure pressure switches (PS-01-102A,B,C&D)

3. Main steam line area temperature detectors

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. If the fire is in the main condenser area and the compartment temperature rises to 212°F, individual sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire.

e. Effect of fire on safe shutdown:

Fire area 88 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.3 Fire Area 89: Reactor Feedwater Pump Lube Oil Areas, Control Rod Drive Water Pump Area, and Condensate Filter/Demineralizer Compartments (el 200'-0")

a. Structural and architectural design features of fire area (Figures 9A-5 and 9A-6):

	Construction	Rating
Walls:	N -Reinforced concrete and concrete masonry unit (part adjacent to fire areas 88 and 115)	3 hr
	N -Reinforced concrete (part adjacent to unexcavated area)	None
	E -Reinforced concrete	3 hr
	S -Reinforced concrete	3 hr
	W -Reinforced concrete(exterior wall)	None
Floor:	Reinforced concrete foundation mat (contains 76 ft^2 grating opening connecting to area 115)	None
Ceiling:	Reinforced concrete (contains156 ft^2 grating opening connecting to area 94)	None
Access:	Three doors connecting to area 88	3 hr
	Double steamtight door connecting to area 1	3 hr**
	Door connecting to stairwell no. 30	1.5 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Leakage of lube oil from the reactor feedwater pump lube oil reservoirs onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212ºF, individual fusible link sprinkler heads in the wet pipe sprinkler systems will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 89 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.4 Fire Area 90: Air Ejector and Steam Packing Exhauster Compartment (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete concrete masonry unit	3 hr
	S -	Reinforced concrete	3 hr
	W -	Reinforced concrete and concrete masonry unit	3 hr
Floor:		Reinforced concrete foundation mat	None
Ceiling:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:		Door connecting to area 113	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 90 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.5 Fire Area 91: Air Ejector and Steam Packing Exhauster Compartment (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete and concrete masonry unit	3 hr
	S -	Reinforced concrete and concrete masonry unit	3 hr
	W -	Reinforced concrete	3 hr
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)		None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)		None
Access:	Door connecting to area 113		3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 91 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.6 Fire Area 92: Mechanical Vacuum Pump-Room (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete and concrete masonry unit	3 hr
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:	Door connecting to area 94	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 92 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.7 Fire Area 93: Air Compressor Area, EHC Power Unit Area, and Turbine Lube Oil Storage Tank Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Precast concrete panels (exterior wall)	None
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete	3 hr
	W -	Precast concrete panels (exterior wall)	None
Floor:		Reinforced concrete foundation mat	None
Ceiling:		Reinforced concrete (contains equipment hatch with 55 ft^2 of steel plate and a 96 ft^2 opening partially filled with grating)	None
Access:		Door connecting to area 94	3 hr
		Door connecting to stairwell no. 32	1.5 hr
		Roll-up door to outside	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Leakage of lube oil from the turbine lube oil storage tanks onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212°F, individual fusible link sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 93 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.8 Fire Area 94: Reactor Feedwater Pump-Turbine Compartments Reactor Feedwater Pump Access Area, Deep Bed Demineralizer Compartments (EL 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr.
	E -	Reinforced concrete and concrete masonry unit	3 hr.
	S -	Reinforced concrete (part)	3 hr.
	S -	Reinforced concrete (part adjacent to area 120)	2 hr.
	S -	Reinforced concrete and concrete masonry unit (part adjacent to area 89; contains 8 HVAC duct pene-trations without fire dampers)	None
	S -	Precast concrete panels (part, exterior wall)	None
	W -	Precast concrete panels (exterior wall)	None
Floor:		Reinforced concrete (contains 156 ft^2 grating opening connecting to area 89)	None
Ceiling:		Reinforced concrete contains equipment hatch with 66 ft^2 of steel plate)	None
Access:		Doors connecting to areas 92 and 93	3 hr.
		Doors connecting to area 120	1.5 hr.
		Steamtight door connecting to area 2	3 hr.**
		Watertight door connecting to	3 hr.**

area 88	
Door connecting to stairwell no. 30	1.5 hr.
Open stairwell leading up to area 95	None
Roll-up doors to Entry Access (5-Line Outage Support Facility)	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 94 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.9 Fire Area 95: MCC Room, TECW Equipment Area, and Turbine Lube Oil Reservoir and Centrifuge Area (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

			Construction	Rating
Walls:	N	-	Precast concrete panels (exterior wall)	None
	E	-	Reinforced concrete	3 hr
	S	-	Reinforced concrete	3 hr

	W - Precast concrete panels (exterior wall)	None
Floor:	Reinforced concrete (contains equipment hatch with 55 ft^2 of steel plate and a 96 ft^2 opening partially filled with grating)	None
Ceiling:	Reinforced concrete	None
Access:	Doors connecting to areas 88 and 96	3 hr
	Door connecting to stairwell no. 32	1.5 hr
	Open stairwell leading down to area 94	None

b. Major safety-related components in fire area:

1. Main turbine first-stage pressure transmitters (PT-01-1N052A,B,C&D)

2. Main steam line pressure transmitters (PT-01-1N076A,B,C&D)

c. Postulated fire in area:

Leakage of lube oil from the turbine lube oil reservoir onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212°F, individual fusible link sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire. In addition, a compartment temperature of 190°F will cause actuation of the deluge systems located over the turbine lube oil reservoir and the turbine lube oil centrifuge. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 95 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.10 Fire Area 96: Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete	3 hr
	S - Concrete masonry unit	3 hr
	W - Concrete masonry unit	3 hr
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 95	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke and heat generated by a fire in this area will activate the smoke and heat detectors which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 96 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.11 Fire Area 97: Equipment Hatch Corridor (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete (part)	3 hr
	S -	Precast concrete panels (part, exterior wall)	None
	W -	Precast concrete panels (exterior wall)	None
Floor:	Reinforced concrete (contains equipment hatch with 66 ft^2 of steel plate)		None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)		None
Access:	Five doors connecting to area 88		3 hr
	Steamtight door connecting to area 7		3 hr**
	Door connecting to stairwell no. 30		1.5 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 97 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.12 Fire Area 98: Reactor Recirculation Pump MG Set Area and Feedwater Heater Rooms (el 269'-0")

a. Structural and architectural design features of fire area (Figure 9A-8):

		Construction	Rating
Walls:	N -	Concrete masonry unit	3 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete (part)	3 hr
	S -	Precast concrete panels (part, exterior wall)	None
	W -	Precast concrete panels (exterior wall)	None
Floor:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:		Reinforced concrete (contains two equipment hatches covered with steel plate, one of 75 ft^2 and one of 110 ft^2)	None
Access:		Door connecting to stairwell no. 30	1.5 hr
		Door connecting to area 45	3 hr
		Two doors connecting to area 114	3 hr
		Two roll-up doors connecting to area 114	3 hr**

b. Major safety-related components in fire area:

1. Junction boxes containing cables associated with the following components:
   (a) Main turbine stop valve position switches (ZS-01-104A,B,C&D)

(b) Turbine control valve fast closure pressure switches (PS-01-102A,B,C&D)

c. Postulated fire in area:

Ignition of electrical cables in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. The preaction sprinkler system over the MG sets has been spared and is not in service. The ASD System has replaced the MG sets. Smoke detection has been added in the area over the ASD System.

e. Effect of fire on safe shutdown:

Fire area 98 contains safe shutdown cables and equipment.

Cables required to support shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 201 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.13 Fire Area 99: Turbine Enclosure HVAC Area and Equipment Compartment Exhaust Filter Area (el 302'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

		Construction	Rating
Walls:	N -	Concrete masonry unit	3 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete (part)	3 hr
	S -	Precast concrete panels (part, exterior wall)	None
	W -	Precast concrete panels (exterior wall)	None
Floor:		Reinforced concrete (contains	None

	two equipment hatches covered with steel plate, one of 75 ft^2 and one of 110 ft^2)	
Ceiling:	Metal deck, nonreinforced concrete, and built-up roofing	UL Class A
Access:	Door connecting to stairwell no. 30	1.5 hr
	Steamtight door connecting to area 27	3 hr
	Double steamtight door connecting to area 27	3 hr**

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the turbine enclosure equipment compartment exhaust filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum. No effect on safety-related systems will result from a fire in this area.

e. Effect of fire on safe shutdown:

Fire area 99 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.14 Fire Area 100: Condensate Pump-Room (el 189'-0")

a. Structural and architectural design features of fire area (Figures 9A-5 and 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete (exterior wall)	None
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete	3 hr

	W - Reinforced concrete (below el 217')	3 hr
	W - Reinforced concrete (above el 217')	2 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:	Watertight door connecting to area 101	3 hr**
	Two doors connecting to area 113	1.5 hr
	Roll-up door connecting to area 113	1.5 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

1. Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of oil in waste oil collection drum associated with the floor drain sump oil removal belt.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 100 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear, via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.15 Fire Area 101: Main Condenser Area and Feedwater Heater Rooms (el 200'-0" and el 239'-0")

a. Structural and architectural design features of fire area (Figures 9A-5, 9A-6, and 9A-7):

Construction	Rating

Walls:	N -	Reinforced concrete and concrete masonry unit (exterior wall, below el 217')	None
	N -	Reinforced concrete and precast concrete panels (exterior wall, above el 217')	None
	E -	Reinforced concrete (portion north of column line N)	3 hr
	E -	Concrete masonry unit and precast concrete panels (exterior wall south of column line N)	None
	S -	Reinforced concrete and concrete masonry unit (below el 217')	3 hr
	S -	Reinforced concrete (between el 217'and el 239')	3 hr
	S -	Reinforced concrete (above el 239'; contains 188 ft^2 of unrated metal blowout panels)	3 hr
	W -	Reinforced concrete (below el 217'; contains 25 ft^2 of unrated steel plate as separation from area 115)	3 hr
	W -	Reinforced concrete and concrete masonry unit (above el 217')	3 hr
Floor:		Reinforced concrete foundation mat (el 200' and el 217')	None
		Reinforced concrete (el 239'; supported by structural steel members without fireproofing)	None
Ceiling:		Reinforced concrete	None
Access:		Watertight doors connecting to areas 100 and 107	3 hr**
		Three doors connecting to area 102	3 hr
		Five doors connecting to area 110	3 hr
		Doors connecting to areas 108 and 113	3 hr

b. Major safety-related components in fire area:

1. Main turbine stop valve position switches (ZS-01-204A,B,C&D)

2. Turbine control valve fast closure pressure switches (PS-01-202A,B,C&D)

3. Main steam line area temperature detectors

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. If the fire is in the main condenser area and the compartment temperature rises to 212°F, individual sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire.

e. Effect of fire on safe shutdown:

Replacement text for paragraph "e."

Fire area 101 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.16 Fire Area 102: Reactor Feedwater Pump Lube Oil Areas, Control Rod Drive Water Pump Area, and Condensate Filter/Demineralizer Compartments (el 200'-0")

a. Structural and architectural design features of fire area (Figures 9A-5 and 9A-6):

Walls:	N -	Reinforced concrete and concrete masonry unit (part adjacent to fire areas 101 and 115)	3 hr
	N -	Reinforced concrete	None

		(part adjacent to unexcavated area)	
	E -	Reinforced concrete (exterior wall)	None
	S -	Reinforced concrete	3 hr
	W -	Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat		None
Ceiling:	Reinforced concrete (contains 156 ft^2 grating opening connecting to area 107)		None
Access:	Three doors connecting to area 101		3 hr
	Two double steamtight doors connecting to area 1		3 hr**
	Door connecting to stairwell no. 31		1.5 hr
	Door connecting to area 115		None

b. Major safety-related components in fire area:

None

c. Postulated fire in area;

Leakage of lube oil from the reactor feedwater pump lube oil reservoirs onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212°F, individual fusible link sprinkler heads in the wet pipe sprinkler systems will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 102 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.17 Fire Area 103: Air Ejector and Steam Packing Exhauster Compartment (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete and concrete masonry unit	3 hr
	S -	Reinforced concrete	3 hr
	W -	Reinforced concrete and concrete masonry unit	3 hr
Floor:		Reinforced concrete foundation mat	None
Ceiling:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:		Door connecting to area 113	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 103 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.18 Fire Area 104: Air Ejector and Steam Packing ExhausterCompartment (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete and concrete masonry unit	3 hr
	W -	Reinforced concrete and concrete masonry unit	3 hr
Floor:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:		Door connecting to area 113	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 104 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.19 Fire Area 105: Mechanical Vacuum Pump-Room (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Reinforced concrete and concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:	Door connecting to area 107	3 hr

b. Major safety-related components in fire area;

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 105 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.20 Fire Area 106: Air Compressor Area, EHC Power Unit Area, and Turbine Lube Oil Storage Tank Area (el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Precast concrete panels (exterior wall)	None
	E - Precast concrete panels (exterior wall)	None
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (contains equipment hatch with 55 ft^2 of steel plate and a 96 ft^2 opening partially filled with grating)	None
Access:	Door connecting to area 107	3 hr
	Door connecting to stairwell no. 33	1.5 hr
	Roll-up door to outside	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Leakage of lube oil from the turbine lube oil storage tanks onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212°F, individual fusible link sprinkler heads in the

wet pipe sprinkler system will open to control and/or extinguish the fire. The plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 106 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.21 Fire Area 107: Reactor Feedwater Pump-Turbine Compartments and Reactor Feedwater Pump Access Area Deep Bed Demineralizer Compartments(el 217'-0")

a. Structural and architectural design features of fire area (Figure 9A-6):

	Construction	Rating
Walls:	N - Reinforced concrete	3 hr
	E - Precast concrete panels (exterior wall)	None
	S - Reinforced concrete (part)	3 hr
	S - Reinforced concrete and concrete masonry unit (part adjacent to area 102; contains 8 HVAC duct penetrations without fire dampers)	None
	W - Reinforced concrete and concrete masonry unit	3 hr
Floor:	Reinforced concrete (contains 156 ft^2 grating opening connecting to area 102)	None
Ceiling:	Reinforced concrete (contains equipment hatch with 66 ft^2 of steel plate)	None
Access:	Doors connecting to areas 105, 106, and an entryway to the Unit 2 reactor enclosure	3 hr
	Two doors connecting to the administration complex	3 hr
	Steamtight door connecting	3 hr**

to area 2	
Watertight door connecting to area 101	3 hr**
Door connecting to stairwell no. 31	1.5 hr
Roll-up door to outside	None
Open stairwell leading to area 108	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 107 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.22 Fire Area 108: MCC Room, TECW Equipment Area, and Turbine Lube Oil Reservoir and Centrifuge Area (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

		Construction	Rating
Walls:	N -	Precast concrete panels (exterior	None

	wall)	
	E - Precast concrete panels (exterior wall)	None
	S - Reinforced concrete	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (contains equipment hatch with 55 ft^2 of steel plate and a 96 ft^2 opening partially filled with grating)	None
Ceiling:	Reinforced concrete	None
Access:	Doors connecting to areas 101 and 109	3 hr
	Door connecting to stairwell no. 33	1.5 hr
	Open stairwell leading down to area 107	None

b. Major safety-related components in fire area:

1. Main turbine first-stage pressure transmitters (PT-01-2N052A,B,C&D)

2. Main steam line pressure transmitters (PT-01-2N076A,B,C&D)

c. Postulated fire in area:

Leakage of lube oil from the turbine lube oil reservoir onto the floor of the compartment, with subsequent ignition of the oil.

d. Consequences of fire with active fire suppression:

The heat generated by a fire in this area will activate the heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. If the compartment temperature rises to 212°F, individual fusible link sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire. In addition, a compartment temperature of 212°F will cause actuation of the deluge systems located over the turbine lube oil reservoir and the turbine lube oil centrifuge. The plant fire brigade will be dispatched to ensure that the fire is extinguished.

e. Effect of fire on safe shutdown:

Fire area 108 contains cables and equipment associated with providing power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown

methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.23 Fire Area 109: Battery Room (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

	Construction	Rating
Walls:	N - Concrete masonry unit	3 hr
	E - Concrete masonry unit	3 hr
	S - Concrete masonry unit	3 hr
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:	Reinforced concrete	3 hr
Access:	Door connecting to area 108	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of battery cases and/or battery spacers as the result of an exposure fire.

d. Consequences of fire with active fire suppression:

The smoke and heat generated by a fire in this area will activate the smoke and heat detectors which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 109 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by

a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.24 Fire Area 110: Equipment Hatch Corridor (el 239'-0")

a. Structural and architectural design features of fire area (Figure 9A-7):

			Construction	Rating
Walls:	N	-	Reinforced concrete	3 hr
	E	-	Precast concrete panels (exterior wall)	None
	S	-	Reinforced concrete (part)	3 hr
	S	-	Precast concrete panels (part, exterior wall)	None
	W	-	Reinforced concrete	3 hr
Floor:	Reinforced concrete (contains equipment hatch with 66 ft^2 of steel plate)			None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)			None
Access:	Five doors connecting to area 101			3 hr
	Steamtight door connecting to area 7			3 hr**
	Door connecting to stairwell no. 30			1.5 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 110 contains cables associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.25 Fire Area 111: Reactor Recirculation Pump MG Set Area and Feedwater Heater Rooms (el 269'-0")

a. Structural and architectural design features of fire area (Figure 9A-8):

		Construction	Rating
Walls:	N -	Concrete masonry unit	3 hr
	E -	Precast concrete panels (exterior wall)	None
	S -	Reinforced concrete (part)	3 hr
	S -	Precast concrete panels (part, exterior wall)	None
	W -	Reinforced concrete	3 hr
Floor:		Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:		Reinforced concrete (contains two equipment hatches covered with steel plate, one of 75 ft^2 and one of 110 ft^2)	None
Access:		Door connecting to stairwell no. 31	1.5 hr
		Door connecting to administration complex	3 hr
		Two doors connecting to area 114	3 hr
		Two roll-up doors connecting to area 114	3 hr**

b. Major safety-related components in fire area:

1. Junction boxes containing cables associated with the following components:
   (a) Main turbine stop valve position switches (ZS-01-204A,B,C&D)
   (b) Turbine control valve fast closure pressure switches (PS-01-202A,B,C&D)

c. Postulated fire in area:

Ignition of electrical cables in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling).

d. Consequences of fire with active fire suppression:

The smoke generated by a fire in this area will activate the smoke detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. The preaction sprinkler system over MG sets has been spared and is not in service. The ASD System has replaced the MG sets. Smoke detection has been added in the area over the ASD System.

e. Effect of fire on safe shutdown:

Fire area 111 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 201 safeguard bus may be affected by a fire in this area. Offsite power to the 4kV switchgear via the 101 safeguard bus is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.26 Fire Area 112: Turbine Enclosure HVAC Area and Equipment Compartment Exhaust Filter Area (el 302'-0")

a. Structural and architectural design features of fire area (Figure 9A-9):

			Construction	Rating
Walls:	N	-	Concrete masonry unit	3 hr
	E	-	Precast concrete panels (exterior wall)	None
	S	-	Reinforced concrete (part)	3 hr

	S - Precast concrete panels (part, exterior wall)	None
	W - Reinforced concrete	3 hr
Floor:	Reinforced concrete (contains two equipment hatches covered with steel plate, one of 75 ft^2 and one of 110 ft^2)	None
Ceiling:	Metal deck, nonreinforced concrete, and built-up roofing	UL Class A
Access:	Door connecting to stairwell no. 31	1.5 hr
	Steamtight door connecting to area 27	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of charcoal filters.

d. Consequences of fire with active fire suppression:

In the event of a fire in one of the turbine enclosure equipment compartment exhaust filters, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum. No effect on safety-related systems will result from a fire in this area.

e. Effect of fire on safe shutdown:

Fire area 112 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.8.27 <u>Fire Area 113: Railroad Access Area and Generator Equipment Area (el 217'-0" and el 239'-0")</u>

a. Structural and architectural design features of fire area (Figures 9A-6 and 9A-7):

<u>Construction</u> <u>Rating</u>

Walls:	N -	Reinforced concrete and concrete masonry unit (exterior wall)	None
	E -	Reinforced concrete and concrete masonry unit (part)	3 hr
	E -	Concrete masonry unit (part adjacent to area 100)	2 hr
	S -	Reinforced concrete and concrete masonry unit	3 hr§
	W -	Reinforced concrete and concrete masonry unit (part)	3 hr
	W -	Concrete masonry unit (part adjacent to area 87)	2 hr
Floor:	Reinforced concrete foundation mat		3 hr
Ceiling:	Reinforced concrete (contains a 1960 ft^2 hatchway partially filled \ with grating)		None
Access:	Two doors connecting to area 87 and two doors connecting to area 100		1.5 hr
	Roll-up door panel connecting to area 87		2 hr
	Roll-up door connecting to area 100		1.5 hr
	Door connecting to areas 88, 90, 91, 101, 103, and 104		3 hr
	Steamtight doors connecting to areas 8, 10, 12, 14, 16, and 18		3 hr
	Steamtight door connecting to stairwell no. 7		3 hr**
	Double steamtight door connecting to area 2		3 hr**

Walls denoted above by the § symbol are capable of being rated as 3 hour fire barriers, except for unrated wall penetration assemblies associated with the 4kV nonsegregated phase bus ducts. These penetration assemblies are described in Section 9A.6.3. A maximum of two penetration assemblies are located in the wall indicated above. This wall separates fire area 113 from fire areas 12 and 18.

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Leakage of seal oil from the generator hydrogen seal oil units onto the floor of the compartment, with subsequent ignition of the oil or ignition of material stored in the Facility/laydown area, Floor Operators Break Facility (Rm 468A,B,C) and Plant Operators Building (Rm 468).

d. Consequences of fire with active fire suppression:

A rise in compartment temperature to 140°F will cause the deluge valve to open and prime the preaction sprinkler system with water. At 165°F, individual sprinkler heads will open to control and/or extinguish the fire. A rise in the temperature of the Facility/laydown area, Floor Operators Break Facility (Rm 468A, B, C) or Plant Operators Building (Rm 468) to 155°F will open individual sprinklers of the wet pipe sprinkler system in that area to control and/or extinguish the fire in the associated area. In addition, a compartment temperature of 212°F will cause actuation of the deluge systems located over the generator hydrogen seal oil units. The plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 113 contains cables and equipment associated with providing offsite power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area. Equipment associated with providing offsite power to shutdown methods A, B, and C for Units 1 and 2 located in this fire area have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

f. Deviations:

See Section 9A.6.3.

9A.5.8.28 Fire Area 114: Turbine Operating Floor (el 269'-0")

a. Structural and architectural design features of fire area (Figures 9A-8 and 9A-9):

		Construction	Rating
Walls:	N -	Precast concrete panels (exterior wall)	None
	E -	Precast concrete panels (exterior wall)	None
	S -	Reinforced concrete and concrete masonry unit	3 hr
	W -	Precast concrete panels (exterior wall)	None
Floor:	Reinforced concrete (contains a 1960 ft^2 hatchway partially filled with grating, plus 14 equipment hatches		None

	covered with steel plate)	
Ceiling:	Metal deck, nonreinforced concrete, and built-up roofing	UL Class A
Access:	Doors connecting to stairwell nos. 32 and 33	1.5 hr
	Two doors connecting to area 98 and two doors connecting to area 111	3 hr
	Two roll-up doors connecting to area 98 and two roll-up doors connecting to area 111	3 hr**
	Two steamtight and bullet-resistant doors connecting to area 24	3 hr**
	Steamtight door connecting to stairwell no. 7	3 hr**

b. Major safety-related components located in fire area:

1. Main condenser pressure transmitters (PT-01-1N075A,B,C&D)

2. Junction boxes containing cables associated with the following components:
   (a) Main turbine first-stage pressure transmitters (PT-01-1N052A,B,C&D)
   (b) Main steam line pressure transmitters (PT-01-1N076A,B,C&D)

c. Postulated fire in area:

Ignition of electrical cabling in cable tray and ignition of materials present in the Control Room Annex. As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling, and an exposure fire involving the materials in the Control Room Annex would be extremely limited in scope and would be confined to a small area due to the configuration of the combustibles within the Control Room Annex. Ignition of the materials in the Control Room Annex is extremely unlikely in the absence of a fire source external to the materials.

d. Consequences of fire with active fire suppression:

The smoke and heat generated by a fire in this area will activate the early warning smoke and heat detectors, which will cause an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. If the fire occurs under the turbine's appearance lagging or under the generator's appearance lagging, the preaction sprinkler system will provide automatic suppression of the fire. At 190°F, the deluge valve will open and prime the preaction sprinkler system with water. At 212°F, individual sprinkler heads will open to control and/or extinguish the fire. If the fire occurs at the Unit 1 and 2 turbine generator exciter bearings, the heat detectors within the exciter enclosure will annunciate the fire condition on the fire protection panel in the control room and initiate the coded alarm annunciation within the plant. A smoke detector suitable for high-velocity air flow in the exciter exhaust ductwork will annunciate the fire. No effect on safety-related systems will result from a turbine generator exciter bearing fire.

e. Effect of fire on safe shutdown:

Fire area 114 contains cables associated with providing power to safe shutdown components.

Cables for offsite power which supports shutdown methods A, B, and C for Units 1 and 2 are associated with equipment that have redundant components that are not affected by a fire in this area.

The availability of offsite power to the 4kV switchgear via the 101 and 201 safeguard buses may be affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9 SAFE SHUTDOWN ANALYSIS - RADWASTE ENCLOSURE

9A.5.9.1 Fire Area 115: Radwaste Pipe Tunnel (el 183'-0", el 187'-0", el 191'-0", and el 200'-0")

a. Structural and architectural design features of fire area (Figures 9A-4 and 9A-5):

	Construction	Rating
Walls:	West wall near column line 18, approx. 19 feet north of column line N, between el 200' and el 205' - Steel plate (25 ft^2)	None
	East wall near column line 28, approx. 19 feet north of column line N, between el 200' and el 205' - Steel plate (25 ft^2)	None
	North wall at 7.5 feet north of column line J, between columns 23 and 26.6, and between el 200' and el 217' - Concrete masonry unit	3 hr
	East wall at column line 26.6 between el 200' and el 217' - reinforced concrete	3 hr
	South walls - Reinforced concrete	3 hr
	All other walls - Reinforced concrete None and concrete masonry unit	
Floor:	Below zone 115D between column lines 19.4 and 26.6 - Reinforced concrete (supported by structural steel members without fireproofing)	None
	Below all other portions of the fire area - Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (contains 76 ft^2	None

	grating opening connecting to area 89)	
Access:	Door connecting to area 102	None
	Door connecting to area 118	3 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 115 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.2 Fire Area 116: Miscellaneous Radwaste Equipment Areas (el 162'-0")

a. Structural and architectural design features of fire area (Figure 9A-4):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete (part north of column line D)	3 hr
	E -	Reinforced concrete (part south of column line D, exterior wall)	None
	S -	Reinforced concrete (exterior wall)	None
	W -	Reinforced concrete	None
Floor:		Reinforced concrete foundation mat	None
Ceiling:		Reinforced concrete (contains equipment hatch filled with 49 ft^2 of steel plate)	None
Access:		Doors connecting to stairwell nos. 1 and 2	1.5 hr

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

1. Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

2. Ignition of charcoal filters.

3. Ignition of oil in a waste oil collection drum associated with the floor drain sump oil removal belt.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. In the event of a fire in the waste tank vent exhaust filter, a thermal sensor inside the filter plenum will cause an audible/visual annunciation to register on the fire protection panels in the control. The fire brigade will utilize a manual valve in the fire protection water supply system to initiate operation of a water spray system inside the filter plenum. No effect on safety-related systems will result from a fire in this area.

e. Effect of fire on safe shutdown:

Fire area 116 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.3 Fire Area 117: Offgas Pipe Tunnel (el 186'-0" and el 187'-6")

a. Structural and architectural design features of fire area (Figure 9A-4):

	Construction	Rating
Walls:	All walls - Reinforced concrete	None
Floor:	Reinforced concrete foundation mat	None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:	Concrete hatch plugs	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Since no combustible materials are located in this area, the origin of a postulated fire is indeterminate.

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 117 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.4 Fire Area 118: Miscellaneous Radwaste Equipment Areas (el 191'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete (part north of column line C)	3 hr
	E -	Reinforced concrete (part, exterior wall)	None
	S -	Reinforced concrete (exterior wall)	None
	W -	Reinforced concrete (part, exterior wall)	None
	W -	Reinforced concrete (part adjacent to area 119; contains piping and electrical penetrations without fire-rated seals and HVAC duct penetrations without fire dampers)	None
Floor:	Reinforced concrete (contains equipment hatch filled with 49 ft^2 of steel plate)		None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)		None
Access:	Door connecting to area 115		3 hr

Doors connecting to stairwell nos. 1 and 2	1.5 hr
Door connecting to area 119	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 118 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.5 Fire Area 119: Offgas Equipment Areas (el 195'-0")

a. Structural and architectural design features of fire area (Figure 9A-5):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete (contains piping and electrical penetrations without fire-rated seals and HVAC duct penetrations without fire dampers)	None
	S -	Reinforced concrete (exterior wall)	None
	W -	Reinforced concrete (exterior wall)	None
Floor:	Reinforced concrete (supported in some areas by structural steel members without fireproofing)		None
Ceiling:	Reinforced concrete (supported		None

	by structural steel members without fireproofing)	
Access:	Door connecting to stairwell no. 1	1.5 hr
	Door connecting to area 118	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

Upon receiving notification that a fire has occurred in this area, the operator will dispatch the plant fire brigade to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 119 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.6 Fire Area 120: Radwaste Control Room, Laundry, Decontamination and Change Areas, Waste Drum Storage Room, and Cask Loading Area (el 217'-0")

Renovated Area of Radwaste Enclosure: Data Acquisition Room, Storage Room, Source Storage/Standard's Preparation Room, Technician's Area (el 217'-0)

Chemical Building: Hot Lab, Frisk Area (corridor - RCA), Office Area, Air Lock, Corridor (Non RCA), Conference/Lunch, Cold Lab, Toilets, Locker Vestibule; Count Room, Instrument Lab (el 217;-0"); Penthouse (el. 234'6")

a. Structural and architectural design features of fire area (Figure 9A-6):

		Construction	Rating
Walls:	N -	Reinforced concrete	2 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete (part, exterior wall)	None
	S -	Reinforced concrete (part adjacent to stairwell no. 1)	2 hr

	W -	Reinforced concrete (exterior wall)	None
		<u>Chemistry Lab Building</u>	
	N -	Precast Concrete Exterior with Gypsum Board Interior	None
	S -	Precast Concrete Exterior with Gypsum Board Interior	None
	W -	Precast Concrete Exterior with Gypsum Board Interior	None
	E -	Reinforced Concrete	None
		<u>Chemistry Lab Building (Penthouse)</u>	
	N -	Metal Siding with Interior Insulation	None
	E -	Metal Siding with Interior Insulation	None
	S -	Metal Siding with Interior Insulation	None
	W -	Metal Siding with Interior Insulation	None
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)		None
	Terrazzo Tile (Chem Lab Bldg)		None
	Concrete (Chem Lab Bldg)		None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)		None
	Suspended Tile (Chem Lab Bldg)		None
Roof:	Metal Deck, Insulation and Built Up Roofing (chem Lab Bldg, Penthouse)		None
Access:	Door connecting to area 94		1.5 hr
	Door connecting to stairwell no. 4		3 hr
	Doors connecting to stairwell nos. 2 and 3		1.5 hr
	Two doors to outside		None
	Roll-up door to outside		None
	Open stairwell leading up to area 121		None
	Two Doors open to exterior, one door Connecting to Radwaste Enclosure		None
	Door connecting to Frisk Area/Corridor (Chem Lab Bldg)		None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

If a fire occurs in the fire zones which are provided with smoke or heat detectors, the smoke and heat generated by the fire will activate the detectors, causing an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. If a fire occurs in the waste drum storage room and the temperature in that area rises to 212°F, individual fusible link sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire. If the fire occurs in the Count room, Instrument Lab, health physics room, radwaste supervisor's office, warm chem. Lab, counting room, file storage area, conventional chem. room, radiation chemical lab, or in the Penthouse, the preaction sprinkler system will provide automatic suppression of the fire. At 190°F, the deluge valve will open and prime the preaction sprinkle system with water. At 212°F, individual sprinkler will open to control and/or extinguish the fire.

If a fire occurs in the Chem Lab rooms and the temperature in that area raised to 165°F, individual fusible link sprinkler heads in the wet pipe sprinkler system will open to control and/or extinguish the fire. Again, the plant fire brigade will be dispatched to ensure that the fire is extinguished. No effect on safety-related systems will result from a fire in this area.

e. Effect of fire on safe shutdown:

Fire area 120 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.5.9.7 <u>Fire Area 121: Centrifuge Rooms, Solid Radwaste Equipment Rooms, Ventilation Filter Compartments, and Supply and Exhaust Fan Areas (el 237'-0" and el 257'-0")</u>

a. Structural and architectural design features of fire area (Figures 9A-7 and 9A-8):

		Construction	Rating
Walls:	N -	Reinforced concrete	3 hr
	E -	Reinforced concrete	3 hr
	S -	Reinforced concrete (part, exterior wall)	None
	S -	Reinforced concrete (part adjacent to area 120 between el 237' and el 257'; contains piping and electrical penetrations without fire-rated seals)	None
	W -	Reinforced concrete (part	None

	adjacent to area 120 between el 237' and el 257'; contains piping penetrations without fire-rated seals)	
	W - Reinforced concrete (part, exterior wall)	None
Floor:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Ceiling:	Reinforced concrete (supported by structural steel members without fireproofing)	None
Access:	Door connecting to stairwell no. 2	1.5 hr
	Two doors connecting to stairwell no. 3	1.5 hr
	Open stairwell leading down to area 120	None

b. Major safety-related components in fire area:

None

c. Postulated fire in area:

Ignition of electrical cabling in cable tray. (As discussed in Table 9A-3, the ignition of electrical cabling is extremely unlikely in the absence of a fire source external to the cabling.)

d. Consequences of fire with active fire suppression:

If a fire occurs in the fire zones which are provided with smoke detectors, the smoke generated by the fire will activate the detectors, causing an audible/visual annunciation to register on the fire protection panels in the control room. Once the alarm has been received in the control room, the plant fire brigade will be dispatched to extinguish the fire. No effect on safety-related systems will result from such a fire.

e. Effect of fire on safe shutdown:

Fire area 121 does not contain safe shutdown cables and equipment.

Offsite power to the 4kV switchgear via the 101 and 201 safeguard buses is not affected by a fire in this area.

Therefore, methods A, B, and C will be available to shutdown Units 1 and 2.

9A.6 SPECIAL TOPICS

9A.6.1 ANALYSIS OF ASSOCIATED CIRCUITS

Generic Letter 81-12, issued by the NRC on February 20, 1981, discussed the types of information that the NRC considers necessary for the completion of their reviews of safe shutdown capability in the event of a fire. One of the enclosures to Generic Letter 81-12 addressed the subject of associated circuits and the possibility that fire-induced damage to associated circuits could prevent operation or cause maloperation of the shutdown methods designated to be used in the event of a fire in the plant. Generic Letter 81-12 defines associated circuits to be those circuits (either safety-related or nonsafety-related) that have a separation from the equipment and cables of the redundant safe shutdown methods that is less than that required by section III.G.2 of Appendix R to 10CFR50 and also have any of the following:

a. A common power source with the safe shutdown equipment, and the power source is not electrically protected from the circuit by coordinated circuit breakers, fuses, or similar devices.

b. A connection to circuits of equipment whose spurious operation could adversely affect the shutdown capability.

c. A common enclosure or raceway with safe shutdown cables, and are not electrically protected by circuit breakers, fuses, or similar devices.

In accordance with guidance contained in Generic Letter 81-12, an analysis has been performed for LGS to verify that fire-induced damage to associated circuits will not jeopardize the plant's safe shutdown capability. This analysis utilizes a systems approach, wherein the features of circuit design, such as overcurrent protection, are evaluated together with cable routing and separation criteria in order to confirm the adequacy of the electrical system design to prevent fire-induced damage to nonsafe shutdown circuits from jeopardizing safe shutdown capability. The methodology and results of the analysis are summarized in the following sections.

9A.6.1.1 Associated Circuits Involving Common Power Sources

All systems and components that are relied on for achieving safe shutdown receive power from the Class 1E ac distribution system or Class 1E dc power system. Offsite power may be credited as the source for the Class 1E ac distribution system for fire areas which do not require Alternative Shutdown and for which the offsite source(s) to the 4kV switchgear is not affected by fire damage. The Emergency Seal Oil Pump (ESOP) that services the main generator and the Emergency Bearing Oil Pump (EBOP) that services the main turbine are powered exclusively by a dedicated non-Class 1E battery and do not involve a common power source with other plant equipment or systems. The main feed from the battery and the battery charger to both motors are protected by coordinated fault actuated protective devices. All other circuits, both Class 1E and non-Class 1E, are individually protected by coordinated fault actuated protective devices. Proper coordination among these protective devices is demonstrated by the time-current coordination curves shown in Figures 9A-13 through 9A-15 for the 4 kV and 440 V ac system, Figure 9A-16 for the 120 V ac system, and Figures 9A-17 through 9A-20 for the 125/250 V dc system. These curves are typical for each type of protective device and application that is represented. The time-current coordination curves show that for each voltage level, the individual circuit breakers or fuses will clear a fault prior to the operation of the source breaker or fuse protecting the source bus. Consequently, the fault-actuated protective devices will act to isolate any

faulted circuit without jeopardizing the availability of other circuits connected to the same power source.

Because of the use of fault-actuated protective devices in power circuits as described above, LGS does not have associated circuits involving common power sources, as defined by Generic Letter 81-12.

9A.6.1.2 Associated Circuits Involving Spurious Operation

Components whose spurious operation could adversely affect the shutdown capability are considered to be essential for safe shutdown of the plant. These components and the circuits that serve them are therefore treated as part of the safe shutdown systems and are included in the review of separation between the different shutdown methods. Item 18 of Section 9A.3.2.2 describes the physical separation, fire barriers, and suppression systems that are provided to ensure that at least one shutdown method remains available to shut the plant down in the event of a fire.

Because of the design and analysis approach described above, LGS does not have associated circuits involving spurious operation, as defined by Generic Letter 81-12.

9A.6.1.3 Associated Circuits Involving Common Enclosures and Raceways

Separation between the different divisions of Class 1E circuits and between Class 1E and non-Class 1E circuits is discussed in Sections 7.1.2.2.3.2 and 8.1.6.1.14.b. Cabling for Class 1E circuits is routed only in raceways designated for Class 1E use. Cabling for non-Class 1E circuits is routed only in raceways designated for non-Class 1E use, except for selected non-Class 1E loads fed from Class 1E buses, which are identified and treated as Class 1E and are routed in dedicated Class 1E raceways. Non-Class 1E cables identified and treated as Class 1E do not become associated with other Class 1E divisions.

The potential for propagation of an electrical fire in enclosures (either raceways or panels) is minimized by the selection of appropriate cable construction systems and by the provision of physical separation. Insulation and jacketing materials used in both Class 1E and non-Class 1E cables are flame retardant, as discussed in Table 9A-3.

As discussed in Section 9A.6.1.1, circuits are individually protected by coordinated fault-actuated protective devices. This protection ensures that faulted circuits in common enclosures will be isolated.

Because of the provisions described above for preventing fire propagation and isolating circuit faults in common enclosures, LGS does not have associated circuits involving common enclosures, as defined by Generic Letter 81-12.

9A.6.1.4 Summary

For the reasons discussed in the preceding sections, LGS does not have associated circuits in any of the three categories established by Generic Letter 81-12. Therefore, fire-induced damage to circuits that are not designated as necessary for safe shutdown will not affect the operability of any of the four safe shutdown methods described in Section 9A.5.2.2.

9A.6.2 ANALYSIS OF HIGH/LOW PRESSURE INTERFACES

Generic Letter 81-12, issued by the NRC on February 20, 1981, discussed the types of information that the NRC considers necessary for the completion of their reviews of safe shutdown capability in the event of a fire. One of the enclosures to Generic Letter 81-12 addressed the subject of interfaces between high pressure and low pressure systems. The NRC's concern involves the valves that serve to isolate low pressure systems from the high pressure reactor coolant system. If the isolation valves at a given interface point consist of two electrically controlled valves in series, and a single fire could damage the cabling associated with both valves, both valves could be caused to open. This consequence could result in a fire-induced LOCA through the high/low pressure system interface.

Information Notice 87-50, issued by the NRC on October 9, 1987, expressed a concern that spurious opening of high/low pressure interface isolation valves would overpressurize the low pressure systems connected to the reactor coolant system, thereby creating the potential for a LOCA that cannot be isolated. The information notice specifically addressed the case of a bypass line around a check valve in the discharge lines of the RHR system for certain plants. This information notice states that "Because of this bypass line around the check valve, credit for the check valve in preventing a LOCA at the high and low pressure interface can no longer be given."

A review of the LGS design has been performed to verify that a high/low pressure interface LOCA cannot be caused by a single fire. Each system that contains interfaces between the RCPB and low pressure portions of the system was reviewed to identify the valves that provide isolation at the interface point, and also to assess the susceptibility of the valves to simultaneous opening due to fire-caused damage. Table 9A-12 identifies each such high/low pressure interface and lists the valves at the interface point.

9A.6.3 FIRE BARRIER PENETRATION ASSEMBLIES FOR 4 KV BUS DUCTS

At el 239' in the control structure, 4 kV nonsegregated phase bus ducts penetrate some of the walls that separate the 4 kV switchgear compartments (fire areas 12 through 19) from each other and from adjacent compartments. The bus ducts are either 15.4 by 36 inches or 19.4 by 36 inches in size, and are constructed of steel plate having a thickness of 0.119 inch. Inside these steel ducts, copper bus bars are supported by porcelain insulators. At each wall penetration, a smoke and hot gas barrier is provided internal to the duct. The bus duct penetrations have been evaluated as being adequate for the hazards present. See reference 9A.7.12.

9A.6.4 ANALYSIS OF EFFECTS OF MULTIPLE HIGH-IMPEDANCE FAULTS ON THE SAFE SHUTDOWN CAPABILITY OF THE PLANT

The NRC response to question No. 5.3.8 of "Appendix R Questions and Answers", an enclosure to Generic Letter 86-10 (issued by the NRC on April 24, 1986) states that in order to meet the separation criteria of sections III.G.2 and III.G.3 of Appendix R, multiple high impedance faults should be considered for all associated (nonsafe shutdown) circuits located in the fire area of concern.

In accordance with the guidelines contained in Generic Letter 86-10, a calculation has been performed for LGS to verify that postulated high impedance faults resulting from fire-induced damage to safe shutdown cables and associated (nonsafe shutdown) cables supplied from the same bus will not jeopardize the plant's safe shutdown capability. The calculation involved a review of protective device coordination with consideration given to multiple high impedance faults for power cables at the 13.2 kV, 4.16 kV, 480 V, and 120/208 V levels of the ac power distribution

system and at the 125 V and 250 V levels of the dc power distribution system. The methodology used in the calculation is based on the intention of implementing restorative actions for manually clearing the effects of multiple high impedance faults if the effects were determined to be detrimental to safe shutdown capability. The methodology used and the results of this study are summarized in the following sections.

9A.6.4.1 Methodology and Assumptions

To determine if restorative actions were required for a particular circuit, a phase analysis approach was utilized as described below.

Phase 1 analysis is a gross screening of the power sources that support safe shutdown loads to evaluate the effects of a High Impedance Fault (HIF) load on the power source circuit breaker or fuse. All circuits from a safe shutdown bus are considered as experiencing simultaneous HIFs regardless of fire area influence. The combined load and HIF current is assumed just below the trip setpoint of the associated branch breaker and to continue indefinitely. The sum of all HIF and load currents on bus is determined and compared with the trip characteristics of the power supply protective device. The high impedance fault current contribution for each load was taken to be equal to the 1000 second current rating of the load's protective device. This value was chosen since it is the maximum current the protective device can pass for an indefinite time without a trip. The high impedance fault currents were summed and compared to the 60 second rating of the feeder breaker. If the sum was less than this rating, no restorative actions were considered to be necessary.

The basis for this approach is a flame test that was performed by the licensee for the PBAPS and which showed that 54 seconds was the maximum duration of an high impedance fault. As before, if the high impedance fault current applied to the feeder breaker did not exceed its 60 second rating, no restorative actions were deemed necessary.

Phase 2 of the analysis is applied to those panels that fail the Phase 1 analysis. This analysis is performed in more detail using the actual circuit routing on a per fire area basis, with only those cables routed through the fire area of concern experiencing a simultaneous HIF. Phase 3 of the analysis is applied to those panels that fail the Phase 2 analysis and review normally de-energized loads while considering the routing of both power and control cables when evaluating specific fire areas. Phase 4 of the analysis is applied to those panels that fail the Phase 3 analysis. This Phase determines if the failed panels are required for safe shutdown in the subject fire area and whether restorative procedures are technically feasible to maintain panel operability in the event of a fire.

9A.6.4.2 Results

The results and conclusions derived in this calculation were input into the LGS Fire Area Analysis Calculations which sufficiently demonstrate that the LGS post-fire safe shutdown capability for both units will not be jeopardized due to fire-induced multiple high impedance faults.

9A.6.5 MINIMUM EFFECTIVE DESIGN DENSITY (MEDD)

This Section will discuss the use of the “Minimum Effective Design Density” (MEDD) concept for determining the operability of water based suppression systems at the Limerick Generating Station Units 1 and 2 (LGS).

In general, the design basis of the Limerick Generating Station sprinkler systems is to provide a density of 0.30 gpm/ft^2 over the hydraulically most remote 3000 ft^2 (unless specified otherwise). Limerick Technical Specifications (now Technical Requirements Manual) define OPERABILITY as...

"A system, subsystem, train, component, or device shall be operable or have operability when it is capable of performing its specified function(s)."

In the referenced paragraph above, the words "capable of performing its specific function(s)" as applied to suppression systems, means their ability to control a fire. A literature review of fire test information on cable and oil fires was performed to determine the minimum effective design density. The focus of this review was to determine how low the design density could be and still extinguish a fire. The literature review was intended to determine the minimum effective design density that will control a fire.

EPRI Research, Sandia National Laboratories and Factory Mutual test reports were reviewed to determine the minimum effective density necessary to extinguish a cable tray fire or oil spill fire. These two fire scenarios were selected because they present the greatest challenge to the plant sprinkler systems and these were the fires postulated in the FPER for the plant areas protected by the majority of the Technical Requirements Manual sprinkler systems.

A variety of tests and studies performed by Factory Mutual Research Corporation and Sandia National Laboratories were reviewed to determine the minimum effective density for automatic water based suppression systems at LGS. The purpose of the tests and studies performed was to determine the required automatic sprinkler design density necessary to extinguish a developing fire in grouped cable tray installations and oil spill fires.

9A.6.5.1 Cable Tray Fires

Literature reviewed indicated that a "delivered" water application rate of 0.16 gpm/ft^2 would control the most severe fire investigated.

Water application rate is generally quantified in terms of discharge density. The discharge density is the average rate of water reaching a unit floor area in unit time and is expressed in units of gpm/ft^2 of floor area. In the tests reviewed, the water application rates are referenced as "delivered densities." Specifically, delivered density means the density (gpm/ft^2) which was delivered at the (top) surface of the burning test array. The delivered density should not be confused with the "design density" commonly used in sprinkler installation standards which is the density available from the sprinkler system in the absence of a fire. (Note: The LGS Specification for fire sprinkler system (M-49) is based on the "design density" concept) In a fire situation, the actual water reaching the burning fuel is usually less than the "design density" due to phenomena such as evaporation, or entrainment of droplets in the hot gas rising from a fire. A "delivered density" of 0.16 gpm/ft^2 is expected to be equivalent to a "design density" of 0.25 gpm/ft^2 because test indicates that the overall penetration of water is approximately 65% when ½" orifice standard sprinklers are used. Therefore, a "design density" of 0.25 gpm/ft^2 is required to provide the "minimum effective density" for extinguishment of grouped cable tray fires.

9A.6.5.2 Oil Spill Fires

Factory Mutual Research Corporation has conducted a series of fire tests with the purpose of determining whether automatic sprinklers will protect against lubricating oil spill fires. In all the tests, the floor based fires were quickly controlled and the test building was satisfactorily protected

by the sprinkler system. The conclusion of Factory Mutual Research Corporation testing indicated that “automatic sprinklers will stop the spread and extinguish the fire in an oil spill on the floor with a design density of 0.13 gpm/ft^2 with some margin of safety.”

9A.6.5.3 Conclusion

The design density specified for the systems at LGS is not required to be met to provide control and extinguishment of the anticipated fires at the plant and, therefore, is not required to be met for system(s) to be considered operable. The design density for the sprinkler systems at LGS will continue to be 0.3 gpm/ft^2 (as specified specification M-49), however, for a system to be considered operable it needs to provide the minimum effective design densities of 0.25 gpm/ft^2 for grouped electrical cable hazards or 0.13 gpm/ft^2 for oil spill fire hazards.

9A.7 REFERENCES

9A.7.1 Appendix A to BTP APCSP 9.5-1 “Guidelines for Fire Protection for Nuclear Power Plants docketed prior to July 1, 1976

9A.7.2 BTP CMEB 9.5-1 “Guidelines for Fire Protection for Nuclear Power Plants", Rev. 2, dated July ,1981

9A.7.3 Appendix R to 10 CFR 50 “Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979”

9A.7.4 NUREG-0991, LGS SER, August 30, 1983.

9A.7.5 NUREG-0991, Supplement 2, October 1984.

9A.7.6 NUREG-0991, Supplement 8, June 1989.

9A.7.7 NUREG-0991, Supplement 9, August 1989.

9A.7.8 Letter from Eugene J. Bradley (PECO) to Dr. Thomas E. Murley (USNRC) dated April 5, 1988 (Revision 10 to FPER).

9A.7.9 Engineering Analysis LEAF-0001 “Smoke Detector Engr Analysis For Fire Areas 1, 2 & 7”.

9A.7.10 Engineering Analysis LEAF-0002 “Suppression System Evaluation”.

9A.7.11 Engineering Analysis LEAF-0009 “Galvanized Steel Cable Tray Covers In CFZ-5”.

9A.7.12 Engineering Analysis LEAF-0010, “Switchgear Room Bus Duct Penetrations”.

9A.7.13 Letter from Darrell G. Eisenhut (NRC) to G. Bauer, Jr. (PECO) dated October 15, 1981, Subject: Appendix R of 10 CFR Part 50 - Fire Protection Rule (Limerick Generating Station, Units 1 and 2).

Table 9A-1

FIRE PROTECTION EVALUATION

Legend for Table 9A-1

The information presented in each column of Table 9A-1 is explained as follows:

Area-Zone:	Identification code for fire areas and zones. Fire zones with identification codes beginning with the same number are located in the same fire area.
Structure:	Location of the fire area-zone, by structure. Locations are shown on Figures 9A-4 through 9A-12.
Elevation:	Elevation of the fire area-zone.
Room No.:	The room number as indicated on the Architectural drawings.
Fire Area-Zone Description:	Description of compartments included within the fire area or fire zone.
SR (Safety-Related):	Indicates whether or not the fire area or zone contains safety-related equipment or electrical cabling.
Floor Area (sqft):	Floor area of the fire area or fire zone.
Fire Hazard Material:	Type of combustible material located in the fire area-zone.
Combustible Loading:	Designator of "Low" ($<$60,000 BTU/ft^2), "Moderate" ($\geq$60,000 BTU/ft^2 or $<$ 140,000 BTU/ft^2) or "High" ($\geq$140,000 BTU/ft^2).
Combustible Loading Change Limit (BTU/ ft^2)	Combustible loading changes which do not exceed these limits do not require additional documentation/justification by the plant Fire Protection Program Engineer.
Detection Type/No.:	Type of fire detectors and number detectors provided in the fire area or zone. Unless indicated otherwise, all smoke detectors are of the ionization type.
Suppression Type/Actuation:	Type of fire suppression system and method of actuation in the fire area

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
1 - A	CS	180'-0"	164 164A 164M	Corridor Corridor Mezzanine	Y	440 48 448 936		Low	N		HS	M
1 - B	CS	180'-0"	166 166A 166M	Corridor Corridor Mezzanine	Y	440 48 448 936	Cable Insulation	Low 160	N		HS	M
1 - C	CS	180'-0"	154	Recombiner room	N	670	Cable Insulation	Low 0	N		HS	M
1 - D	CS	180'-0"	155	Recombiner room	N	670	Cable Insulation	Low 0	N		HS	M
1 - E	CS	180'-0"	153	Future recombiner room	N	670		Low 0	N		HS	M
1 - F	CS	180'-0"	156	Future recombiner room	N	670		Low 0	N		HS	M
1 - G	CS	180'-0"	163	Backwash receiving tank room	Y	680	Cable Insulation	Low 600	N		HS	M
1 - H	CS	180'-0"	157	Backwash receiving tank room	N	680	Cable Insulation	Low 1040	N		HS	M
1 - J	CS	180'-0"	161 162 165	Backwash transfer pump room Backwash transfer pump room Sump pump room	N	108 108 126 342	Cable Insulation Lube Oil	Low 280	N		HS	M
1 - K	CS	180'-0"	158 159 160	Backwash transfer pump room Backwash transfer pump room Sump pump room	N	120 120 120 360	Cable Insulation Lube Oil	Low 960	N		HS	M

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
1 - L	CS	200'-0"	258/258A 362A 362B 362C 362D	Control structure chillers & Cooling water heat exchanger & pump room Analyzer compartment Analyzer compartment Analyzer compartment Analyzer compartment	Y	2200 35 35 35 35 2340	Cable Insulation Lube Oil R/A Insulation	Low 136	S	3	HS	M
1 - M	CS	200'-0"	263/263A 362E 362F 362G 362H	Control structure chillers & Cooling water heat exchanger & pump room Analyzer compartment Analyzer compartment Analyzer compartment Analyzer compartment	Y	2200 35 35 35 35 2340	Cable Insulation Lube Oil R/A Insulation	Low 112	S	3	HS	M
1 - N	CS	200'-0"	259	Recombiner access area	Y	1405	Thermo-Lag 330-1	Low 0	S	3	HS	M
2 -	CS	217'-0"	336	13 Kv switchgear area	Y	6570	Cable Insulation Thermo-Lag 330-1 Thermo-Lag 770-1	Low 640	S	49	PR (Localized)	A
3 -	CS	217'-0"	323	Battery room	Y	144	Battery Cases Battery Spacers Battery Covers Wood	Low 696	S H	1 1	HS E	M
4 -	CS	217'-0"	324	Battery room	Y	128	Battery Cases Battery Spacers Cable Insulation Battery Covers	Low 776	S H	1 1	HS E	M
5 -	CS	217'-0"	360	Battery room	Y	144	Battery Cases Battery Spacers Battery Covers	Low 696	S H	1 1	HS E	M
6 -	CS	217'-0"	361	Battery room	Y	144	Battery Cases Battery Spacers Battery Covers	Low 696	S H	1 1	HS E	M
7 -	CS	239'-0"	437	Corridor	Y	528	Cable Insulation Thermo-Lag 330-1	Moderate 1040	S	5	WP	A
8 -	CS	239'-0"	425	Battery room	Y	470	Battery Cases Battery Spacers Cable Insulation	Low 320	S H	2 1	HS	M

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
9 -	CS	239'-0"	436	Battery room	Y	470	Battery Cases Battery Spacers Cable Insulation	Low 80	S H	2 1	HS	M
10 - A	CS	239'-0"	426	Battery room	Y	468	Battery Cases Battery Spacers Cable Insulation	Low 216	S H	2 1	HS	M
10 - B	CS	239'-0"	454	Swtchgaer maintainence area	Y	360	Cable Insulation Wood	Low 0	S H	1 2	HS	M
11 -	CS	239'-0"	427	Battery room	Y	442	Battery Cases Battery Spacers Cable Insulation	Low 272	S H	2 1	HS	M
12 -	CS	239'-0"	434	4 kV switchgear room	Y	470	Cable Insulation Wood	Low 640	S H	2 2	HS	M
13 -	CS	239'-0"	435	4 Kv switchgear room	Y	470	Cable Insulation	Low 208	S H	2 2	HS	M
14 -	CS	239'-0"	432	4 Kv switchgear room	Y	400	Cable Insulation	Low 752	S H	2 2	HS	M
15 -	CS	239'-0"	433	4 Kv switchgear room	Y	400	Cable Insulation Thermo-Lag 330-1	Low 176	S H	2 2	HS	M
16 -	CS	239'-0"	430	4 Kv switchgear room	Y	400	Cable Insulation	Low 376	S H	2 2	HS	M
17 -	CS	239'-0"	431	4 Kv switchgear room	Y	400	Cable Insulation R/A Insulation Thermo-Lag 330-1	Low 248	S H	2	HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
18 -	CS	239'-0"	428	4 Kv switchgear room	Y	470	Cable Insulation R/A Insulation	Low 320	S H	2 2	HS	M
19 -	CS	239'-0"	429	4 Kv switchgear room	Y	470	Cable Insulation	Low 208	S H	2 2	HS	M
20 -	CS	254'-0"	452	Unit 1 static inverter room	Y	715	Cable Insulation Thermo-Lag 330-1 Thermo-Lag 770-1	Moderate 1400	S H	4 1	HS	M
21 -	CS	254'-0"	453	Unit 2 static inverter room	Y	986	Cable Insulation Thermo-Lag 330-1	Low 1000	S	6	HS	M
22 -	CS	254'-0"	449	Unit 1cable spreading room	Y	2610	Cable Insulation R/A Insulation Thermo-Lag 330-1	Moderate 768	S	14	HS E WP	M A
23 -	CS	254'-0"	450	Unit 2 cable spreading room	Y	2610	Cable Insulation	Moderate 768	S	14	HS E WP	M A
24 - A	CS	269'-0"	533	Control room	Y	5336	Cable Insulation Paper Plastic Carpet	Low 0	S S	23(1) 11(2)	CH HS	M
24 - B	CS	269'-0"	529 530	Control room kitchen Bathroom	Y	146 90 236	Paper Wood Plastic Alcohol	Low 0	S	1	CH HS	M
24 - C	CS	269'-0"	531	L brary and conference room	Y	240	Paper Carpet Plastic	Moderate 0	S	1	CH HS	M
24 - D	CS	269'-0"	532	Shift manager's office	Y	225	Paper Carpet Plastic	Moderate 0	S	2	CH HS	M
24 - E	CS	269'-0"	534	Work control supervisor's office	Y	314	Cable Insulation Paper Carpet Plastic	Moderate 0	S	1(6)	CH HS	M

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
24 - F	CS	269'-0"	535	Conference room	Y	392	Cable Insulation Paper Wood Carpet Plastic	Moderate 0	S	1[6]	E HS	M
25 -	CS	289'-0"	542 541	Auxiliary equipment room Computer maintenance	Y	6676 126 6802	Cable Insulation Paper Plastic Wood Thermo-Lag 330-1 Thermo-Lag 770-1 Floor Tiles	Low 160	S S S S H H S S S H H	57[19] 56[20] 14[21] 32[22] 112[4] 13[4],[21] 46[23] 6[24] 32[25] 88[4],[23] 8[4],[24]	H (Raised Floor)	A
26 -	CS	289'-0"	540	Remote shutdown room	Y	300	Cable Insulation Paper Plastic	Low 168	S S H	3[26] 2[27] 4[4],[27]	H (Raised Floor)	A
27 -	CS	304'-0"	619	Control structure fan room	Y	7610	Cable Insulation Charcoal Rubber R/A Insulation Thermo-Lag 330-1 Plastic	Control of Combustibles 152	S H H	10 4[3] 23[4]	PR FWS	A M
28 - A	CS	350'-0"	622/625 625A 704	SGTS Access Area & Access to FP Upper fan room mezzanine Elevator machine room	Y	3630 5632 98 9360	Charcoal Plastic R/A Insulation Rubber	No Combustible Material Allowed[28] 0	H	4[3]	FWS HS	M
28 - B	CS	332'-0"	624 624A 624B	SGTS filter compartment SBGT filter A compartment SBGT filter B compartment	Y	1072 972 972 3016	Charcoal Plastic Rubber	No Combustible Materials Allowed[28] 0	H	4[3]	FWS HS	M
28 - C	CS	332'-0"	625	Control room fresh air intake plenum	Y	320		Low 0	S	3	HS	M
29 - A	RB-1	181'-11"	101	Suppression chamber	Y	5464		Low	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
								0				
29 - B	RB-1	181'-11"	100	Suppression chamber inside pedestal	Y	314		Low / 0	N			
29 - C	RB-1	217'-0"	100	Drywell drain sump area	Y	314		Low / 0	N		HS	M
30 - A	RB-1	237'-11"	400 401 405	Drywell area Drywell equipment access Drywell personnel and equipment	Y	4627 65 290 4982	Cable Insulation Lube Oil R/A Insulation Alpha Maritex Lead Shielding Blanket Material Silicon Rubber	Low / 352	N		HS	M
30 - B	RB-1	237'-11"	400	Drywell inside pedstal	Y	314	Cable Insulation	Low / 1520	N		HS	M
31 -	RB-1	177'-0"	103 204	RHR Heat Exchanger & Pump Room B/D RHR Heat Exchanger & Pump	Y	2050 1880 3930	Cable Insulation Lube Oil Rubber Plastic	Low / 240	S	6	HS	M
32 -	RB-1	177'-0"	102 203	RHR Heat Exchanger & Pump Room A/C RHR Heat Exchanger & Pump	Y	1700 1880 3580	Cable Insulation Lube Oil Plastic	Low / 296	S	5	HS	M
33 -	RB-1	177'-0"	106 108 289	Airlock RCIC pump room RCIC pipeway	Y	36 830 300 1166	Cable Insulation Lube Oil	Low / 800	S H	2 3[(4)]	PR	A

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
34 -	RB-1	177'-0"	109 288	HPCI pump room HPCI pipeway	Y	1380 550 1930	Cable Insulation Lube Oil R/A Insulation	Low 456	S H	3 4(4)	PR	A
35 -	RB-1	177'-0"	110	Core spray pump room	Y	575	Cable Insulation Lube Oil Plastic	Low 880	S	2	HS	M
36 -	RB-1	177'-0"	113	Core spray pump room	Y	600	Cable Insulation Lube Oil	Low 800	S	2	HS	M
37 -	RB-1	177'-0"	114 114A	Core spray pump room Pipeway	Y	600 108 708	Cable Insulation Lube Oil	Low 800	S	2	HS	M
38 -	RB-1	177'-0"	117	Core spray pump room	Y	575	Cable Insulation Lube Oil	Low 800	S	2	HS	M
39 -	RB-1	177'-0"	115 118	Sump room Passageway	Y	408 1176 1584	Cable Insulation	Low 56	S	4	HS	M
40 -	RB-1	177'-0"	111	Corridor	Y	525	Cable Insulation Rubber Plastic	Low 0	S	2	HS	M
41 -	RB-1	201'-0"	207 210	RECW equipment area Pipeway	Y	2920 108 3028	Cable Insulation	Low 248	S H	3 10(4)	PR	A
42 - A	RB-1	201'-0"	200 201	Safeguard systems access area Airlock	Y	3178 42 3220	Cable Insulation Rubber	Low 320	S H	3 12(4)	PR	A
42 - B	RB-1	201'-0"	209	Isolation valve compartment	Y	280		No Combustible Materials Allowed 0	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection		Suppression	
									Type	No.	Type	Actuation
43 -	RB-1	217'-0"	306 307 309	Safeguard system Isolation valve area Safeguard system Isolation valve area Safeguard system Isolation valve area	Y	340 159 2446 2945	Cable Insulation R/A Insulation Thermo-Lag 330-1 Plastic	Control of Combustibles 0	S	8	HS	M
44 -	RB-1	217'-0"	301 302 303 304 308	Equipment airlock Pipeway Airlock Safeguard systems access area Airlock	Y	532 108 40 8269 42 8991	Cable Insulation Wood Thermo-Lag 330-1	Control of Combustibles 0	S H	27 22(4)	PR (Partial) WC	A M
45 - A	RB-1	253'-0"	402 406M 409 444	CRD hydraulic equipment area Mezzanine above room 406 CRD removal hatch Airlock	Y	12860 630 28 120 13638	Cable Insulation R/A Insulation Thermo-Lag 330-1 Lead Blanket Insulation (Nylon) Fiberglass	Control of Combustibles 0	S H	20 16(4)	PR (Partial) WC	A M
45 - B	RB-1	253'-0"	406	Neutron monitoring system area	Y	630	Cable Insulation Thermo-Lag 330-1	Control of Combustibles 0	S H	2 2(4)	PR (Partial)	A
45 - C	RB-1	253'-0"	403 404 408	CRD repair room CRD hydraulic equipment area Airlock	Y	785 154 35 974		Control of Combustibles 0	S	1	HS	M
46 -	RB-1	253'-0"	407 518 627	Main steam tunnel Main steam tunnel Steam vent platform	Y	870 1092 456 2418		No Combustible Materials Allowed 0	N		HS	M
47 - A	RB-1	283'-0"	500 506 506M 519 599 599M	General equipment area Corridor Corridor Service area Valve compartment Mezzanine above valve compartment	Y	392 8798 147 2610 170 216 12333	Cable Insulation Lube Oil Rubber R/A Insulation Thermo-Lag 330-1 Fiberglass	Control of Combustibles 0	S H	21 18(4)	PR (Partial)	A

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
47 - B	RB-1	295'-3"	523	Isolation valve compartment	Y	750	Cable Insulation R/A Insulation Thermo-Lag 330-1	Control of Combustibles 0	S	2	HS	M
47 - C	RB-1	283'-0"	511	Fuel pool cooling water pump and HX	Y	1660	Cable Insulation Shielding Blankets (Nylon Cover)	Control of Combustibles 0	S	2	HS	M
47 - D	RB-1	283'-0"	510 522	Isolation valve compartment Isolation valve compartment	Y	512 765 1277	Cable insulation Plastic	Control of Combustibles 0	S	1	HS	M
47 - E	RB-1	283'-0"	509	RWCU pump room	Y	160		Control of Combustibles 0	N		HS	M
47 - F	RB-1	283'-0"	508	RWCU pump room	Y	130		Control of Combustibles 0	N		HS	M
47 - G	RB-1	283'-0"	507	RWCU pump room	Y	145		Control of Combustibles 0	S	1	HS	M
47 - H	RB-1	283'-0"	505	Non-Regenerative Heat Exchanger	Y	420	Cable insulation Plastic	Control of Combustibles 0	S	1	HS	M
47 - J	RB-1	283'-0"	504	Non-Regenerative Heat Exchanger	Y	420	Cable insulation Plastic	Control of Combustibles 0	S	1	HS	M
47 - K	RB-1	283'-0"	503	Regenerative Heat Exchanger Room	Y	420	Cable insulation Plastic	Control of Combustibles 0	S	1	HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
47 - L	RB-1	283'-0"	502	RWCU backwash receiving tank area	Y	400		Control of Combustibles / 0	N		HS	M
47 - M	RB-1	283'-0"	501 501A	Isolation valve compartment Isolation valve compartment	Y	469 128 597		No Combustible Materials Allowed / 0	N		HS	M
48 - A	RB-1	313'-0"	600C 601 602 605 605A 605B 609A 609B	RWCU holding pump compartment Laydown Area Laydown Area RERS fan area and corridor Alcove Alcove RWCU filter demin compartment RWCU filter demin compartment	Y	245 990 2540 3100 270 270 48 48 7511	Cable Insulation R/A Insulation Thermo-Lag 330-1	Control of Combustibles / 0	N	8	WC	M
48 - B	RB-1	313'-0"	600B	RWCU holding pump compartment	N	230	Cable insulation Plastic	Control of Combustibles / 0	N		HS	M
48 - C	RB-1	313'-0"	600A	RWCU holding pump compartment	N	230	Cable insulation Plastic	Control of Combustibles / 0	N		HS	M
49 -	RB-1	313'-0"	607 608 606	Reactor enclosure lower fan room Airlock Airlock	Y	4320 42 145 4507	Cable Insulation Thermo-Lag 330-1	Low / 40	N		HS	M
50 - A	RB-1	331'-0"	615 613 614	Reactor enclosure upper fan room Corridor Airlock	Y	2416 182 42 2640	Fiberglass	Low / 0	N		HS	M
50 - B	RB-1	331'-0"	616	Equip.compartment exhaust filter room	N	468	Charcoal	High / 0	H	2(3)	FWS	M

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
50 - C	RB-1	331'-0"	617	Equip.compartment exhaust filter room	N	468	Charcoal	High 0	H	2(3)	FWS	M
51 - A	RB-1	331'-0"	618	RERS filter compartment	Y	720	Charcoal	Low 0	H	2(3)	FWS	M
51 - B	RB-1	331'-0"	612	RERS filter compartment	Y	720	Charcoal	Low 0	H	2(3)	FWS	M
52 - A	RB-2	181'-11"	172	Suppression chamber	Y	5464		Low 0	N		HS	M
52 - B	RB-2	181'-11"	171	Suppression chamber inside pedestal	Y	314		Low 0	N		HS	M
52 - C	RB-2	217'-0"	171	Drywell drain sump area	Y	314		Low 0	N			
53 - A	RB-2	237'-11"	473 474 478	Drywell area Drywell equipment access Drywell personnel and equipment access	Y	4627 65 290 4982	Cable Insulation Lube Oil Alpha Maritex Lead Shielding Blanket Material	Low 320	N		HS	M
53 - B	RB-2	237'-11"	473	Drywell inside pedestal	Y	314	Cable Insulation	Low 1520	N		HS	M
54 -	RB-2	177'-0"	173 280	A/C RHR heat exchanger and pump A/C RHR heat exchanger and pump	Y	2050 1880 3930	Cable Insulation Lube Oil Rubber	Low 240	S	8	HS	M
55 -	RB-2	177'-0"	174 281	B/D RHR heat exchanger and pump B/D RHR heat exchanger and pump	Y	1700 1880 3580	Cable Insulation Lube Oil Rubber	Low 288	S	7	HS	M
56 -	RB-2	177'-0"	179 285 177	RCIC pump room RCIC pipeway Airlock	Y	830 120 42 992	Cable Insulation Lube Oil Wood	Low 800	S H	2 3(4)	PR	A

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
57 -	RB-2	177'-0"	180 283	HPCI pump room HPCI pipeway	Y	1380 550 1930	Cable Insulation Lube Oil Plastic	Low 456	S H	3 4(4)	PR	A
58 -	RB-2	177'-0"	181	Core sray pump room	Y	575	Cable Insulation Lube Oil	Low 880	S	2	HS	M
59 -	RB-2	177'-0"	184 184A	Core spray pump room Pipeway	Y	600 144 744	Cable Insulation Lube Oil	Low 800	S	2	HS	M
60 -	RB-2	177'-0"	185	Core spray pump room	Y	600	Cable Insulation Lube Oil	Low 800	S	2	HS	M
61 -	RB-2	177'-0"	188	Core sray pump room	Y	575	Cable Insulation Lube Oil	Low 880	S	2	HS	M
62 -	RB-2	177'-0"	186 189	Sump room Passageway	Y	304 1176 1480	Cable Insulation	Low 288	S	4	HS	M
63 -	RB-2	177'-0"	182	Corridor	Y	525	Cable Insulation Plastic Rubber	Low 0	S	2	HS	M
64 - A	RB-2	201'-0"	284	RECW equipment area	Y	4020	Cable Insulation	Low 248	S H	5 9	PR	A
64 - B	RB-2	201'-0"	286	Isolation valve compartment	Y	280	Thermo-Lag 330-1	Low 320	S	2	HS	M
65 -	RB-2	201'-0"	279 282 287	Safeguard system access area Airlock Pipeway	Y	3178 42 108 3328	Cable Insulation Plastic Rubber	Low 0	S H	4 14	PR	A

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
66 -	RB-2	217'-0"	374 375 376	Safeguard system Isolation valve area Safeguard system Isolation valve area Safeguard system Isolation valve area	Y	340 3512 2446 6298	Cable Insulation Thermo-Lag 330-1	Control of Combustibles 0	S	8	HS	M
67 -	RB-2	217'-0'	368 370 372 367 369	Pipeway Safeguard system access area Airlock Equipment airlock Airlock	Y	114 7836 35 532 40 8557	Cable Insulation Rubber Wood R/A Insulation Thermo-Lag 330-1	Control of Combustibles 0	S H	30 36	PR (Partial) WC	A M
68 - A	RB-2	253'-0"	475 476M 482 479M	CRD hydraulic equipment area Mezzanine above CRD maint. room CRD removal hatch Mezzanine above neut. mon. room	Y	11960 900 28 630 13518	Cable Insulation Rubber Thermo-Lag 330-1 Plastic Fiberglass	Control of Combustibles 0	S H	20 16	PR (Partial) WC	A M
68 - B	RB-2	253'-0"	479	Neutron monitoring system area	Y	630	Cable Insulation	Control of Combustibles 0	S	2	HS	M
68 - C	RB-2	253'-0"	476 477 481	CRD maintenance room CRD maintenance room Airlock	Y	785 225 35 1045	Fiberglass Polyester Resin Rubber	Control of Combustibles 0	S	2	HS	M
69 -	RB-2	253'-0"	480 587 626	Main steam tunnel Main steam tunnel Steam vent platform	Y	870 850 456 2176		No Combustible Materials Allowed 0	N		HS	M
70 - A	RB-2	283'-0"	574 580 580M 589 589M 594 596	General equipment area Corridor Mezzanine Valve compartment RHR valve compartment mezzanine Service area Fuel pool service water booster pump	Y	570 8555 147 170 216 2610 1935 14203	Cable Insulation Lube Oil Rubber R/A Insulation Thermo-Lag 330-1 Plastic Fiberglass	Control of Combustibles 0	S H	22 15	PR (Partial)	A

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
70 - B	RB-2	295'-3"	593	Isolation valve compartment	Y	750	Cable Insulation	Control of Combustibles / 0	S	2	HS	M
70 - C	RB-2	283'-0"	585	Fuel pool cooling water pump and HX	Y	760	Cable Insulation Shielding Blankets (Nylon Cover)	Control of of Combustibles / 0	S	2	HS	M
70 - D	RB-2	283'-0"	584 597	Isolation valve compartment Isolation valve compartment	Y	352 450 802	Cable Insulation	Control of Combustibles / 0	S	1	HS	M
70 - E	RB-2	283'-0"	583	RWCU pump room	Y	160	Cable Insulation	Control of Combustibles / 0	N		HS	M
70 - F	RB-2	283'-0"	582	RWCU pump room	Y	130	Cable Insulation	Control of Combustibles / 0	N		HS	M
70 - G	RB-2	283'-0"	581	RWCU pump room	Y	145	Cable Insulation	Control of Combustibles / 0	S	1	HS	M
70 - H	RB-2	283'-0"	579	Nonregenerative heat exchanger area	Y	420		Control of Combustibles / 0	S	1	HS	M
70 - J	RB-2	283'-0"	578	Nonregenerative heat exchanger area	Y	420		Control of Combustibles / 0	S	1	HS	M
70 - K	RB-2	283'-0"	577	Regenerative heat exchanger area	Y	420		Control of Combustibles / 0	S	1	HS	M
70 - L	RB-2	283'-0"	576	RWCU backwash receiving tank area	Y	400		Control of Combustibles / 0	N		HS	M
70 - M	RB-2	283'-0"	575 575A	Isolation valve compartment Isolation valve compartment	Y	675 50 725		No Combustible Materials Allowed / 0	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
71 - A	RB-2	313'-0"	637 638 641 633 636C 644 641A 641B 644A 644B	Laydown area Laydown area RERS fan area Gamma scan compartment Holding pump compartment corridor RWCU filter demin. access Alcove Alcove RWCU filter demin compartment RWCU filter demin compartment	Y	990 3540 3100 220 190 120 270 270 48 48 8796	Cable Insulation Plastic Rubber Thermo-Lag 330-1	Control of Combustibles 0	S S	17 1(6)	WC	M
71 - B	RB-2	313'-0"	636B	RWCU holding pump compartment	N	216		Control of Combustibles 0	N		HS	M
71 - C	RB-2	313'-0"	636A	RWCU holding pump compartment	N	216	Cable Insulation	Control of Combustibles 0	N		HS	M
72 -	RB-2	313'-0"	642 635 643	Airlock Airlock Reactor enclosure lower fan room	Y	42 145 4320 4507	Cable Insulation Plastic	Low 112	N		HS	M
73 - A	RB-2	331'-0"	647 650 652	Reactor enclosure upper fan room Airlock Corridor	Y	2416 42 190 2648	Plastic Cable Insulation	Low 0	N		HS	M
73 - B	RB-2	331'-0"	649	Equip. compartment exhaust filter room	Y	468	Charcoal	High 0	H	2(3)	FWS	M
73 - C	RB-2	331'-0"	648	Equip.compartment exhaust filter room	N	468	Charcoal	High 0	H	2(3)	FWS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection		Suppression	
									Type	No.	Type	Actuation
74 - A	RB-2	331'-0"	651	RERS filter compartment	Y	720	Charcoal	Low / 0	H	2(3)	FWS	M
74 - B	RB-2	331'-0"	653	RERS filter compartment	Y	720	Charcoal	Low / 0	H	2(3)	FWS	M
75 -	RB-1/2	198'-0"	202	Service water pipe tunnel	Y	3840	Thermo-Lag 330-1	No Combustible Materials Allowed / 0	N		HS	M
76 -	RB-1/2	217'-0"	310 300 366	Refueling hoistway Airlock Airlock	Y	1710 36 36 1782	Rubber	Low / 0	N		HS	M
77 -	RB-1/2	360'-0"	711 711	South exhaust stack Air Lock	Y	620 145		Low / 0	N			

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
78 - A	RB-1/2	352'-0"	603 604 610 611 634 639 640 645 646 700 702 702A 703 707 708 710 710A	New fuel storage vault Spent fuel pool Skimmer surge tank pit Skimmer surge tank pit Cask washdown and storage area New fuel storage vault Spent fuel pool Skimmer surge tank pit Skimmer surge tank pit Refueling/laydown area Refueling/laydown area Steam dryer Airlock Airlock Refueling/laydown area Refueling/laydown area Steam dryer	Y	182 1032 115 115 247 126 1032 115 115 13637 780 3000 36 36 13637 780 3000 37985	Plastic Rubber Polycarbonate Lube Oil Cable Insulation Nylon	Control of Combustibles 0	N		HS	M
78 - B	RB-1/2	352'-0"	655 701	Airlock Shower and dressing area	Y	36 3500 3536	Cable Insulation Paper	Low 144	N		HS	M
78 - C	RB-1/2	352'-0"	654 705 706 709	Airlock Elevator machinery room Elevator machinery room Shower and dressing area	N	36 72 72 3500 3680		Low 0	N		HS	M
79 -	DG1	217'-0"	311A 312A	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
80 -	DG1	217'-0"	311C 312C	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
81 -	DG1	217'-0"	311B 312B	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
82 -	DG1	217'-0"	311D 312D	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
83 -	DG2	217'-0"	315A 316A	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
84 -	DG2	217'-0"	315C 316C	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
85 -	DG2	217'-0"	315B 316B	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
86 -	DG2	217'-0"	315D 316D	Diesel generator cell Day tank room	Y	1690 72 1762	Cable Insulation Lube Oil R/A Insulation Fuel Oil Rubber	Moderate 560	F H H	1 1 5[4]	PR	A
87 -	TB-1	189'-0"	256 342	Condensate pump room Condensate pump room	N	1620 1643 3263	Cable Insulation Lube Oil	Low 640	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
88 - A	TB-1	200'-0"	253 254 255 260A 261A 262A 332 332M 438 438M	Circ. water inlet pit area Condenser Area Drain cooler & circ. water outlet area feed pump turbine exhaust room feed pump turbine exhaust room feed pump turbine exhaust room Condenser Area Main steam tunnel Feedwater heater service area Main steam tunnel	Y	2332 4600 4260 200 200 200 17248 3024 4885 6956 43905	Cable Insulation Lube Oil Fiberglass	Low 400	N		WP (Partial)	A
88 - B	TB-1	239'-0"	441	Feedwater heater room	N	2220	Cable Insulation	Low 480	N		HS	M
88 - C	TB-1	239'-0"	440	Feedwater heater room	N	2220		Low 0	N		HS	M
88 - D	TB-1	239'-0"	439	Feedwater heater room	N	2220		Low 0	N		HS	M
89 - A	TB-1	200'-0"	252 252A 252B 260 261 262 265 212 265M	Control rod drive water pump area Spent resin tank room Resin measuring tank room Lube oil reservoir area Lube oil reservoir area Lube oil reservoir area Corridor Pipeway Mezzanine Permanent in-plant storage	N	6908 390 390 506 506 253 2290 726 336 12305	Cable Insulation Lube Oil Plastic Rubber Wood R/A Insulation Trash Fiberglass	Low 216	H		WP (Partial)	A

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
89 - B	TB-1	200'-0"	264A	Condensate filter/demin compartment	N	190	Cable Insulation	Low	N		HS	M
			264B	Condensate filter/demin compartment		190		896				
			264C	Condensate filter/demin compartment		190						
			264D	Condensate filter/demin compartment		190						
			264E	Condensate filter/demin compartment		190						
			264F	Condensate filter/demin compartment		190						
			264G	Condensate filter/demin compartment		190						
			264H	Condensate filter/demin compartment		247						
			264I	Condensate filter/demin compartment		190						
			339A	Condensate filter/demin compartment		140						
			339B	Condensate filter/demin compartment		140						
			339C	Condensate filter/demin compartment		140						
			339D	Condensate filter/demin compartment		140						
			339E	Condensate filter/demin compartment		140						
			339F	Condensate filter/demin compartment		140						
			339G	Condensate filter/demin compartment		140						
			339H	Condensate filter/demin compartment		140						
			325A	Corridor		104						
			249	Pipeway		462						
						3453						
90 -	TB-1	217'-0"	333	Air ejec. and steam packing exhauster	N	1610	Cable Insulation	Low	N		HS	M
								184				
91 -	TB-1	217'-0"	334	Air ejec. and steam packing exhauster	N	1610	Cable Insulation	Low	N		HS	M
							Plastic	184				
92 -	TB-1	217'-0"	337	Vacuum pump room	N	702	Cable Insulation	Low	N		HS	M
							Lube Oil	960				
93 -	TB-1	217'-0"	328	Air compressor area	N	1342	Cable Insulation	High	N		WP (Partial)	A
			330	EHC power unit area		546	Lube Oil	1440				
			331	Lube oil storage tank area		1302	Plastic					
						3190	Rubber					
							Polyvinyl Chloride (PVC)					
							Fiberglass					
							Cloth					
							Polyethylene					

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
94 - A	TB-1	217'-0"	325 327 338 341 341A 341B 341C 341D 341E 341F 341G 341H 341I	Reactor feed pump access area MCC area Passageway Control panel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area Deep bed vessel area	Y	2968 802 450 160 336 336 336 336 336 336 336 336 336 7404	Cable Insulation Plastic Rubber R/A Insulation	Low 480	N		HS	M
94 - B	TB-1	217'-0"	340A	Reactor feed pump turbine compartment	N	570		Low 0	H	1	HS	M
94 - C	TB-1	217'-0"	340B	Reactor feed pump turbine compartment	N	570		Low 0	H	1	HS	M
94 - D	TB-1	217'-0"	340C	Reactor feed pump turbine compartment	N	570		Low 0	H	12	HS	M
94 - F	TB-1	217'-0"	341	Control panel area (western extension)	N	160		Low 0	N		HS	M
95 -	TB-1	239'-0"	442 445 446	MCC room TECW equipment area Lube oil equipment area	Y	280 2357 840 3477	Cable Insulation Lube Oil Plastic	High 1280	H	7(4)	WP DL	A A
96 -	TB-1	239'-0"	443	Battery room	N	462	Battery Cases Battery Spacers Cable Insulation	Low 560	S H	1 1	HS	M
97 -	TB-1	239'-0"	448 448A	Equipment hatch corridor Passageway	N	2535 390 2925	Cable Insulation Rubber Wood	Low 160	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
98 - A	TB-1	269'-0"	548 548M	Recirculation pump MG area Feedwater heater mezzanine	N	13020 2000 15020	Cable Insulation Plastic Rubber R/A Insulation	Low 400	S	19	HS	M
98 - B	TB-1	269'-0"	547	Feedwater heater room	N	880		Low 0	N		HS	M
98 - C	TB-1	269'-0"	546	Feedwater heater room	N	880		Low 0	N		HS	M
98 - D	TB-1	269'-0"	545	Feedwater heater room	N	880		Low 0	N		HS	M
99 - A	TB-1	302'-0"	620	Turbine enclosure HVAC area	N	13080	Cable Insulation Lube Oil Wood R/A Insulation Rubber	Low 400	S	1	HS	M
99 - B	TB-1	302'-0"	621	TEECE filter area	N	1228	Charcoal	High 0	H	4(3)	FWS	M
100 -	TB-2	189'-0"	266 347	Condensate pump room Condensate pump room	N	1620 1643 3263	Cable Insulation Lube Oil	Low 960	N		HS	M

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
101 - A	TB-2	200'-0"	267	Drain cooler & circ. water outlet area	Y	4260	Cable Insulation	Low	N		WP (Partial)	A
			268	Condenser area		4600	Lube Oil	400				
			269	Circ. water inlet pit area		2332						
			274A	feed pump turbine exhaust room		200						
			275A	feed pump turbine exhaust room		200						
			276A	feed pump turbine exhaust room		200						
			355	Condenser area		17248						
			464	Feedwater heater service area		4885						
			464M	Main steam tunnel		6956						
			355M	Main steam tunnel		1080						
						41961						
101 - B	TB-2	239'-0'	458	Feedwater Heater Room	N	2220	Cable Insulation	Low	N		HS	M
								880				
101 - C	TB-2	239'-0'	457	Feedwater Heater Room	N	2220		Low	N		HS	M
								0				
101 - D	TB-2	239'-0'	456	Feedwater Heater Room	N	2220		Low	N		HS	M
								0				
102 - A	TB-2	200'-0"	270	Control rod drive water pump area	Y	6908	Cable Insulation	Low	H	7	WP (Partial)	A
			270A	Spent resin tank room		390	Lube Oil	560				
			270B	Resin measuring room		348	Wood					
			270C	Resin measuring room		42	FG Pipe Insulation					
			271	Stairway		506	Plastic					
			273A	Vertical pipeway		54	Fiberglass					
			274	Lube oil reseroir		506						
			275	Lube oil reseroir		506						
			276	Lube oil reseroir		253						
			277	Corridor		2560						
			277M	Mezzanine		336						
						12409						

LGS FIRE PROTECTION PROGRAM
TABLE 9A-1 (Cont'd)

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
102 - B	TB-2	200'-0"	352A	Condensate filter/demin compartment	N	140	Cable Insulation	Low	N		HS	M
			352B	Condensate filter/demin compartment		140		880				
			352C	Condensate filter/demin compartment		140						
			352D	Condensate filter/demin compartment		140						
			352E	Condensate filter/demin compartment		140						
			352F	Condensate filter/demin compartment		140						
			352G	Condensate filter/demin compartment		140						
			352H	Condensate filter/demin compartment		140						
			272A	Condensate filter/demin compartment		242						
			272B	Condensate filter/demin compartment		200						
			272C	Condensate filter/demin compartment		200						
			272D	Condensate filter/demin compartment		200						
			272E	Condensate filter/demin compartment		200						
			272F	Condensate filter/demin compartment		200						
			272G	Condensate filter/demin compartment		200						
			272H	Condensate filter/demin compartment		200						
			272I	Condensate filter/demin compartment		200						
			273	Vertical pipeway		496						
			346A	Corridor		104						
						3562						
103 -	TB-2	217'-0"	348	Air ejec. and steam packing exhauster	N	1610	Cable Insulation	Low	N		HS	M
								640				
104 -	TB-2	217'-0"	349	Air ejec. and steam packing exhauster	N	1610	Cable Insulation	Low	N		HS	M
								640				
105 -	TB-2	217'-0"	350	Vacuum pump room	N	702	Cable Insulation	Low	N		HS	M
							Lube Oil	1000				
106 -	TB-2	217'-0"	356	Lube oil storage tank area	N	1302	Cable Insulation	High	N		WP (Partial)	A
			357	Air compressor area		1342	Lube Oil	1440				
			358	EHC power unit area		546	Fiberglass					
			359	Stairway		112	Polyethylene					
						3302	Plastic					
							Rubber					
							Cloth					

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
107 - A	TB-2	217'-0"	346	Reactor feed pump access area	N	2968	Cable Insulation	Low	N		HS	M
			351	Passageway		420	Rubber	480				
			354	Control panel area		5034	Plastic					
			354A	Deep bed vessel area		336						
			354B	Deep bed vessel area		336						
			354C	Deep bed vessel area		336						
			354D	Deep bed vessel area		336						
			354E	Deep bed vessel area		336						
			354F	Deep bed vessel area		336						
			354G	Deep bed vessel area		336						
			354H	Deep bed vessel area		336						
			354I	Deep bed vessel area		336						
			357A	MCC area		802						
			371	Vestibule		81						
						12329						
107 - B	TB-2	217'-0"	353A	Reactor feed pump turbine compartment	N	570		Low / 0	H	1	HS	M
107 - C	TB-2	217'-0"	353B	Reactor feed pump turbine compartment	N	570		Low / 0	H	1	HS	M
107 - D	TB-2	217'-0"	353C	Reactor feed pump turbine compartment	N	570		Low / 0	H	1	HS	M
107 - E	TB-2	217'-0"	800	Secondary equipment access area	N	650		Low / 0	H		HS	M
107 - F	TB-2	217'-0"	802	Health physics access control area	N	720		Low / 0	S	1	HS	M
107 - G	TB-2	217'-0"	803	Vestibule	N	250		Low / 0	S	1	HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
108 -	TB-2	239'-0"	459 461 463	MCC area TECW equipment area Lube oil equipment room	Y	280 2357 840 3477	Cable Insulation Lube Oil Wood	High 1040	H	7(4)	AS (Partial) DL (Partial)	A A
109 -	TB-2	239'-0"	460	Battery room	N	462	Battery Cases Battery Spacers Cable Insulation	Low 880	S H	1 1	HS	M
110 -	TB-2	239'-0"	466 466A	Equipment hatch corridor Passageway	Y	2535 390 2925	Cable Insulation Rubber Wood Polycarbonate	Low 640	N		HS	M
111 - A	TB-2	269'-0"	562 563 564 564M 568 569	Janitor's room First aid locker Recirculation pump MG area MG set area mezzanine Maintenance Room Fire Brigade Locker	N	42 56 13020 2000 155 228 15501	Cable Insulation Plastic Rubber Wood Polycarbonate	Low 400	S S	20	HS	M
111 - B	TB-2	269'-0"	561	Feedwater heater room	N	880		Low 0	N		HS	M
111 - C	TB-2	269'-0"	560	Feedwater heater room	N	880		Low 0	N		HS	M
111 - D	TB-2	269'-0"	559	Feedwater heater room	N	880		Low 0	N		HS	M
112 - A	TB-2	302'-0"	628	Turbine enclosure HVAC area	N	13080	Cable Insulation Lube Oil Wood R/A Insulation Plastic	Low 160	S		HS	M
112 - B	TB-2	302'-0"	629	TEECE filter area	Y	1228	Charcoal	High 0	H	2(3)	FWS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	SR	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
113 - A	TB-1/2	217'-0"	335	Railroad access area	N	7632	Cable Insulation Lube Oil Plastic Rubber Wood Fiberglass Paper	Low 640	H H(5)	7(4) 7(4)	PR	A
113 - B	TB-1/2	239'-0"	447 465 467 468 468A 468B 468C	Generator equipment area Generator equipment area Ops hose storage facility V bration analysis & predictive maint. Ops equipment storage facility Ops equipment storage facility Ops equipment storage facility	N	8976 8976 180 220 304 48 48 18752	Cable Insulation Lube Oil R/A Insulation Plastic Rubber Fiberglass	Low 320	H H(5) S	20(4) 20(4) 1(7)	PR DL (Partial) WP (11,12,13)	A A A
114 -	TB-1/2	269'-0"	543 544 549 550 551 558 565 565A 566 567 588 549A 552 553	Turbine operating floor Turbine laydown area Washdown area Turbine laydown area Clean steam seal evaporator room Turbine laydown area Washdown area Turbine laydown area Turbine laydown area Clean steam seal evaporator room Turbine laydown area Turbine laydown area Emergency fire responce facility I&C shop	N	7456 6984 552 4225 760 6984 770 3660 768 836 5440 4208 380 420 43443	Cable Insulation Cotton Cloth Plastic Rubber Wood Polycarbonate Paper Fiberglass Polyethylene	Low 104	H H S H S	8 41(4) 5(8) 2(14) 1(15)	PR (Partial) HS E	A M
115 - A	TUNNEL	187'-0"	119	Radwaste pipe tunnel	Y	943		Low 0	N		N	
115 - B	TUNNEL	187'-0"	121	Radwaste pipe tunnel	N	986		Low 0	N		N	

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
115 - C	TUNNEL	183'-0"	119 213A 120	Radwaste pipe tunnel Pipe Tunnel Access Unexcavatred Areas	Y	828 100 1686 2614		Low 0	N		N	
115 - D	TUNNEL	191'-0"	119	Radwaste pipe tunnel	Y	207		Low 0	N		N	
116 - A	RW	162'-0"	122	Pipe tunnel access	N	590		Low 0	N		N	
116 - B	RW	162'-0"	135	Corridor	N	1096	Cable Insulation	Low 880	N		HS	M
116 - C	RW	162'-0"	149	Corridor	N	496	Cable Insulation	Low 1040	N		HS	M
116 - D	RW	162'-0"	152 145	Corridor MCC room	N	154 160 314	Cable Insulation Wood	Low 960	N		HS	M
116 - E	RW	162'-0"	124	Waste sludge pump room	N	288		Low 0	N		HS	M
116 - F	RW	162'-0"	123	Waste sludge tank room	N	576		Low 0	N		HS	M
116 - G	RW	162'-0"	126	Condensate decant pump room	N	175		Low 0	N		HS	M

Area - Zone	Structure	Elevation	Room No.	Area-Zone Description	S R	Area (sqft)	Hazard Material	Combustible Loading / Combustible Loading Change Limit	Detection Type	Detection No.	Suppression Type	Suppression Actuation
116 - H	RW	162'-0"	127	Condensate sludge discharge pump room	N	198	Cable Insulation	Low 800	N		HS	M
116 - J	RW	162'-0"	125	Condensate phase separator room	N	800		Low 0	N		HS	M
116 - K	RW	162'-0"	129	Condensate sludge discharge pump room	N	192		Low 0	N		HS	M
116 - L	RW	162'-0"	130	Condensate decant pump room	N	240		Low 0	N		HS	M
116 - M	RW	162'-0"	128	Condensate phase separator room	N	800		Low 0	N		HS	M
116 - N	RW	162'-0"	137	Chemical waste tank pump room	N	144		Low 0	N		HS	M
116 - P	RW	162'-0"	136	Chemical waste tank room	N	144		Low 0	N		HS	M
116 - Q	RW	162'-0"	131	Equipment drain collection tank room	N	864		Low 0	N		HS	M
116 - R	RW	162'-0"	132	Equipment drain collection tank room	N	320		Low 0	N		HS	M

Table 9A-1 (Cont'd)

Notes:
(1) These smoke detectors are located below the suspended ceiling in the control room.
(2) These smoke detectors are located above the suspended ceiling in the control room.
(3) These heat detectors are located inside the charcoal filter plenum.
(4) These heat detectors are used to actuate the automatic suppression systems.
(5) Fire zone 113a and 113B are located in a portion of the turbine enclosure that is common to Unit 1 and Unit 2. The detectors identified by this note will be installed east of column line 23 for Unit 2 operation.
(6) These smoke detectors are of the photoelectric-type.
(7) These detectors are located inside offices 467, 568, and 569.
(8) These detectors are located inside offices 552, 553, 570, and 571.
(9) These smoke detectors are located inside the test engineer's workshop.
(10) Deleted
(11) This sprinkler system is installed above and inside facility/laydown area.
(12) This sprinkler system is installed in the Floor Operations Break Facility (Rm 468A, B, C).
(13) This sprinkler system is installed in the Plant Operations Building (Rm 468).
(14) These heat detectors are located inside the Unit 1/2 turbine generator exciter enclosures (2 per unit).
(15) These smoke detectors are located in the Unit 1/2 turbine generator exciter exhaust ductwork (1 per unit). (Detector suitable for high velocity airstream)
(16) Deleted.
(17) Room 258A floor area is contained in Room 258 floor area.
(18) Room 236A floor area is contained in Room 263 floor area.
(19) Common - Ceiling level.
(20) Unit 1 - PGCC Floor.
(21) Unit 1 - non-PGCC Floor.
(22) Unit - Termination Cabinets.
(23) Unit 2 - PGCC Floor.
(24) Unit 2 - non-PGCC Floor.
(25) Unit 2 - Termination Cabinets.
(26) Ceiling Level.
(27) Raised Floor.
(28) Charcoal enclosed in steel filter plenums has been accepted by NRC.

Table 9A-2

Heat of Combustion for Specific Materials (All values rounded to nearest 100 BTU/Unit)		
Material	Units	Heat of Combustion (BTU/Unit)
Acetylene Gas	lb	21,500
Alcohol (Ethyl)	gal.	83,800
Alcohol (Methyl)	gal.	65,500
Alpha Maritex Lead Shielding Blanket	Linear foot	2404
Battery Cases (Butadiene Acrylonitrile)	lb	17,200
Battery Spacers (Polystyrene Foam)	lb	17,100
Cable Insulation	lb	10,000
Carpet (Nylon)	lb	13,600
Charcoal	lb	14,900
Cloth (Cotton)	lb	8,800
Floor Tiles (Polyester Resin)	lb	10,000
Fuel Oil	gal.	135,500
Gasoline	gal.	120,600
Hydrogen	lb	61,000
Lube Oil	gal.	150,900
Lubricant (Grease)	lb	150,900
Methane Gas	cu. ft.	23,900
Oxygen	cu. ft.	0
Paper	lb	8,500
Plastic (Polyethylene)	lb	20,000
Propane	lb	21,700
Rubber (Butyl)	lb	19,700
Trash (40 lb bag)	ea.	290,500
Wood (White Pine)	lb	8,300
R/A Insulation	lb	8,000
Polycarbonate	lb	13,300
Thermo-Lag 330-1	lb	7,000
Thermo-Lag 770-1	lb	4,800
Polyvinyl Chloride (PVC)	lb	7,730
Fiberglass	lb	14,000
Silicon Rubber	lb	7,200

Table 9A-3

INSULATION AND JACKETING MATERIALS
USED FOR ELECTRICAL CABLING

CABLE APPLICATION	INSULATION	JACKETING
Communication	Polyvinyl chloride	Polyvinyl chloride
Lighting	Thermoplastic (THHN, THWN, or THW)	None
Grounding	Thermoplastic (THW)	None
Instrumentation	Cross-linked polyethylene	Neoprene
	Flamtrol (flame-retardant cross-linked polyolefin)	Flamtrol
Coaxial and triaxial	Cross-linked Polyolefin	Cross-linked polyolefin
600 V control	Cross-linked polyethylene	Neoprene
	Rubber	Neoprene
	Rockbestos "Heatzone I"	Rockbestos "Heatzone I"
600 V power	Cross-linked polyethylene	Neoprene
	Ethylene propylene rubber	Hypalon
	Cross-linked polyethylene(4)	Polyvinyl chloride
	Cross-linked Polyethylene	Chlorinated polyethylene
5 kV and 15 kV power(5)	Ethylene propylene rubber	Hypalon
	Ethylene propylene Rubber	Semi-conducting chlorinated polyethylene
	Cross-linked polyethylene	Polyvinyl chloride
Computer cables	Cross-linked polyethylene	Neoprene
	Rayolin F (cross-linked radiation-resistant polyolefin)	Flamtrol
Multiconductor(1)	Cross-linked polyethylene	Neoprene

Table 9A-3 (Cont'd)

CABLE APPLICATION	INSULATION	JACKETING
Multiconductor (shielded)[(1)]	Cross-linked polyethylene or cross-linked modified polyolefin	Neoprene or cross-linked polyolefin
Twisted shielded pairs[(1)]	Cross-linked polyalkene and polyvinylidene fluoride	Cross-linked modified polyolefin
Thermocouple[(1)]	Cross-linked polyethylene	Cross-linked polyethylene
Coaxial (RG-type)[(1)]	Cross-linked polyethylene	Cross-linked polyethylene polyvinyl chloride
Coaxial (twin conductor)[(1)]	Alkaneimide polymer cross-linked polyolefin polyethylene	Cross-linked polyethylene polyvinyl chloride
Coaxial (high temperature, radiation resistant)[(1)]	Cross-linked polyethylene	Cross-linked polyethylene
Twisted pairs or twisted triples (high performance)[(1)]	Polyalkene and polyvinylidene fluoride	Cross-linked polyvinylidene fluoride and cross-linked polyolefin
Armored Coaxial Cable for Video signals from Drywell video cameras[(6)]	Cross-linked polyethylene	Polyvinyl Chloride
Armored Multiconductor cable for Drywell video camera control and audio signals[(6)]	Cross-linked polyethylene	Polyvinyl Chloride

Table 9A-3 (Cont'd)

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(1) These cables are associated with the PGCC and the deep bed demineralizer system.

(2) Insulation for lighting cables and grounding cables is specified as flame retardant in accordance with the National Electric Code. Insulation and jacketing for all other cables, with the exception of communications cables, are specified to meet the IEEE 383 flame test requirements. An insignificant length of data cable which is not IEEE 383 rated is added to the Unit 1 and Unit 2 drywell as a part of the MUR (Measurement Uncertainty Recapture) Project. The cables were evaluated and found to be acceptable. The cables were not routed together with cables associated with other plant systems.

(3) Ignition of electrical cabling, in the absence of a fire source external to the cabling, is extremely unlikely. The consequences of an overload condition are minimized by conservative cable ratings and by the use of overload devices in power circuits and fault current interrupting devices in essentially all circuits. In addition, cable insulation and jacketing materials are chosen for their fire retardant and self-extinguishing properties, such that fuel contribution to a cable fire is minimized and propagation of a fire along cables is self-limiting.

(4) This cable is used in the main condenser areas and condensate pump rooms.

(5) Use of cross-linked polyethylene insulation and polyvinyl chloride applies to 15kV cable only.

(6) These cables are used with the Health Physics temporary video cameras and Remote Console. The cables route video signals, control and audio signals to and from the Remote console, which is located outside the Drywell, to the cameras located inside the Drywell during outages.

Table 9A-4

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
00A119	101 SAFEGUARD BUS	APS	0	428 429 430 431 432 433 434 435 447 YARD	018 019 016 017 014 015 012 013 113 YARD	
00A120	201 SAFEGUARD BUS	APS	0	428 429 430 431 432 433 434 435 465 YARD	018 019 016 017 014 015 012 013 113 YARD	
00B131	480V MCC	EPS	C	619	027	
00B132	480V MCC	EPS	D	619	027	
00B519	480V MCC	EPS	A	1000	122	
00B520	480V MCC	EPS	B	1005	123	
00B521	480V MCC	EPS	C	1000	122	
00B522	480V MCC	EPS	D	1005	123	
01X566	TRANSFORMER	EPS	A	1000	122	
01Y501	120V AC INST PANEL	EPS	A	1000	122	
02X566	TRANSFORMER	EPS	B	1005	123	
02Y501	120V AC INST PANEL	EPS	B	1005	123	
03X566	TRANSFORMER	EPS	C	1000	122	
03Y501	120V AC INST PANEL	EPS	C	1000	122	
04X566	TRANSFORMER	EPS	D	1005	123	
04Y501	120V AC INST PANEL	EPS	D	1005	123	
0AP506	RHRSW PUMP "A"	RHRSW	A	1000	122	1-RHRSW-A 2-RHRSW-A
0AP548	ESW PUMP "A"	ESW	A	1000	122	0-ESW-A 0-ESW-R
0AV543	SYSTEM "A" FAN CABINET	SPPV	A	1000	122	1-RHRSW-A 2-RHRSW-A 0-ESW-R 0-ESW-A
0AX103	101 SAFEGUARD XMFR	APS	0	YARD	YARD	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
0AX104	101 SAFEGUARD XMFR GROUNDING RESISTOR	APS	0	YARD	YARD	
0BP506	RHRSW PUMP "B"	RHRSW	B	1005	123	1-RHRSW-B 2-RHRSW-B
0BP548	ESW PUMP "B"	ESW	B	1005	123	0-ESW-B
0BV543	SYSTEM "B" FAN CABINET	SPPV	B	1005	123	2-RHRSW-B 1-RHRSW-B 0-ESW-B
0BX103	201 SAFEGUARD XMFR	APS	0	YARD	YARD	
0BX104	201 SAFEGUARD XMFR GROUNDING RESISTOR	APS	0	YARD	YARD	
0CP506	RHRSW PUMP "C"	RHRSW	A	1000	122	1-RHRSW-A 2-RHRSW-A
0CP548	ESW PUMP "C"	ESW	C	1000	122	0-ESW-A
0CV543	SYSTEM "C" FAN CABINET	SPPV	C	1000	122	1-RHRSW-A 2-RHRSW-A 0-ESW-A
0DP506	RHRSW PUMP "D"	RHRSW	B	1005	123	2-RHRSW-B 1-RHRSW-B
0DP548	ESW PUMP "D"	ESW	D	1005	123	0-ESW-B
0DV543	SYSTEM "D" FAN CABINET	SPPV	D	1005	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
101D112	101 NON-SAFEGUARD BATTERY	APS	0(D)	443	096	
101D113	BATTERY CHARGER	APS	0(D)	445	095	
102D112	102 NON-SAFEGUARD BATTERY	APS	0(D)	443	096	
102D113	BATTERY CHARGER	APS	0(D)	445	095	
105CROM*	105 CROMBY SUBSTATION BREAKER	APS	0	YARD	YARD	
10A103	10 STATION AUX BUS 13.2 KV	APS	0	336	002	
10A115	D11 SAFEGUARD SWGR	EPS	A	435	013	
10A116	D12 SAFEGUARD SWGR	EPS	B	433	015	
10A117	D13 SAFEGUARD SWGR	EPS	C	434	012	
10A118	D14 SAFEGUARD SWGR	EPS	D	432	014	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
10B129	480V MCC	EPS	A	548	098	
10B201	480V SAFEGUARD LOAD CTR	EPS	A	602W	048W	
10B202	480V SAFEGUARD LOAD CTR	EPS	B	602E	048E	
10B203	480V SAFEGUARD LOAD CTR	EPS	C	402W	045W	
10B204	480V SAFEGUARD LOAD CTR	EPS	D	506E	047E	
10B211	480V MCC	EPS	A	304W	044W	
10B212	480V MCC	EPS	B	304E	044E	
10B213	480V MCC	EPS	A	506W	047W	
10B214	480V MCC	EPS	B	506E	047E	
10B215	480V MCC	EPS	A	304W	044W	
10B216	480V MCC	EPS	B	304E	044E	
10B217	480V MCC	EPS	C	200	042	
10B218	480V MCC	EPS	D	207	041	
10B223	480V MCC	EPS	C	402W	045W	
10B224	480V MCC	EPS	D	402E	045E	
10B515	480V MCC	EPS	A	311A	079	
10B516	480V MCC	EPS	B	311B	081	
10B517	480V MCC	EPS	C	311C	080	
10B518	480V MCC	EPS	D	311D	082	
10D106	125/250V DC GROUND DETECTION CABINET	APS	0(D)	445	095	
10D114	125/250V DC FUSE BOX	APS	0(D)	445	095	
10D115	125/250V DC FUSE BOX	APS	0(D)	338	089	
10D116	UNIT CROSS TIE FUSE BOX	APS	0(D)	445	095	
10D201	250V DC MCC	EPS	A	304W	044W	
10D202	250V DC MCC	EPS	B	304E	044E	
10D203	250V DC MCC	EPS	B	304E	044E	
10P203	RCIC PUMP	RCIC	N/A	108	033	1-RCIC

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
10P204	HPCI PUMP	HPCI	N/A	109	034	1-HPCI
10P213	HPCI TURBINE AUXILIARY OIL PUMP	HPCI	B	109	034	1-HPCI
10TB-HPCIEGM*	HPCI TURBINE FLOW CONTROL	HPCI	B	200	042	
10TB-RCICEGM*	RCIC TURBINE FLOW CONTROL	RCIC	A	108	033	
10X106	TRANSFORMER	EPS	A	435	013	
10X107	TRANSFORMER	EPS	B	433	015	
10X108	TRANSFORMER	EPS	C	434	012	
10X109	TRANSFORMER	EPS	D	432	014	
10X110	TRANSFORMER	EPS	0(A)	438	088	
10X182	TRANSFORMER	EPS	C	619	027	
10X183	TRANSFORMER	EPS	D	619	027	
10X201	TRANSFORMER	EPS	A	602W	048W	
10X202	TRANSFORMER	EPS	B	602E	048E	
10X203	TRANSFORMER	EPS	C	402W	045W	
10X204	TRANSFORMER	EPS	D	506E	047E	
10X281	TRANSFORMER	EPS	A	619	027	
10Y101	120V AC INST PANEL	EPS	A	435	013	
10Y102	120V AC INST PANEL	EPS	B	433	015	
10Y103	120V AC INST PANEL	EPS	C	434	012	
10Y104	120V AC INST PANEL	EPS	D	432	014	
10Y105	120V AC INST PANEL	EPS	0(A)	438	088	
10Y163	120V AC DIST PANEL	EPS	C	619	027	
10Y164	120V AC DIST PANEL	EPS	D	619	027	
10Y206	120V AC DIST PANEL	EPS	A	619	027	
1A1D101	125V BATTERY	EPS	A	436	009	
1A1D103	BATTERY CHARGER	EPS	A	436	009	
1A1K513	1A1 DG STARTING AIR COMPRESSOR	SDG	A	311A	079	
1A1T558	A DG STARTING AIR RESERVOIR A1	SDG	N/A	311A	079	
1A2D101	125V BATTERY	EPS	A	436	009	
1A2D103	BATTERY CHARGER	EPS	A	436	009	
1A2T558	A DG STARTING AIR RESERVOIR A2	SDG	N/A	311A	079	
1AD102	125V DC DIST PANEL	EPS	A	435	013	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
1AD105	125/250V DC BUS FUSE BOX	EPS	A	436	009	
1AD162	125V DC DIST PANEL	EPS	A	435	013	
1AD501	125V DC POWER DIST PANEL	EPS	A	311A	079	
1AE205	1A RHR HEAT EXCHANGER	RHR	N/A	203	032	1-RHRASC-C 1-RHRSPC-C 1-RHRSPC-A 1-RHRSC-C 1-RHRLPCI-A 1-RHRASC-A 1-RHRSC-A
1AG501	DIESEL GENERATOR "A"	SDG	A	311A	079	
1AP202	RHR PUMP "A"	RHR	A	102	032	1-RHRASC-A 1-RHRSPC-A 1-RHRSC-A 1-RHRLPCI-A
1AP514	DIESEL OIL TRANSFER PUMP	SDG	A	YARD	YARD	
1AS252-1	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304W	044W	1-RHRASC-A 1-RHRASC-B
1AS252-2	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304W	044W	1-RHRASC-A 1-RHRASC-B
1AS252-3	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304W	044W	1-RHRASC-A 1-RHRASC-B
1AT003	MSRV ACCUMULATOR	MSRV	N/A	400	030	
1AV208	RCIC COMPARTMENT UNIT COOLER	REV	A	108	033	1-RCIC
1AV209	HPCI COMPARTMENT UNIT COOLER	REV	B	109	034	1-HPCI
1AV210	RHR COMPARTMENT UNIT COOLER	REV	A	102	032	1-RHRASC-A 1-RHRLPCI-A 1-RHRSC-A 1-RHRSPC-A
1AV512	CELL "A" AIR EXHAUST FAN	DGEV	A	311A	079	
1B1D101	125V BATTERY	EPS	B	425	008	
1B1D103	BATTERY CHARGER	EPS	B	425	008	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
1B1K513	1B1 DG STARTING AIR COMPRESSOR	SDG	B	311B	081	
1B1T558	B DG STARTING AIR RESERVOIR B1	SDG	N/A	311B	081	
1B2D101	125V BATTERY	EPS	B	425	008	
1B2D103	BATTERY CHARGER	EPS	B	425	008	
1B2T558	B DG STARTING AIR RESERVOIR B2	SDG	N/A	311B	081	
1BD102	125V DC DIST PANEL	EPS	B	452	020	
1BD105	125/250V DC BUS FUSE BOX	EPS	B	425	008	
1BD501	125V DC POWER DIST PANEL	EPS	B	311B	081	
1BE205	1B RHR HEAT EXCHANGER	RHR	N/A	204	031	1-RHRASC-D 1-RHRSPC-D 1-RHRSPC-B 1-RHRSC-D 1-RHRLPCI-B 1-RHRASC-B 1-RHRSC-B
1BG501	DIESEL GENERATOR "B"	SDG	B	311B	081	
1BP202	RHR PUMP "B"	RHR	B	103	031	1-RHRSC-B 1-RHRLPCI-B 1-RHRASC-B 1-RHRSPC-B
1BP514	DIESEL OIL TRANSFER PUMP	SDG	B	YARD	YARD	
1BS252-1	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304E	044E	1-RHRASC-A 1-RHRASC-B
1BS252-2	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304E	044E	1-RHRASC-A 1-RHRASC-B
1BS252-3	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	304E	044E	1-RHRASC-A 1-RHRASC-B
1BV208	RCIC COMPARTMENT UNIT COOLER	REV	A	108	033	1-RCIC
1BV209	HPCI COMPARTMENT UNIT COOLER	REV	B	109	034	1-HPCI

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
1BV210	RHR COMPARTMENT UNIT COOLER	REV	B	103	031	1-RHRASC-B 1-RHRLPCI-B 1-RHRSC-B 1-RHRSPC-B
1BV512	CELL "B" AIR EXHAUST FAN	DGEV	B	311B	081	
1C1K513	1C1 DG STARTING AIR COMPRESSOR	SDG	C	311C	080	
1C1T558	C DG STARTING AIR RESERVOIR C1	SDG	N/A	311C	080	
1C2T558	C DG STARTING AIR RESERVOIR C2	SDG	N/A	311C	080	
1CD101	125V BATTERY	EPS	C	324	004	
1CD102	125V DC DIST PANEL	EPS	C	434	012	
1CD103	BATTERY CHARGER	EPS	C	324	004	
1CD105	125V DC BUS FUSE BOX	EPS	C	324	004	
1CD108	125V DC POWER DIST PANEL	APS	0(D)	338	089	
1CD501	125V DC POWER DIST PANEL	EPS	C	311C	080	
1CG501	DIESEL GENERATOR "C"	SDG	C	311C	080	
1CP202	RHR PUMP "C"	RHR	C	102	032	1-RHRSC-C 1-RHRSPC-C 1-RHRLPCI-C 1-RHRASC-C
1CP514	DIESEL OIL TRANSFER PUMP	SDG	C	YARD	YARD	
1CT003	MSRV ACCUMULATOR	MSRV	N/A	400	030	
1CV210	RHR COMPARTMENT UNIT COOLER "C"	REV	C	102	032	1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C 1-RHRSPC-C
1CV512	CELL "C" AIR EXHAUST FAN	DGEV	C	311C	080	
1D1T558	D DG STARTING AIR RESERVOIR D1	SDG	N/A	311D	082	
1D2T558	D DG STARTING AIR RESERVOIR D2	SDG	N/A	311D	082	
1DD101	125V BATTERY	EPS	D	323	003	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
1DD102	125V DC DIST PANEL	EPS	D	452	020	
1DD103	BATTERY CHARGER	EPS	D	323	003	
1DD105	125V DC BUS FUSE BOX	EPS	D	323	003	
1DD501	125V DC POWER DIST PANEL	EPS	D	311D	082	
1DG501	DIESEL GENERATOR "D"	SDG	D	311D	082	
1DP202	RHR PUMP "D"	RHR	D	103	031	1-RHRASC-D 1-RHRLPCI-D 1-RHRSC-D 1-RHRSPC-D
1DP514	DIESEL OIL TRANSFER PUMP	SDG	D	YARD	YARD	
1DV210	RHR COMPARTMENT UNIT COOLER "D"	REV	D	103	031	1-RHRSPC-D 1-RHRASC-D 1-RHRLPCI-D 1-RHRSC-D
1DV512	CELL "D" AIR EXHAUST FAN	DGEV	D	311D	082	
1ET003	MSRV ACCUMULATOR	ADS	N/A	400	030	
1EV210	RHR COMPARTMENT UNIT COOLER	REV	A	102	032	1-RHRASC-A 1-RHRLPCI-A 1-RHRSC-A 1-RHRSPC-A
1EV512	CELL "A" AIR EXHAUST FAN	DGEV	A	311A	079	
1FV210	RHR COMPARTMENT UNIT COOLER	REV	B	103	031	1-RHRASC-B 1-RHRSPC-B 1-RHRLPCI-B 1-RHRSC-B
1FV512	CELL "B" AIR EXHAUST FAN	DGEV	B	311B	081	
1GV210	RHR COMPARTMENT UNIT COOLER	REV	C	102	032	1-RHRSPC-C 1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C
1GV512	CELL "C" AIR EXHAUST FAN	DGEV	C	311C	080	
1HT003	MSRV ACCUMULATOR	ADS	N/A	400	030	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
1HV512	CELL "D" AIR EXHAUST FAN	DGEV	D	311D	082	
1KT003	MSRV ACCUMULATOR	ADS	N/A	400	030	
1MT003	MSRV ACCUMULATOR	ADS	N/A	400	030	
1NT003	MSRV ACCUMULATOR	MSRV	N/A	400	030	
1ST003	MSRV ACCUMULATOR	ADS	N/A	400	030	
201D112	201 NON-SAFEGUARD BATTERY	APS	0(D)	460	109	
201D113	BATTERY CHARGER	APS	0(D)	461	108	
202D112	202 NON-SAFEGUARD BATTERY	APS	0(D)	460	109	
202D113	BATTERY CHARGER	APS	0(D)	461	108	
205WHIT*	205 WHITPAIN SUBSTATION BREAKER	APS	0	YARD	YARD	
20A103	20 STATION AUX BUS 13.2 KV	APS	0	336	002	
20A115	D21 SAFEGUARD SWITCHGEAR	EPS	A	429	019	
20A116	D22 SAFEGUARD SWITCHGEAR	EPS	B	431	017	
20A117	D23 SAFEGUARD SWITCHGEAR	EPS	C	428	018	
20A118	D24 SAFEGUARD SWITCHGEAR	EPS	D	430	016	
20A121	CABLE BUS	APS	0	336 346 354 357A YARD	002 107 107 107 YARD	
20B129	480V MCC	EPS	A	564	111	
20B201	480V SAFEGUARD LOAD CTR	EPS	A	638W	071W	
20B202	480V SAFEGUARD LOAD CTR	EPS	B	638E	071E	
20B203	480V SAFEGUARD LOAD CTR	EPS	C	475W	068W	
20B204	480V SAFEGUARD LOAD CTR	EPS	D	580W	070W	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
20B211	480V MCC	EPS	A	370W	067W	
20B212	480V MCC	EPS	B	370E	067E	
20B213	480V MCC	EPS	A	580W	070W	
20B214	480V MCC	EPS	B	580E	070E	
20B215	480V MCC	EPS	A	370W	067W	
20B216	480V MCC	EPS	B	370E	067E	
20B217	480V MCC	EPS	C	284	064	
20B218	480V MCC	EPS	D	279	065	
20B223	480V MCC	EPS	C	475W	068W	
20B224	480V MCC	EPS	D	475E	068E	
20B515	480V MCC	EPS	A	315A	083	
20B516	480V MCC	EPS	B	315B	085	
20B517	480V MCC	EPS	C	315C	084	
20B518	480V MCC	EPS	D	315D	086	
20D106	125/250V DC GROUND DETECTION CABINET	APS	0(D)	463	108	
20D114	125/250V DC FUSE BOX	APS	0(D)	461	108	
20D115	125/250V DC FUSE BOX	APS	0(D)	351	102	
20D201	250V DC MCC	EPS	A	370W	067W	
20D202	250V DC MCC	EPS	B	370E	067E	
20D203	250V DC MCC	EPS	B	370E	067E	
20P203	RCIC PUMP	RCIC	N/A	179	056	2-RCIC
20P204	HPCI PUMP	HPCI	N/A	180	057	2-HPCI
20P213	HPCI TURBINE AUXILIARY OIL PUMP	HPCI	B	180	057	2-HPCI
20TB-HPCIEGM*	HPCI TURBINE FLOW CONTROL	HPCI	B	279	065	
20TB-RCICEGM*	RCIC TURBINE FLOW CONTROL	RCIC	A	179	056	
20X106	TRANSFORMER	EPS	A	429	019	
20X107	TRANSFORMER	EPS	B	431	017	
20X108	TRANSFORMER	EPS	C	428	018	
20X109	TRANSFORMER	EPS	D	430	016	
20X110	TRANSFORMER	EPS	0(A)	464	101	
20X201	TRANSFORMER	EPS	A	638W	071W	
20X202	TRANSFORMER	EPS	B	638E	071E	
20X203	TRANSFORMER	EPS	C	475W	068W	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
20X204	TRANSFORMER	EPS	D	580W	070W	
20X281	TRANSFORMER	EPS	A	625	028	
20X282	TRANSFORMER	EPS	B	619	027	
20X283	TRANSFORMER	EPS	C	625	028	
20X284	TRANSFORMER	EPS	D	619	027	
20Y101	120V AC INST PANEL	EPS	A	429	019	
20Y102	120V AC INST PANEL	EPS	B	431	017	
20Y103	120V AC INST PANEL	EPS	C	428	018	
20Y104	120V AC INST PANEL	EPS	D	430	016	
20Y105	120V AC INST PANEL	EPS	0(A)	464	101	
20Y163	120V AC DIST PANEL	EPS	C	625	028	
20Y164	120V AC DIST PANEL	EPS	D	619	027	
20Y206	120V AC DIST PANEL	EPS	A	625	028	
20Y207	120V AC DIST PANEL	EPS	B	619	027	
2A1D101	125V BATTERY	EPS	A	427	011	
2A1D103	BATTERY CHARGER	EPS	A	427	011	
2A1K513	2A1 DG STARTING AIR COMPRESSOR	SDG	A	315A	083	
2A1T558	A DG STARTING AIR RESERVOIR A1	SDG	N/A	315A	083	
2A2D101	125V BATTERY	EPS	A	427	011	
2A2D103	BATTERY CHARGER	EPS	A	427	011	
2A2T558	A DG STARTING AIR RESERVOIR A2	SDG	N/A	315A	083	
2AD102	125V DC DIST PANEL	EPS	A	429	019	
2AD105	125/250V DC BUS FUSE BOX	EPS	A	427	011	
2AD501	125V DC POWER DIST PANEL	EPS	A	315A	083	
2AE205	2A RHR HEAT EXCHANGER	RHR	N/A	280	054	2-RHRSC-A 2-RHRSPC-C 2-RHRSC-C 2-RHRLPCI-A 2-RHRASC-C 2-RHRASC-A 2-RHRSPC-A
2AG501	DIESEL GENERATOR "A"	SDG	A	315A	083	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
2AP202	RHR PUMP "A"	RHR	A	173	054	2-RHRSPC-A 2-RHRASC-A 2-RHRLPCI-A 2-RHRSC-A
2AP514	DIESEL OIL TRANSFER PUMP	SDG	A	YARD	YARD	
2AS252-1	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2AS252-2	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2AS252-3	A PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2AT003	MSRV ACCUMULATOR	MSRV	N/A	473	053	
2AV208	RCIC COMPARTMENT UNIT COOLER	REV	A	179	056	2-RCIC
2AV209	HPCI COMPARTMENT UNIT COOLER	REV	B	180	057	2-HPCI
2AV210	RHR COMPARTMENT UNIT COOLER	REV	A	173	054	2-RHRASC-A 2-RHRLPCI-A 2-RHRSC-A 2-RHRSPC-A
2AV512	CELL "A" AIR EXHAUST FAN	DGEV	A	315A	083	
2B1D101	125V BATTERY	EPS	B	426	010	
2B1D103	BATTERY CHARGER	EPS	B	426	010	
2B1K513	2B1 DG STARTING AIR COMPRESSOR	SDG	B	315B	085	
2B1T558	B DG STARTING AIR RESERVOIR B1	SDG	N/A	315B	085	
2B2D101	125V BATTERY	EPS	B	426	010	
2B2D103	BATTERY CHARGER	EPS	B	426	010	
2B2T558	B DG STARTING AIR RESERVOIR B2	SDG	N/A	315B	085	
2BD102	125V DC DIST	EPS PANEL	B	453	021	
2BD105	125/250V DC BUS FUSE BOX	EPS	B	426	010	
2BD501	125V DC POWER DIST PANEL	EPS	B	315B	085	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
2BE205	2B RHR HEAT EXCHANGER	RHR	N/A	281	055	2-RHRSC-B 2-RHRSPC-D 2-RHRSC-D 2-RHRLPCI-B 2-RHRASC-D 2-RHRASC-B 2-RHRSPC-B
2BG501	DIESEL GENERATOR "B"	SDG	B	315B	085	
2BP202	RHR PUMP "B"	RHR	B	174	055	2-RHRSPC-B 2-RHRASC-B 2-RHRLPCI-B 2-RHRSC-B
2BP514	DIESEL OIL TRANSFER PUMP	SDG	B	YARD	YARD	
2BS252-1	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2BS252-2	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2BS252-3	B PCIG/ADS LONG TERM NITROGEN BOTTLE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B
2BV208	RCIC COMPARTMENT UNIT COOLER	REV	A	179	056	2-RCIC
2BV209	HPCI COMPARTMENT UNIT COOLER	REV	B	180	057	2-HPCI
2BV210	RHR COMPARTMENT UNIT COOLER	REV	B	174	055	2-RHRLPCI-B 2-RHRSC-B 2-RHRASC-B 2-RHRSPC-B
2BV512	CELL "B" AIR EXHAUST FAN	DGEV	B	315B	085	
2C1T558	C DG STARTING AIR RESERVOIR C1	SDG	N/A	315C	084	
2C2T558	C DG STARTING AIR RESERVOIR C2	SDG	N/A	315C	084	
2CD101	125V BATTERY	EPS	C	361	006	
2CD102	125V DC DIST PANEL	EPS	C	428	018	
2CD103	BATTERY CHARGER	EPS	C	361	006	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
2CD105	125V DC BUS FUSE BOX	EPS	C	361	006	
2CD108	125V DC POWER DIST PANEL	APS	0(D)	351	102	
2CD162	125V DC DIST PANEL	EPS	C	428	018	
2CD501	125V DC POWER DIST PANEL	EPS	C	315C	084	
2CG501	DIESEL GENERATOR "C"	SDG	C	315C	084	
2CP202	RHR PUMP "C"	RHR	C	173	054	2-RHRASC-C 2-RHRLPCI-C 2-RHRSC-C 2-RHRSPC-C
2CP514	DIESEL OIL TRANSFER PUMP	SDG	C	YARD	YARD	
2CT003	MSRV ACCUMULATOR	MSRV	N/A	473	053	
2CV210	RHR COMPARTMENT UNIT COOLER "C"	REV	C	173	054	2-RHRLPCI-C 2-RHRSC-C 2-RHRSPC-C 2-RHRASC-C
2CV512	CELL "C" AIR EXHAUST FAN	DGEV	C	315C	084	
2D1T558	D DG STARTING AIR RESERVOIR D1	SDG	N/A	315D	086	
2D2T558	D DG STARTING AIR RESERVOIR D2	SDG	N/A	315D	086	
2DD101	125V BATTERY	EPS	D	360	005	
2DD102	125V DC DIST PANEL	EPS	D	453	021	
2DD103	BATTERY CHARGER	EPS	D	360	005	
2DD105	125V DC BUS FUSE BOX	EPS	D	360	005	
2DD501	125V DC POWER DIST PANEL	EPS	D	315D	086	
2DG501	DIESEL GENERATOR "D"	SDG	D	315D	086	
2DP202	RHR PUMP "D"	RHR	D	174	055	2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D
2DP514	DIESEL OIL TRANSFER PUMP	SDG	D	YARD	YARD	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
2DV210	RHR COMPARTMENT UNIT COOLER "D"	REV	D	174	055	2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D
2DV512	CELL "D" AIR EXHAUST FAN	DGEV	D	315D	086	
2ET003	MSRV ACCUMULATOR	ADS	N/A	473	053	
2EV210	RHR COMPARTMENT UNIT COOLER	REV	A	173	054	2-RHRLPCI-A 2-RHRSC-A 2-RHRSPC-A 2-RHRASC-A
2EV512	CELL "A" AIR EXHAUST FAN	DGEV	A	315A	083	
2FV210	RHR COMPARTMENT UNIT COOLER	REV	B	174	055	2-RHRASC-B 2-RHRLPCI-B 2-RHRSC-B 2-RHRSPC-B
2FV512	CELL "B" AIR EXHAUST FAN	DGEV	B	315B	085	
2GV210	RHR COMPARTMENT UNIT COOLER	REV	C	173	054	2-RHRSPC-C 2-RHRASC-C 2-RHRLPCI-C 2-RHRSC-C
2GV512	CELL "C" AIR EXHAUST FAN	DGEV	C	315C	084	
2HT003	MSRV ACCUMULATOR	ADS	N/A	473	053	
2HV210	RHR COMPARTMENT UNIT COOLER	REV	D	174	055	2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D
2HV512	CELL "D" AIR EXHAUST FAN	DGEV	D	315D	086	
2KT003	MSRV ACCUMULATOR	ADS	N/A	473	053	
2MT003	MSRV ACCUMULATOR	ADS	N/A	473	053	
2NT003	MSRV ACCUMULATOR	MSRV	N/A	473	053	
2ST003	MSRV ACCUMULATOR	ADS	N/A	473	053	
51-1F067A	RHR PUMP SHUTDOWN COOLING SUCTION VALVE	RHR	N/A	203	032	1-RHRSC-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
51-1F067B	RHR PUMP SHUTDOWN COOLING SUCTION VALVE	RHR	N/A	204	031	1-RHRSC-D
51-2F067A	RHR PUMP SHUTDOWN COOLING SUCTION VALVE	RHR	N/A	280	054	2-RHRSC-C
51-2F067B	RHR PUMP SHUTDOWN COOLING SUCTION VALVE	RHR	N/A	281	055	2-RHRSC-D
FC-55-1R600	FLOW CONTROLLER	HPCI	B	533	024	
FC-55-2R600	FLOW CONTROLLER	HPCI	B	533	024	
FI-11-013A	ESW LOOP A SUPPLY	ESW	A	533	024	0-ESW-A
FI-11-013B	ESW LOOP B SUPPLY	ESW	B	533	024	0-ESW-B
FI-49-1R001-1	PUMP DISCHARGE LINE FLOW INDICATOR	RCIC	A	540	026	1-RCIC
FI-49-1R600-1	PUMP DISCHARGE LINE FLOW INDICATOR	RCIC	A	533	024	1-RCIC
FI-49-2R001-1	PUMP DISCHARGE LINE FLOW INDICATOR	RCIC	A	540	026	2-RCIC
FI-49-2R600-1	PUMP DISCHARGE LINE FLOW INDICATOR	RCIC	A	533	024	2-RCIC
FI-51-1R005	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	A	540	026	1-RHRSC-A 1-RHRSPC-A
FI-51-1R602A	RHR HEAT EXCHANGER "A" SHELL SIDE INLET FLOW INDICATOR	RHRSW	A	533	024	1-RHRSW-A
FI-51-1R602B	RHR HEAT EXCHANGER "B" SHELL SIDE INLET FLOW INDICATOR	RHRSW	B	533	024	1-RHRSW-B
FI-51-1R603A	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	A	533	024	1-RHRSC-C 1-RHRSPC-C 1-RHRSPC-A 1-RHRLPCI-A 1-RHRASC-C 1-RHRASC-A 1-RHRSC-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
FI-51-1R603B	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	B	533	024	1-RHRSC-B 1-RHRSPC-D 1-RHRSC-D 1-RHRLPCI-B 1-RHRASC-D 1-RHRASC-B 1-RHRSPC-B
FI-51-1R603C	LOOP "C" DISCHARGE LINE FLOW INDICATOR	RHR	C	533	024	1-RHRLPCI-C
FI-51-1R603D	LOOP "D" DISCHARGE LINE FLOW INDICATOR	RHR	D	533	024	1-RHRLPCI-D
FI-51-2R005	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	A	540	026	2-RHRSC-A 2-RHRSPC-A
FI-51-2R602A	RHR HEAT EXCHANGER "A" SHELL SIDE INLET FLOW INDICATOR	RHRSW	A	533	024	2-RHRSW-A
FI-51-2R602B	RHR HEAT EXCHANGER "B" SHELL SIDE INLET FLOW INDICATOR	RHRSW	B	533	024	2-RHRSW-B
FI-51-2R603A	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	A	533	024	2-RHRSPC-C 2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRASC-A
FI-51-2R603B	HEAT EXCHANGER DISCHARGE LINE FLOW INDICATOR	RHR	B	533	024	2-RHRSPC-D 2-RHRSPC-B 2-RHRSC-D 2-RHRSC-B 2-RHRLPCI-B 2-RHRASC-B 2-RHRASC-D
FI-51-2R603C	LOOP "C" DISCHARGE LINE FLOW INDICATOR	RHR	C	533	024	2-RHRLPCI-C
FI-51-2R603D	LOOP "D" DISCHARGE LINE FLOW INDICATOR	RHR	D	533	024	2-RHRLPCI-D
FI-55-1R600-1	PUMP DISCHARGE LINE FLOW INDICATOR	HPCI	B	533	024	1-HPCI
FI-55-2R600-1	PUMP DISCHARGE LINE FLOW INDICATOR	HPCI	B	533	024	2-HPCI

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
FIC-49-1R001	FLOW INDICATING CONTROLLER	RCIC	A	540	026	
FIC-49-1R600	FLOW INDICATING CONTROLLER	RCIC	A	533	024	
FIC-49-2R001	FLOW INDICATING CONTROLLER	RCIC	A	540	026	
FIC-49-2R600	FLOW INDICATING CONTROLLER	RCIC	A	533	024	
FIS-49-1N651	FLOW INDICATING SWITCH	RCIC	A	542	025	
FIS-49-2N651	FLOW INDICATING SWITCH	RCIC	A	542	025	
FIS-55-1N651	PUMP DISCHARGE LINE FLOW INDICATING SWITCH	HPCI	B	542	025	
FIS-55-2N651	PUMP DISCHARGE LINE FLOW INDICATING SWITCH	HPCI	B	542	025	
FISL-51-1N652A	FLOW INDICATING SWITCH	RHR	A	542	025	
FISL-51-1N652B	FLOW INDICATING SWITCH	RHR	B	542	025	
FISL-51-1N652C	FLOW INDICATING SWITCH	RHR	C	542	025	
FISL-51-1N652D	FLOW INDICATING SWITCH	RHR	D	542	025	
FISL-51-2N652A	FLOW INDICATING SWITCH	RHR	A	542	025	
FISL-51-2N652B	FLOW INDICATING SWITCH	RHR	B	542	025	
FISL-51-2N652C	FLOW INDICATING SWITCH	RHR	C	542	025	
FISL-51-2N652D	FLOW INDICATING SWITCH	RHR	D	542	025	
FS-49-1N659	FLOW SWITCH	RCIC	A	542	025	
FS-49-2N659	FLOW SWITCH	RCIC	A	542	025	
FS-55-1N659	FLOW SWITCH	HPCI	B	542	025	
FS-55-2N659	FLOW SWITCH	HPCI	B	542	025	
FT-49-2N051	FLOW TRANSMITTER	RCIC	A	279	065	
FT-51-1N001	FLOW TRANSMITTER	RHR	A	304W	044W	
FT-51-1N007A	FLOW TRANSMITTER	RHRSW	A	200	042	
FT-51-1N007B	FLOW TRANSMITTER	RHRSW	B	207	041	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
FT-51-1N015A	FLOW TRANSMITTER	RHR	A	304W	044W	
FT-51-1N015B	FLOW TRANSMITTER	RHR	B	304E	044E	
FT-51-1N015C	FLOW TRANSMITTER	RHR	C	304W	044W	
FT-51-1N015D	FLOW TRANSMITTER	RHR	D	304E	044E	
FT-51-1N052A	FLOW TRANSMITTER	RHR	A	304W	044W	
FT-51-1N052B	FLOW TRANSMITTER	RHR	B	304E	044E	
FT-51-1N052C	FLOW TRANSMITTER	RHR	C	304W	044W	
FT-51-1N052D	FLOW TRANSMITTER	RHR	D	304E	044E	
FT-51-2N001	FLOW TRANSMITTER	RHR	A	370W	067W	
FT-51-2N007A	FLOW TRANSMITTER	RHRSW	A	189	062	
FT-51-2N007B	FLOW TRANSMITTER	RHRSW	B	279	065	
FT-51-2N015A	FLOW TRANSMITTER	RHR	A	370W	067W	
FT-51-2N015B	FLOW TRANSMITTER	RHR	B	370E	067E	
FT-51-2N015C	FLOW TRANSMITTER	RHR	C	370W	067W	
FT-51-2N015D	FLOW TRANSMITTER	RHR	D	370E	067E	
FT-51-2N052A	FLOW TRANSMITTER	RHR	A	370W	067W	
FT-51-2N052B	FLOW TRANSMITTER	RHR	B	370E	067E	
FT-51-2N052C	FLOW TRANSMITTER	RHR	C	370W	067W	
FT-51-2N052D	FLOW TRANSMITTER	RHR	D	370E	067E	
FT-55-1N008	FLOW TRANSMITTER	HPCI	B	111	040	
FT-55-1N051	FLOW TRANSMITTER	HPCI	B	111	040	
FT-55-2N008	FLOW TRANSMITTER	HPCI	B	182	063	
FT-55-2N051	FLOW TRANSMITTER	HPCI	B	182	063	
FV-50-113	TURBINE CONTROL VALVE	RCIC	N/A	108	033	1-RCIC
FV-50-213	TURBINE CONTROL VALVE	RCIC	N/A	179	056	2-RCIC
FV-56-111	TURBINE CONTROL VALVE	HPCI	N/A	109	034	1-HPCI
FV-56-112	TURBINE STOP VALVE	HPCI	B	109	034	1-HPCI
FV-56-112	TURBINE STOP VALVE	HPCI	B	109	034	1-HPCITRIP
FV-56-211	TURBINE CONTROL VALVE	HPCI	N/A	180	057	2-HPCI
FV-56-212	TURBINE STOP VALVE	HPCI	B	180	057	2-HPCI
FV-56-212	TURBINE STOP VALVE	HPCI	B	180	057	2-HPCITRIP
FY-11-013A	ESW LOOP A SUPPLY	ESW	A	533	024	
FY-11-013B	ESW LOOP B SUPPLY	ESW	B	533	024	
FY-11-060B	ESW LOOP B SUPPLY	ESW	B	533	024	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
FY-49-1K001	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-1K013	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-1K014	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-1K015	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-1K601	SIGNAL ISOLATOR - FLOW	RCIC	A	533	024	
FY-49-2K001	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-2K013	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-2K014	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-2K015	SIGNAL ISOLATOR - FLOW	RCIC	A	540	026	
FY-49-2K601	SIGNAL ISOLATOR - FLOW	RCIC	A	533	024	
FY-51-114A	SQUARE ROOT CONVERTER	RHRSW	A	542	025	
FY-51-114B	SQUARE ROOT CONVERTER	RHRSW	B	542	025	
FY-51-1K600A	SQUARE ROOT CONVERTER	RHR	A	542	025	
FY-51-1K600B	SQUARE ROOT CONVERTER	RHR	B	542	025	
FY-51-1K600C	SQUARE ROOT CONVERTER	RHR	C	542	025	
FY-51-1K600D	SQUARE ROOT CONVERTER	RHR	D	542	025	
FY-51-1K011	SQUARE ROOT CONVERTER-RHR LOOP A FLOW	RHR	A	540	026	
FY-51-214A	SQUARE ROOT CONVERTER	RHRSW	A	542	025	
FY-51-214B	SQUARE ROOT CONVERTER	RHRSW	B	542	025	
FY-51-2K600A	SQUARE ROOT CONVERTER	RHR	A	542	025	
FY-51-2K600B	SQUARE ROOT CONVERTER	RHR	B	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
FY-51-2K600C	SQUARE ROOT CONVERTER	RHR	C	542	025	
FY-51-2K600D	SQUARE ROOT CONVERTER	RHR	D	542	025	
FY-55-1K601	SQUARE ROOT CONVERTER	HPCI	B	533	024	
FY-55-2K601	SQUARE ROOT CONVERTER	HPCI	B	533	024	
HD-81-041A	SYSTEM "A" OUTSIDE AIR INLET DAMPER	SPPV	A	1000	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HD-81-041B	SYSTEM "B" OUTSIDE AIR INLET DAMPER	SPPV	B	1005	123	2-RHRSW-B 1-RHRSW-B 0-ESW-B
HD-81-041C	SYSTEM "C" OUTSIDE AIR INLET DAMPER	SPPV	C	1000	122	1-RHRSW-A 2-RHRSW-A 0-ESW-A
HD-81-041D	SYSTEM "D" OUTSIDE AIR INLET DAMPER	SPPV	D	1005	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HD-81-042A	SYSTEM "A" RECIRCULATION AIR DAMPER	SPPV	A	1000	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HD-81-042B	SYSTEM "B" RECIRCULATION AIR DAMPER	SPPV	B	1005	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HD-81-042C	SYSTEM "C" RECIRCULATION AIR DAMPER	SPPV	C	1000	122	0-ESW-A 2-RHRSW-A 1-RHRSW-A
HD-81-042D	SYSTEM "D" RECIRCULATION AIR DAMPER	SPPV	D	1005	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HV-11-011A	LOOP "A" DISCHARGE VALVE TO RHRSW RETURN HEADERS	ESW	A	202	075	0-ESW-A 0-ESW-R
HV-11-011B	LOOP "B" DISCHARGE VALVE TO RHRSW RETURN HEADERS	ESW	B	202	075	0-ESW-B
HV-11-015A	LOOP "A" DISCHARGE VALVE TO RHRSW RETURN HEADERS	ESW	C	202	075	0-ESW-A 0-ESW-R

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-015B	LOOP "B" DISCHARGE VALVE TO RHRSW RETURN HEADERS	ESW	D	202	075	0-ESW-B
HV-11-041	LOOP "A" EQUIPMENT HEADER RETURN VALVE	ESW	A	203	032	0-ESW-A 0-ESW-R
HV-11-042	HPCI COMPARTMENT UNIT COOLER RETURN VALVE	HPCI	B	109	034	1-HPCI
HV-11-043	SERVICE WATER INTERTIE VALVE FOR HPCI UNIT COOLER	ESW	B	109	034	0-ESW-B
HV-11-044	LOOP "B" EQUIPMENT HEADER RETURN VALVE	ESW	B	207	041	0-ESW-B
HV-11-046	LOOP "A" EQUIPMENT HEADER RETURN VALVE	ESW	A	281	055	0-ESW-R 0-ESW-A
HV-11-047	LOOP "B" EQUIPMENT HEADER RETURN VALVE	ESW	B	281	055	0-ESW-B
HV-11-048	SERVICE WATER INTERTIE VALVE FOR RCIC UNIT COOLER	ESW	A	279	065	0-ESW-A 0-ESW-R
HV-11-049	RCIC COMPARTMENT UNIT COOLER RETURN VALVE	RCIC	A	279	065	2-RCIC 0-ESW-R
HV-11-051A	SERVICE WATER INTERTIE VALVE FOR CONTROL STRUCTURE CHILLER	ESW		258	001	0-ESW-A 0-ESW-R
HV-11-051B	SERVICE WATER INTERTIE VALVE FOR CONTROL STRUCTURE CHILLER	ESW		263	001	0-ESW-B
HV-11-055A	SERVICE WATER INTERTIE FOR CONTROL STRUCTURE CHILLER	ESW		258	001	0-ESW-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-055B	SERVICE WATER INTERTIE VALVE FOR CONTROL STRUCTURE CHILLER	ESW		263	001	0-ESW-B
HV-11-071	LOOP "A" EQUIPMENT HEADER RETURN VALVE	ESW	C	203	032	0-ESW-A
HV-11-072	HPCI COMPARTMENT UNIT COOLER RETURN VALVE	HPCI	D	109	034	1-HPCI
HV-11-073	SERVICE WATER INTERTIE FOR HPCI UNIT COOLER	ESW	D	109	034	0-ESW-B
HV-11-074	LOOP "B" EQUIPMENT HEADER RETURN VALVE	ESW	D	207	041	0-ESW-B
HV-11-076	LOOP "A" EQUIPMENT HEADER RETURN VALVE	ESW	C	284	064	0-ESW-A
HV-11-077	LOOP "B" EQUIPMENT HEADER RETURN VALVE	ESW	D	281	055	0-ESW-B
HV-11-078	SERVICE WATER INTERTIE VALVE FOR RCIC UNIT COOLER	ESW	C	279	065	0-ESW-A
HV-11-079	RCIC COMPARTMENT UNIT COOLER RETURN VALVE	RCIC	C	279	065	2-RCIC
HV-11-103A	HPCI COMPARTMENT UNIT COOLER INLET VALVE	ESW	B	109	034	1-HPCI
HV-11-103B	HPCI COMPARTMENT UNIT COOLER INLET VALVE	ESW	B	109	034	1-HPCI
HV-11-104A	RHR COMPARTMENT UNIT COOLER "A" INLET VALVE	ESW	A	102	032	1-RHRLPCI-A 1-RHRSC-A 1-RHRASC-A 1-RHRSPC-A
HV-11-104B	RHR COMPARTMENT UNIT COOLER "B" INLET VALVE	ESW	B	103	031	1-RHRASC-B 1-RHRLPCI-B 1-RHRSC-B 1-RHRSPC-B
HV-11-104C	RHR COMPARTMENT UNIT COOLER "C" INLET VALVE	ESW	C	102	032	1-RHRASC-C 1-RHRSPC-C 1-RHRSC-C 1-RHRLPCI-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-104D	RHR COMPARTMENT UNIT COOLER "D" INLET VALVE	ESW	D	103	031	1-RHRASC-D 1-RHRLPCI-D 1-RHRSC-D 1-RHRSPC-D
HV-11-104E	RHR COMPARTMENT UNIT COOLER "E" INLET VALVE	ESW	A	102	032	1-RHRLPCI-A 1-RHRSC-A 1-RHRASC-A 1-RHRSPC-A
HV-11-104F	RHR COMPARTMENT UNIT COOLER "F" INLET VALVE	ESW	B	103	031	1-RHRASC-B 1-RHRLPCI-B 1-RHRSC-B 1-RHRSPC-B
HV-11-104G	RHR COMPARTMENT UNIT COOLER "G" INLET VALVE	ESW	C	102	032	1-RHRASC-C 1-RHRSPC-C 1-RHRLPCI-C 1-RHRSC-C
HV-11-104H	RHR COMPARTMENT UNIT COOLER "H" INLET VALVE	ESW	D	103	031	1-RHRASC-D 1-RHRLPCI-D 1-RHRSC-D 1-RHRSPC-D
HV-11-105	ESW TO TECW HX INTERTIE SHUTOFF VALVE	ESW	A	YARD	YARD	0-ESW-A 0-ESW-R
HV-11-106A	RCIC COMPARTMENT UNIT COOLER INLET VALVE	ESW	A	108	033	1-RCIC
HV-11-106B	RCIC COMPARTMENT UNIT COOLER INLET VALVE	ESW	A	108	033	1-RCIC
HV-11-107	ESW TO TECW HX INTERTIE SHUTOFF VALVE	ESW	C	YARD	YARD	0-ESW-A 0-ESW-R
HV-11-121	SERVICE WATER INTERTIE VALVE FOR LOOP "A" EQUIPMENT	ESW	A	203	032	0-ESW-R 0-ESW-A
HV-11-123	SERVICE WATER INTERTIE VALVE FOR LOOP "A" EQUIPMENT	ESW	C	203	032	0-ESW-A
HV-11-124	SHUT OFF VALVE FOR ESW TO RECW HEAT EXCHANGER INTERTIE LINE	ESW	B	207	041	0-ESW-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-125	SERVICE WATER INTERTIE VALVE FOR LOOP "B" EQUIPMENT	ESW	B	207	041	0-ESW-B
HV-11-126	SERVICE WATER INTERTIE VALVE FOR "B" LOOP EQUIPMENT	ESW	D	207	041	0-ESW-B
HV-11-128	SHUTOFF VALVE FOR ESW TO RHRSW HEAT EXCHANGER INTERTIE LINE	ESW	D	207	041	0-ESW-B
11-1131A	DIESEL GENERATOR "A" COOLING LOOP INLET VALVE	ESW	A	311A	079	
HV-11-131B	DIESEL GENERATOR "B" COOLING LOOP INLET VALVE	ESW	B	311B	081	0-ESW-A 0-ESW-R
11-1131C	DIESEL GENERATOR "C" COOLING LOOP INLET VALVE	ESW	C	311C	080	
HV-11-131D	DIESEL GENERATOR "D" COOLING LOOP INLET VALVE	ESW	D	311D	082	0-ESW-A 0-ESW-R
HV-11-132A	DIESEL GENERATOR "A" COOLING LOOP OUTLET VALVE	ESW	A	311A	079	
HV-11-132B	DIESEL GENERATOR "B" COOLING LOOP OUTLET VALVE	ESW	B	311B	081	
HV-11-132C	DIESEL GENERATOR "C" COOLING LOOP OUTLET VALVE	ESW	C	311C	080	
HV-11-132D	DIESEL GENERATOR "D" COOLING LOOP OUTLET VALVE	ESW	D	311D	082	
HV-11-133A	DIESEL GENERATOR "A" COOLING LOOP INLET VALVE	ESW	A	311A	079	0-ESW-B
11-1133B	DIESEL GENERATOR "B" COOLING LOOP INLET VALVE	ESW	B	311B	081	
HV-11-133C	DIESEL GENERATOR "C" COOLING LOOP INLET VALVE	ESW	C	311C	080	0-ESW-B
11-1133D	DIESEL GENERATOR "D" COOLING LOOP INLET VALVE	ESW	D	311D	082	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-134A	DIESEL GENERATOR "A" COOLING LOOP OUTLET VALVE	ESW	A	311A	079	
HV-11-134B	DIESEL GENERATOR "B" COOLING LOOP OUTLET VALVE	ESW	B	311B	081	
HV-11-134C	DIESEL GENERATOR "C" COOLING LOOP OUTLET VALVE	ESW	C	311C	080	
HV-11-134D	DIESEL GENERATOR "D" COOLING LOOP OUTLET VALVE	ESW	D	311D	082	
HV-11-203A	HPCI COMPARTMENT UNIT COOLER INLET VALVE	ESW	B	180	057	2-HPCI
HV-11-203B	HPCI COMPARTMENT UNIT COOLER INLET VALVE	ESW	B	180	057	2-HPCI
HV-11-204A	RHR COMPARTMENT UNIT COOLER "A" INLET VALVE	ESW	A	173	054	2-RHRASC-A 2-RHRLPCI-A 2-RHRSC-A 2-RHRSPC-A
HV-11-204B	RHR COMPARTMENT UNIT COOLER "B" INLET VALVE	ESW	B	174	055	2-RHRSC-B 2-RHRSPC-B 2-RHRASC-B 2-RHRLPCI-B
HV-11-204C	RHR COMPARTMENT UNIT COOLER "C" INLET VALVE	ESW	C	173	054	2-RHRASC-C 2-RHRLPCI-C 2-RHRSC-C 2-RHRSPC-C
HV-11-204D	RHR COMPARTMENT UNIT COOLER "D" INLET VALVE	ESW	D	174	055	2-RHRLPCI-D 2-RHRSC-D 2-RHRASC-D 2-RHRSPC-D
HV-11-204H	RHR COMPARTMENT UNIT COOLER "H" INLET VALVE	ESW	D	174	055	2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D
HV-11-205	ESW TO TECW HX INTERTIE SHUTOFF VALVE	ESW	B	YARD	YARD	0-ESW-B
HV-11-206A	RCIC COMPARTMENT UNIT COOLER INLET VALVE	ESW	A	179	056	2-RCIC

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-206B	RCIC COMPARTMENT UNIT COOLER INLET VALVE	ESW	A	179	056	2-RCIC
HV-11-207	ESW TO TECW HX INTERTIE SHUTOFF VALVE	ESW	D	YARD	YARD	0-ESW-B
HV-11-221	SERVICE WATER INTERTIE VALVE FOR LOOP "A" EQUIPMENT	ESW	A	284	064	0-ESW-A 0-ESW-R
HV-11-223	SERVICE WATER INTERTIE VALVE FOR LOOP "A" EQUIPMENT	ESW	C	284	064	0-ESW-A
HV-11-224	SHUTOFF VALVE FOR ESW TO RECW HEAT EXCHANGER INTERTIE LINE	ESW	A	284	064	0-ESW-A 0-ESW-R
HV-11-225	SERVICE WATER INTERTIE VALVE FOR LOOP "B" EQUIPMENT	ESW	B	281	055	0-ESW-B
HV-11-226	SERVICE WATER INTERTIE VALVE FOR LOOP "B" EQUIPMENT	ESW	D	281	055	0-ESW-B
HV-11-228	SHUTOFF VALVE FOR ESW TO RECW HEAT EXCHANGER INTERTIE LINE	ESW	C	284	064	0-ESW-R 0-ESW-A
11-2231A	DIESEL GENERATOR "A" COOLING LOOP INLET VALVE	ESW	A	315A	083	
HV-11-231B	DIESEL GENERATOR "B" COOLING LOOP INLET VALVE	ESW	B	315B	085	0-ESW-R 0-ESW-A
11-2231C	DIESEL GENERATOR "C" COOLING LOOP INLET VALVE	ESW	C	315C	084	
HV-11-231D	DIESEL GENERATOR "D" COOLING LOOP INLET VALVE	ESW	D	315D	086	0-ESW-A 0-ESW-R
HV-11-232A	DIESEL GENERATOR "A" COOLING LOOP OUTLET VALVE	ESW	A	315A	083	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-11-232B	DIESEL GENERATOR "B" COOLING LOOP OUTLET VALVE	ESW	B	315B	085	
HV-11-232C	DIESEL GENERATOR "C" COOLING LOOP OUTLET VALVE	ESW	C	315C	084	
HV-11-232D	DIESEL GENERATOR "D" COOLING LOOP OUTLET VALVE	ESW	D	315D	086	
HV-11-233A	DIESEL GENERATOR "A" COOLING LOOP INLET VALVE	ESW	A	315A	083	0-ESW-B
11-2233B	DIESEL GENERATOR "B" COOLING LOOP INLET VALVE	ESW	B	315B	085	
HV-11-233C	DIESEL GENERATOR "C" COOLING LOOP INLET VALVE	ESW	C	315C	084	0-ESW-B
11-2233D	DIESEL GENERATOR "D" COOLING LOOP INLET VALVE	ESW	D	315D	086	
HV-11-234A	DIESEL GENERATOR "A" COOLING LOOP OUTLET VALVE	ESW	A	315A	083	
HV-11-234B	DIESEL GENERATOR "B" COOLING LOOP OUTLET VALVE	ESW	B	315B	085	
HV-11-234C	DIESEL GENERATOR "C" COOLING LOOP OUTLET VALVE	ESW	C	315C	084	
HV-11-234D	DIESEL GENERATOR "D" COOLING LOOP OUTLET VALVE	ESW	D	315D	086	
HV-12-003A	WET PIT SLUICE GATE	RHRSW	A	1000	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-003B	WET PIT SLUICE GATE	RHRSW	B	1005	123	1-RHRSW-B 2-RHRSW-B 0-ESW-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-12-003C	WET PIT SLUICE GATE	RHRSW	C	1000	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-003D	WET PIT SLUICE GATE	RHRSW	D	1005	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HV-12-017A	LOOP "A" TO UNIT 2 COOLING TOWER CROSS-TIE VALVE	RHRSW	A	YARD	YARD	0-ESW-A 2-RHRSW-B 1-RHRSW-B 2-RHRSW-A 1-RHRSW-A 0-ESW-B 0-ESW-R
HV-12-017B	LOOP "B" TO UNIT 1 COOLING TOWER CROSS-TIE VALVE	RHRSW	B	YARD	YARD	0-ESW-A 2-RHRSW-B 1-RHRSW-B 2-RHRSW-A 0-ESW-B 1-RHRSW-A
HV-12-031A	SPRAY NETWORK BYPASS VALVE	RHRSW	A	1010	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-031B	SPRAY NETWORK BYPASS VALVE	RHRSW	B	1015	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HV-12-031C	SPRAY NETWORK BYPASS VALVE	RHRSW	C	1010	122	2-RHRSW-A 0-ESW-A 0-ESW-R 1-RHRSW-A
HV-12-031D	SPRAY NETWORK BYPASS VALVE	RHRSW	D	1015	123	2-RHRSW-B 1-RHRSW-B 0-ESW-B
HV-12-032A	SPRAY NETWORK INLET VALVE	RHRSW	A	1010	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-032B	SPRAY NETWORK INLET VALVE	RHRSW	B	1015	123	0-ESW-B 1-RHRSW-B 2-RHRSW-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-12-032C	SPRAY NETWORK INLET VALVE	RHRSW	C	1010	122	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-032D	SPRAY NETWORK INLET VALVE	RHRSW	D	1015	123	1-RHRSW-B 2-RHRSW-B 0-ESW-B
HV-12-034A	RHR SERVICE WATER SPRAY NOZZLE CROSS TIE VALVE	ESW	A	1010	122	2-RHRSW-B 0-ESW-B 0-ESW-R 1-RHRSW-A 2-RHRSW-A 1-RHRSW-B 0-ESW-A
HV-12-034B	RHR SERVICE WATER SPRAY NOZZLE CROSS TIE VALVE	ESW	B	1015	123	1-RHRSW-B 2-RHRSW-A 1-RHRSW-A 0-ESW-A 2-RHRSW-B 0-ESW-B
HV-12-111	RHRSW TO COOLING TOWER INTERTIE SHUTOFF VALVE	RHRSW	A	YARD	YARD	2-RHRSW-A 1-RHRSW-A 0-ESW-R 0-ESW-A
HV-12-113	RHRSW TO COOLING TOWER INTERTIE SHUTOFF VALVE	RHRSW	C	YARD	YARD	0-ESW-A 0-ESW-R 1-RHRSW-A 2-RHRSW-A
HV-12-211	RHRSW TO COOLING TOWER INTERTIE SHUTOFF VALVE	RHRSW	B	YARD	YARD	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HV-12-213	RHRSW TO COOLING TOWER INTERTIE SHUTOFF VALVE	RHRSW	D	YARD	YARD	0-ESW-B 1-RHRSW-B 2-RHRSW-B
HV-41-109A	REACTOR FEEDWATER BYPASS VALVE	HI/LOW	A	518	046	1-HI/LOW 1-HPCI

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-41-109B	REACTOR FEEDWATER BYPASS VALVE	HI/LOW	B	518	046	1-HI/LOW 1-RCIC
HV-41-110	RX FW STARTUP FLUSHING SHUTOFF	HI/LOW	C	407	046	1-HI/LOW
HV-41-140	BYPASS LEAKAGE BARRIER VENT MAIN STEAM LINE BLEED DRAIN	HI/LOW	C	407	046	1-HI/LOW
HV-41-141	BYPASS LEAKAGE BARRIER VENT MAIN STEAM LINE BLEED DRAIN	HI/LOW	D	407	046	1-HI/LOW
HV-41-1F001	NUCLEAR BOILER SYS HEAD VENT VALVE	HI/LOW	0	400	030	1-HI/LOW
HV-41-1F002	NUCLEAR BOILER SYS HEAD VENT VALVE	HI/LOW	0	400	030	1-HI/LOW
HV-41-1F011A	FEEDWATER LINE "A" INBD MAINT ISO VALVE	HPCI	A	400	030	1-HPCI
HV-41-1F011B	FEEDWATER LINE "B" INBD MAINT ISO VALVE	RCIC	C	400	030	1-RCIC
HV-41-1F016	MAIN STEAM LINE DRAIN INBD PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-41-1F019	MAIN STEAM LINE DRAIN OUTBD PCIV	HI/LOW	B	407	046	1-HI/LOW
HV-41-1F021	NUCLEAR BOILER SYSTEM MSL DRAIN TO COND.	HI/LOW	B	407	046	1-HI/LOW
HV-41-1F022A	A MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	400	030	1-HI/LOW
HV-41-1F022B	B MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	400	030	1-HI/LOW
HV-41-1F022C	C MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	400	030	1-HI/LOW
HV-41-1F022D	D MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	400	030	1-HI/LOW

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-41-1F028A	A MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	407	046	1-HI/LOW
HV-41-1F028B	B MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	407	046	1-HI/LOW
HV-41-1F028C	C MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	407	046	1-HI/LOW
HV-41-1F028D	D MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	407	046	1-HI/LOW
HV-41-1F084	MAIN STEAM LINE C INBD SAMPLE PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-41-1F085	MAIN STEAM LINE C OUTBD SAMPLE PCIV	HI/LOW	B	510	047W	1-HI/LOW
HV-41-209A	REACTOR FEEDWATER BYPASS VALV	HI/LOW	A	587	069	2-HI/LOW 2-HPCI
HV-41-209B	REACTOR FEEDWATER BYPASS VALVE	HI/LOW	B	587	069	2-HI/LOW 2-RCIC
HV-41-210	RX FW STARTUP FLUSHING SHUTOFF	HI/LOW	C	480	069	2-HI/LOW
HV-41-240	BYPASS LEAKAGE BARRIER VENT MAIN STEAM LINE BLEED DRAIN	HI/LOW	C	480	069	2-HI/LOW
HV-41-241	BYPASS LEAKAGE BARRIER VENT MAIN STEAM LINE BLEED DRAIN	HI/LOW	D	480	069	2-HI/LOW
HV-41-2F001	NUCLEAR BOILER SYS HEAD VENT VALVE	HI/LOW	0	473	053	2-HI/LOW
HV-41-2F002	NUCLEAR BOILER SYS HEAD VENT VALVE	HI/LOW	0	473	053	2-HI/LOW
HV-41-2F011A	FEEDWATER LINE "A" INBD MAINT ISO VALVE	HPCI	A	473	053	2-HPCI
HV-41-2F011B	FEEDWATER LINE "B" INBD MAINT ISO VALVE	RCIC	C	473	053	2-RCIC
HV-41-2F016	MAIN STEAM LINE DRAIN INBD PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-41-2F019	MAIN STEAM LINE DRAIN OUTBD PCIV	HI/LOW	B	480	069	2-HI/LOW

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-41-2F021	NUCLEAR BOILER SYSTEM MSL DRAIN TO COND.	HI/LOW	B	480	069	2-HI/LOW
HV-41-2F022A	A MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	473	053	2-HI/LOW
HV-41-2F022B	B MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	473	053	2-HI/LOW
HV-41-2F022C	C MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	473	053	2-HI/LOW
HV-41-2F022D	D MAIN STEAM ISO VALVE INBD PCIV	HI/LOW	A,W	473	053	2-HI/LOW
HV-41-2F028A	A MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	480	069	2-HI/LOW
HV-41-2F028B	B MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	480	069	2-HI/LOW
HV-41-2F028C	C MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	480	069	2-HI/LOW
HV-41-2F028D	D MAIN STEAM ISO VALVE OUTBD PCIV	HI/LOW	B,X	480	069	2-HI/LOW
HV-41-2F084	MAIN STEAM LINE C INBD SAMPLE PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-41-2F085	MAIN STEAM LINE C OUTBD SAMPLE PCIV	HI/LOW	B	584	070E	2-HI/LOW
HV-43-1F019	RECIRC LOOP SAMPLE INBD PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-43-1F020	RECIRC LOOP SAMPLE OUTBD PCIV	HI/LOW	B	501	047E	1-HI/LOW
HV-43-2F019	RECIRC LOOP SAMPLE INBD PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-43-2F020	RECIRC LOOP SAMPLE OUTBD PCIV	HI/LOW	B	575	070W	2-HI/LOW
HV-44-1F031	RWCU RESTRICTED ORFICE BYPASS VALVE	HI/LOW	0	510	047W	1-HI/LOW
HV-44-1F034	RWCU DISCHARGE TO MAIN CONDENSER	HI/LOW	0	510	047W	1-HI/LOW
HV-44-1F035	RWCU DISCHARGE TO EQUIP DRAIN COLLECTION TANK	HI/LOW	0	510	047W	1-HI/LOW
HV-44-2F031	RWCU RESTRICTED ORFICE BYPASS VALVE	HI/LOW	0	584	070E	2-HI/LOW

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-44-2F034	RWCU DISCHARGE TO MAIN CONDENSER	HI/LOW	0	584	070E	2-HI/LOW
HV-44-2F035	RWCU DISCHARGE TO EQUIP DRAIN COLLECTION TANK	HI/LOW	0	584	070E	2-HI/LOW
HV-49-1F007	STEAM SUPPLY LINE INBD CTMT ISO VALVE	RCIC	C	400	030	1-RCIC 1-RCICTRIP
HV-49-1F008	STEAM SUPPLY LINE OUTBD CTMT ISO VALVE	RCIC	A	309E	043E	1-RCIC 1-RCICTRIP
HV-49-1F010	PUMP SUCTION VALVE FROM CONDENSATE STORAGE TANK	RCIC	A	108	033	1-RCIC
HV-49-1F012	RCIC PUMP DISCHARGE VALVE	RCIC	A	200	042	1-RCIC
HV-49-1F013	INJECTION VALVE TO FEEDWATER LINE	RCIC	A	518	046	1-RCIC
HV-49-1F019	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RCIC	A	108	033	1-RCIC
HV-49-1F022	SHUTOFF VALVE IN DISCHARGE LINE TO CONDENSATE STORAGE TANK	RCIC	A	200	042	1-RCIC
HV-49-1F029	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RCIC	A	108	033	1-RCIC
HV-49-1F031	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER CTMT ISO VALVE	RCIC	A	108	033	1-RCIC
HV-49-1F060	TURBINE EXHAUST LINE CTMT ISO VALVE	RCIC	A	289	033	1-RCIC
HV-49-1F080	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	RCIC	A	203	032	1-RCIC
HV-49-1F084	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	RCIC	C	203	032	1-RCIC
HV-49-2F007	STEAM SUPPLY LINE INBD CTMT ISO VALVE	RCIC	C	473	053	2-RCIC 2-RCICTRIP
HV-49-2F008	STEAM SUPPLY LINE OUTBD CTMT ISO VALVE	RCIC	A	376E	066E	2-RCIC 2-RCICTRIP
HV-49-2F010	PUMP SUCTION VALVE FROM CONDENSATE STORAGE TANK	RCIC	A	179	056	2-RCIC

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-49-2F012	RCIC PUMP DISCHARGE VALVE	RCIC	A	279	065	2-RCIC
HV-49-2F013	INJECTION VALVE TO FEEDWATER LINE	RCIC	A	587	069	2-RCIC
HV-49-2F019	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RCIC	A	281	055	2-RCIC
HV-49-2F022	SHUTOFF VALVE IN DISCHARGE LINE TO CONDENSATE STORAGE TANK	RCIC	A	279	065	2-RCIC
HV-49-2F029	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RCIC	A	179	056	2-RCIC
HV-49-2F031	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER CTMT ISO VALVE	RCIC	A	179	056	2-RCIC
HV-49-2F060	TURBINE EXHAUST LINE CTMT ISO VALVE	RCIC	A	285	056	2-RCIC
HV-49-2F080	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	RCIC	A	281	055	2-RCIC
HV-49-2F084	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	RCIC	C	281	055	2-RCIC
HV-50-112	TURBINE STOP VALVE	RCIC	A	108	033	1-RCIC 1-RCICTRIP
HV-50-1F045	STEAM SUPPLY LINE INLET VALVE TO TURBINE	RCIC	A	108	033	1-RCIC 1-RCICTRIP
HV-50-1F046	COOLING WATER LINE SHUTOFF VALVE	RCIC	A	108	033	1-RCIC
HV-50-212	TURBINE STOP VALVE	RCIC	A	179	056	2-RCIC 2-RCICTRIP
HV-50-2F045	STEAM SUPPLY LINE INLET VALVE TO TURBINE	RCIC	A	179	056	2-RCIC 2-RCICTRIP
HV-50-2F046	COOLING WATER LINE SHUTOFF VALVE	RCIC	A	179	056	2-RCIC
HV-51-105A	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RHR	C	203	032	1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C 1-RHRSPC-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-105B	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RHR	D	204	031	1-RHRLPCI-D 1-RHRSC-D 1-RHRASC-D 1-RHRSPC-D
HV-51-125A	SUPPRESSION POOL COOLING LINE CTMT ISO VALVE	RHR	A	304W	044W	1-RHRASC-A 1-RHRLPCI-A 1-RHRSPC-A 1-RHRSPC-C
HV-51-125B	SUPPRESSION POOL COOLING LINE CTMT ISO VALVE	RHR	B	304E	044E	1-RHRSC-B 1-RHRSPC-B 1-RHRASC-B 1-RHRLPCI-B 1-RHRSPC-D
HV-51-142A	1A LPCI INJECTION HEADER INBD PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-51-142B	1B LPCI INJECTION HEADER INBD PCIV	HI/LOW	B	400	030	1-HI/LOW
HV-51-142C	1C LPCI INJECTION HEADER INBD PCIV	HI/LOW	C	400	030	1-HI/LOW
HV-51-142D	1D LPCI INJECTION HEADER INBD PCIV	HI/LOW	D	400	030	1-HI/LOW
HV-51-151A	1A RHR SHUTDOWN COOLING INJ HDR INLET PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-51-151B	1B RHR SHUTDOWN COOLING INJ HDR INLET PCIV	HI/LOW	B	400	030	1-HI/LOW
HV-51-182A	RHR LOOP A/LOOP C INTERTIE ISO VALVE	RHR	A	309W	043W	1-RHRASC-A 1-RHRSPC-A 1-RHRSC-C 1-RHRSC-A 1-RHRLPCI-C 1-RHRASC-C 1-RHRSPC-C 1-RHRLPCI-A
HV-51-182B	RHR LOOP B/LOOP D INTERTIE ISO VALVE	RHR	B	309E	043E	1-RHRSC-B 1-RHRSPC-D 1-RHRSPC-B 1-RHRSC-D 1-RHRLPCI-D 1-RHRLPCI-B 1-RHRASC-B 1-RHRASC-D

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F003A	HEAT EXCHANGER SHELL SIDE DISCHARGE VALVE	RHR	A	203	032	1-RHRASC-A 1-RHRASC-C 1-RHRSC-A 1-RHRSC-C 1-RHRSPC-A 1-RHRSPC-C
HV-51-1F003B	HEAT EXCHANGER SHELL SIDE DISCHARGE VALVE	RHR	B	204	031	1-RHRASC-B 1-RHRSPC-D 1-RHRSPC-B 1-RHRASC-D 1-RHRSC-D 1-RHRSC-B
HV-51-1F004A	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	A	102	032	1-RHRASC-A 1-RHRLPCI-A 1-RHRSC-A 1-RHRSPC-A
HV-51-1F004B	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	B	103	031	1-RHRASC-B 1-RHRSPC-B 1-RHRLPCI-B 1-RHRSC-B
HV-51-1F004C	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	C	102	032	1-RHRSPC-C 1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C
HV-51-1F004D	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	D	103	031	1-RHRSPC-D 1-RHRSC-D 1-RHRASC-D 1-RHRLPCI-D
HV-51-1F006A	PUMP SUCTION VALVE FROM SHUTDOWN COOLING HEADER	RHR	A	102	032	1-RHRASC-A 1-RHRLPCI-A 1-RHRSC-A 1-RHRSC-B 1-RHRSC-C 1-RHRSC-D 1-RHRSPC-A
HV-51-1F006B	PUMP SUCTION VALVE FROM SHUTDOWN COOLING HEADER	RHR	B	103	031	1-RHRSC-B 1-RHRASC-B 1-RHRLPCI-B 1-RHRSC-C 1-RHRSC-D 1-RHRSPC-B 1-RHRSC-A
HV-51-1F007A	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	A	102	032	1-RHRASC-A 1-RHRLPCI-A 1-RHRSC-A 1-RHRSPC-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F007B	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	B	103	031	1-RHRASC-B 1-RHRSPC-B 1-RHRLPCI-B 1-RHRSC-B
HV-51-1F007C	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	C	102	032	1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C 1-RHRSPC-C
HV-51-1F007D	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	D	103	031	1-RHRSC-D 1-RHRSPC-D 1-RHRASC-D 1-RHRLPCI-D
HV-51-1F008	SHUTDOWN COOLING SUCTION LINE OUTBD CTMT ISO VALVE	RHR/ HILOW	B	309E 309W	043E 043W	1-HI/LOW 1-RHRSC-A 1-RHRSC-B 1-RHRSC-C 1-RHRSC-D
HV-51-1F009	SHUTDOWN COOLING SUCTION LINE INBD CTMT ISO VALVE	RHR/ HILOW	A	400	030	1-HI/LOW 1-RHRSC-A 1-RHRSC-B 1-RHRSC-C 1-RHRSC-D
HV-51-1F010A	PUMP DISCHARGE FULL FLOW BYPASS VALVE	RHR	C	304W	044W	1-RHRSPC-A 1-RHRSC-C 1-RHRLPCI-C 1-RHRASC-C 1-RHRSPC-C
HV-51-1F010B	PUMP DISCHARGE FULL FLOW BYPASS VALVE	RHR	D	304E	044E	1-RHRSPC-D 1-RHRASC-D 1-RHRLPCI-D 1-RHRSC-D 1-RHRSPC-B
HV-51-1F011A	HEAT EXCHANGER DISCH LINE TO SUPPRESSION CHAMBER SHUTOFF VALVE	RHR	N/A	203	032	1-RHRSPC-C 1-RHRSPC-A 1-RHRSC-C 1-RHRLPCI-A 1-RHRSC-A
HV-51-1F011B	HEAT EXCHANGER DISCH LINE TO SUPPRESSION CHAMBER SHUTOFF VALVE	RHR	N/A	204	031	1-RHRSC-D 1-RHRSPC-D 1-RHRLPCI-B 1-RHRASC-D 1-RHRASC-B 1-RHRSPC-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F014A	RHR HEAT EXCHANGER TUBE SIDE INLET VALVE	RHRSW	A	203	032	1-RHRSW-A
HV-51-1F014B	RHR HEAT EXCHANGER TUBE SIDE INLET VALVE	RHRSW	B	204	031	1-RHRSW-B
HV-51-1F015A	SHUTDOWN COOLING RETURN LINE OUTBD CTMT ISO VALVE	RHR	B	309W	043W	1-RHRASC-C 1-RHRSPC-C 1-RHRSPC-A 1-RHRSC-C 1-RHRLPCI-A 1-RHRASC-A 1-HI/LOW 1-RHRSC-A
HV-51-1F015B	SHUTDOWN COOLING RETURN LINE OUTBD CTMT ISO VALVE	RHR	B	309E 309W	043E 043W	1-RHRASC-B 1-RHRSC-D 1-RHRSPC-D 1-RHRSPC-B 1-HI/LOW 1-RHRASC-D 1-RHRLPCI-B 1-RHRSC-B
HV-51-1F016A	DRYWELL SPRAY LINE OUTBD CTMT ISO VALVE	RHR	A	501	047E	1-RHRASC-A 1-RHRASC-C 1-RHRLPCI-A 1-RHRSC-A 1-RHRSC-C 1-RHRSPC-A 1-RHRSPC-C
HV-51-1F016B	DRYWELL SPRAY LINE OUTBD CTMT ISO VALVE	RHR	B	523	047W	1-RHRSC-B 1-RHRSPC-D 1-RHRSC-D 1-RHRLPCI-B 1-RHRASC-D 1-RHRASC-B 1-RHRSPC-B
HV-51-1F017A	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	A	510	047W	1-RHRLPCI-A 1-RHRSPC-C 1-RHRSPC-A 1-RHRSC-A 1-RHRASC-C 1-RHRASC-A 1-HI/LOW 1-RHRSC-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F017B	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	B	599	047E	1-RHRLPCI-B 1-RHRSPC-B 1-RHRSPC-D 1-RHRSC-B 1-RHRASC-B 1-HI/LOW 1-RHRSC-D 1-RHRASC-D
HV-51-1F017C	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	C	510	047W	1-RHRSPC-C 1-HI/LOW 1-RHRASC-C 1-RHRLPCI-C 1-RHRSC-C
HV-51-1F017D	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	D	599	047E	1-RHRSPC-D 1-RHRSC-D 1-RHRLPCI-D 1-HI/LOW 1-RHRASC-D
HV-51-1F021A	DRYWELL SPRAY LINE INBD CTMT ISO VALVE	RHR	A	400	030	1-RHRASC-A 1-RHRASC-C 1-RHRLPCI-A 1-RHRSC-A 1-RHRSC-C 1-RHRSPC-A 1RHRSPC-C
HV-51-1F021B	DRYWELL SPRAY LINE INBD CTMT ISO VALVE	RHR	B	400	030	1-RHRASC-B 1-RHRASC-D 1-RHRLPCI-B 1-RHRSC-B 1-RHRSC-D 1-RHRSPC-B 1-RHRSPC-D
HV-51-1F024A	SUPPRESSION POOL COOLING LINE SHUTOFF VALVE	RHR	A	304W	044W	1-RHRSC-C 1-RHRASC-A 1-RHRSPC-A 1-RHRSPC-C 1-RHRSC-A 1-RHRASC-C 1-RHRLPCI-A
HV-51-1F024B	SUPPRESSION POOL COOLING LINE SHUTOFF VALVE	RHR	B	304E	044E	1-RHRASC-B 1-RHRASC-D 1-RHRLPCI-B 1-RHRSC-B 1-RHRSC-D 1-RHRSPC-B 1-RHRSPC-D

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F026A	HEAT EXCHANGER DISCHARGE LINE TO RCIC SHUTOFF VALVE	RHR	N/A	102	032	1-RHRSC-C 1-RHRSPC-A 1-RHRSC-A 1-RHRLPCI-A 1-RHRSPC-C
HV-51-1F026B	HEAT EXCHANGER DISCHARGE LINE TO RCIC SHUTOFF VALVE	RHR	N/A	103	031	1-RHRSPC-B 1-RHRSPC-D 1-RHRSC-D 1-RHRLPCI-B 1-RHRASC-D 1-RHRASC-B
HV-51-1F027A	SUPPRESSION POOL SPRAY LINE CTMT ISO VALVE	RHR	A	304W	044W	1-RHRASC-C 1-RHRLPCI-A 1-RHRSC-A 1-RHRSC-C 1-RHRASC-A
HV-51-1F027B	SUPPRESSION POOL SPRAY LINE CTMT ISO VALVE	RHR	B	304E	044E	1-RHRLPCI-B 1-RHRSC-B 1-RHRASC-D 1-RHRASC-B 1-RHRSC-D
HV-51-1F040	HEAT EXCHANGER DISCHARGE LINE TO RADWASTE SHUTOFF VALVE	RHR	A	203	032	1-RHRSPC-A 1-RHRSPC-C 1-RHRSC-C 1-RHRSC-A 1-RHRLPCI-A 1-RHRASC-C 1-RHRASC-A
HV-51-1F047A	HEAT EXCHANGER INLET VALVE FROM PUMP DISCHARGE	RHR	A	309W	043W	1-RHRSPC-C 1-RHRASC-C 1-RHRSC-A 1-RHRSC-C 1-RHRSPC-A 1-RHRASC-A
HV-51-1F047B	HEAT EXCHANGER INLET VALVE FROM PUMP DISCHARGE	RHR	B	309E	043E	1-RHRSPC-D 1-RHRSPC-B 1-RHRSC-D 1-RHRASC-B 1-RHRSC-B 1-RHRASC-D
HV-51-1F049	HEAT EXCHANGER DISCHARGE LINE TO RADWASTE SHUTOFF VALVE	RHR	B	203	032	1-RHRSC-C 1-RHRSPC-A 1-RHRSC-A 1-RHRLPCI-A 1-RHRASC-C 1-RHRASC-A 1-RHRSPC-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-1F068A	RHR HEAT EXCHANGER TUBE SIDE OUTLET VALVE	RHRSW	C	203	032	1-RHRSW-A
HV-51-1F068B	RHR HEAT EXCHANGER TUBE SIDE OUTLET VALVE	RHRSW	D	204	031	1-RHRSW-B
HV-51-1F073	RHRSW TO RHR INTERTIE LINE SHUTOFF VALVE	RHR	B	204	031	1-RHRSW-B
HV-51-1F068A	RHR HEAT EXCHANGER	RHRSW	C	203	032	1-RHRSW-A
HV-51-1F074	RHR SW CROSSTIE DRAIN VALVE	RHR	B	103	031	1-RHRSW-B
HV-51-1F075	RHRSW TO RHR INTERTIE SHUTOFF VALVE	RHR	B	204	031	1-RHRSW-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-205A	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RHR	C	280	054	2-RHRSPC-C
HV-51-205A	MINIMUM FLOW BYPASS	RHR	C	280	054	2-RHRSC-C 2-RHRASC-C 2-RHRLPCI-C
HV-51-205B	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	RHR	D	281	055	2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D
HV-51-225A	SUPPRESSION POOL COOLING LINE CTMT ISO VALVE	RHR	A	370W	067W	2-RHRASC-A 2-RHRLPCI-A 2-RHRSPC-A
HV-51-225A	SUPPRESSION POOL	RHR	A	370W	067W	2-RHRSPC-C
HV-51-225B	SUPPRESSION POOL COOLING LINE CTMT ISO VALVE	RHR	B	370E	067E	2-RHRASC-B 2-RHRSPC-D 2-RHRSPC-B 2-RHRLPCI-B 2-RHRSC-B
HV-51-242A	2A LPCI INJECTION HEADER INBD PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-51-242B	2B LPCI INJECTION HEADER INBD PCIV	HI/LOW	B	473	053	2-HI/LOW
HV-51-242C	2C LPCI INJECTION HEADER INBD PCIV	HI/LOW	C	473	053	2-HI/LOW
HV-51-242D	2D LPCI INJECTION HEADER INBD PCIV	HI/LOW	D	473	053	2-HI/LOW
HV-51-251A	2A RHR SHUTDOWN COOLING INJ HDR INLET PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-51-251B	2B RHR SHUTDOWN COOLING INJ HDR INLET PCIV	HI/LOW	B	473	053	2-HI/LOW
HV-51-282A	RHR LOOP A/LOOP C INTERTIE ISO VALVE	RHR	A	376W	066W	2-RHRASC-C 2-RHRSPC-A 2-RHRSC-C 2-RHRSC-A 2-RHRLPCI-A 2-RHRSPC-C 2-RHRASC-A 2-RHRLPCI-C

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-282B	RHR LOOP B/LOOP D INTERTIE ISO VALVE	RHR	B	376E	066E	2-RHRSC-B 2-RHRSPC-D 2-RHRSPC-B 2-RHRSC-D 2-RHRLPCI-D 2-RHRLPCI-B 2-RHRASC-B 2-RHRASC-D
HV-51-2F003A	HEAT EXCHANGER SHELL SIDE DISCHARGE VALVE	RHR	A	280	054	2-RHRASC-A 2-RHRASC-C 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C
HV-51-2F003B	HEAT EXCHANGER SHELL SIDE DISCHARGE VALVE	RHR	B	281	055	2-RHRASC-B 2-RHRSPC-D 2-RHRSPC-B 2-RHRASC-D 2-RHRSC-B 2-RHRSC-D
HV-51-2F004A	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	A	173	054	2-RHRASC-A 2-RHRLPCI-A 2-RHRSC-A 2-RHRSPC-A
HV-51-2F004B	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	B	174	055	2-RHRASC-B 2-RHRLPCI-B 2-RHRSC-B 2-RHRSPC-B
HV-51-2F004C	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	C	173	054	2-RHRSC-C 2-RHRSPC-C 2-RHRASC-C 2-RHRLPCI-C
HV-51-2F004D	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	RHR	D	174	055	2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-D 2-RHRASC-D
HV-51-2F006A	PUMP SUCTION VALVE FROM SHUTDOWN COOLING HEADER	RHR	A	173	054	2-RHRLPCI-A 2-RHRSPC-A 2-RHRSC-D 2-RHRSC-C 2-RHRSC-A 2-RHRASC-A 2-RHRSC-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-2F006B	PUMP SUCTION VALVE FROM SHUTDOWN COOLING HEADER	RHR	B	174	055	2-RHRSC-A 2-RHRSC-D 2-RHRSPC-B 2-RHRASC-B 2-RHRSC-C 2-RHRLPCI-B 2-RHRSC-B
HV-51-2F007A	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	A	173	054	2-RHRASC-A 2-RHRLPCI-A 2-RHRSC-A 2-RHRSPC-A
HV-51-2F007B	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	B	174	055	2-RHRASC-B 2-RHRSPC-B 2-RHRLPCI-B 2-RHRSC-B
HV-51-2F007C	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	C	173	054	2-RHRASC-C 2-RHRLPCI-C 2-RHRSC-C 2-RHRSPC-C
HV-51-2F007D	PUMP DISCHARGE MINIMUM FLOW BYPASS VALVE	RHR	D	174	055	2-RHRSC-D 2-RHRSPC-D 2-RHRASC-D 2-RHRLPCI-D
HV-51-2F008	SHUTDOWN COOLING SUCTION LINE OUTBD CTMT ISO VALVE	RHR/ HILOW	B	376E 376W	066E 066W	2-HI/LOW 2-RHRSC-A 2-RHRSC-B 2-RHRSC-C 2-RHRSC-D
HV-51-2F009	SHUTDOWN COOLING SUCTION LINE INBD CTMT ISO VALVE	RHR/ HILOW	A	473	053	2-HI/LOW 2-RHRSC-A 2-RHRSC-B 2-RHRSC-C 2-RHRSC-D
HV-51-2F010A	PUMP DISCHARGE FULL FLOW BYPASS VALVE	RHR	C	370W	067W	2-RHRSPC-C 2-RHRLPCI-C 2-RHRASC-C 2-RHRSPC-A 2-RHRSC-C
HV-51-2F010B	PUMP DISCHARGE FULL FLOW BYPASS VALVE	RHR	D	370E	067E	2-RHRSPC-D 2-RHRASC-D 2-RHRLPCI-D 2-RHRSC-D 2-RHRSPC-B
HV-51-2F011A	HEAT EXCHANGER DISCH LINE TO SUPPRESSION CHAMBER SHUTOFF VALVE	RHR	N/A	280	054	2-RHRSPC-C 2-RHRSPC-A 2-RHRSC-C 2-RHRLPCI-A 2-RHRSC-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-2F011B	HEAT EXCHANGER DISCH LINE TO SUPPRESSION CHAMBER SHUTOFF VALVE	RHR	N/A	281	055	2-RHRLPCI-B 2-RHRSPC-D 2-RHRSC-D 2-RHRASC-B 2-RHRASC-D 2-RHRSPC-B
HV-51-2F014A	RHR HEAT EXCHANGER TUBE SIDE INLET VALVE	RHRSW	A	280	054	2-RHRSW-A
HV-51-2F014B	RHR HEAT EXCHANGER TUBE SIDE INLET VALVE	RHRSW	B	281	055	2-RHRSW-B
HV-51-2F015A	SHUTDOWN COOLING RETURN LINE OUTBD CTMT ISO VALVE	RHR	B	376W	066W	2-RHRASC-C 2-RHRSPC-C 2-RHRSPC-A 2-RHRSC-C 2-RHRLPCI-A 2-RHRASC-A 2-HI/LOW 2-RHRSC-A
HV-51-2F015B	SHUTDOWN COOLING RETURN LINE OUTBD CTMT ISO VALVE	RHR	B	376E	066E	2-HI/LOW 2-RHRSPC-D 2-RHRSPC-B 2-RHRSC-D 2-RHRLPCI-B 2-RHRASC-B 2-RHRASC-D 2-RHRSC-B
HV-51-2F016A	DRYWELL SPRAY LINE OUTBD CTMT ISO VALVE	RHR	A	575	070W	2-RHRASC-A 2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C
HV-51-2F016B	DRYWELL SPRAY LINE OUTBD CTMT ISO VALVE	RHR	B	593	070E	2-RHRSC-B 2-RHRSPC-D 2-RHRSC-D 2-RHRLPCI-B 2-RHRASC-D 2-RHRASC-B 2-RHRSPC-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-2F017A	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	A	589	070W	2-RHRLPCI-A 2-RHRSPC-C 2-RHRSPC-A 2-RHRSC-A 2-RHRASC-C 2-RHRASC-A 2-HI/LOW 2-RHRSC-C
HV-51-2F017B	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	B	584	070E	2-RHRLPCI-B 2-RHRSPC-B 2-RHRSPC-D 2-RHRSC-B 2-RHRASC-B 2-HI/LOW 2-RHRSC-D 2-RHRASC-D
HV-51-2F017C	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	C	589	070W	2-RHRSPC-C 2-HI/LOW 2-RHRASC-C 2-RHRLPCI-C 2-RHRSC-C
HV-51-2F017D	LPCI INJECTION LINE OUTBD CTMT ISO VALVE	RHR	D	584	070E	2-RHRSPC-D 2-RHRSC-D 2-RHRLPCI-D 2-HI/LOW 2-RHRASC-D
HV-51-2F021A	DRYWELL SPRAY LINE INBD CTMT ISO VALVE	RHR	A	473	053	2-RHRASC-A 2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C
HV-51-2F021B	DRYWELL SPRAY LINE INBD CTMT ISO VALVE	RHR	B	473	053	2-RHRASC-B 2-RHRASC-D 2-RHRLPCI-B 2-RHRSC-B 2-RHRSC-D 2-RHRSPC-B 2-RHRSPC-D
HV-51-2F024A	SUPPRESSION POOL COOLING LINE SHUTOFF VALVE	RHR	A	370W	067W	2-RHRSC-C 2-RHRASC-A 2-RHRSPC-A 2-RHRSPC-C 2-RHRSC-A 2-RHRASC-C 2-RHRLPCI-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-2F024B	SUPPRESSION POOL COOLING LINE SHUTOFF VALVE	RHR	B	370E	067E	2-RHRASC-B 2-RHRASC-D 2-RHRLPCI-B 2-RHRSC-B 2-RHRSC-D 2-RHRSPC-B 2-RHRSPC-D
HV-51-2F026A	HEAT EXCHANGER DISCHARGE LINE TO RCIC SHUTOFF VALVE	RHR	N/A	173	054	2-RHRSC-C 2-RHRSPC-A 2-RHRLPCI-A 2-RHRSPC-C 2-RHRSC-A
HV-51-2F026B	HEAT EXCHANGER DISCHARGE LINE TO RCIC SHUTOFF VALVE	RHR	N/A	174	055	2-RHRSPC-B 2-RHRSPC-D 2-RHRSC-D 2-RHRLPCI-B 2-RHRASC-D 2-RHRASC-B
HV-51-2F027A	SUPPRESSION POOL SPRAY LINE CTMT ISO VALVE	RHR	A	370W	067W	2-RHRSC-C 2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRASC-A
HV-51-2F027B	SUPPRESSION POOL SPRAY LINE CTMT ISO VALVE	RHR	B	370E	067E	2-RHRSC-B 2-RHRSC-D 2-RHRLPCI-B 2-RHRASC-B 2-RHRASC-D
HV-51-2F040	HEAT EXCHANGER DISCHARGE LINE TO RADWASTE SHUTOFF VALVE	RHR	A	280	054	2-RHRASC-A 2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C
HV-51-2F047A	HEAT EXCHANGER INLET VALVE FROM PUMP DISCHARGE	RHR	A	376W	066W	2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C 2-RHRSC-A 2-RHRASC-C 2-RHRASC-A
HV-51-2F047B	HEAT EXCHANGER INLET VALVE FROM PUMP DISCHARGE	RHR	B	376E	066E	2-RHRSPC-B 2-RHRSPC-D 2-RHRSC-D 2-RHRSC-B 2-RHRASC-D 2-RHRASC-B

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-51-2F049	HEAT EXCHANGER DISCHARGE LINE TO RADWASTE SHUTOFF VALVE	RHR	B	280	054	2-RHRASC-C 2-RHRLPCI-A 2-RHRSC-A 2-RHRSC-C 2-RHRSPC-A 2-RHRSPC-C 2-RHRASC-A
HV-51-2F068A	RHR HEAT EXCHANGER TUBE SIDE OUTLET VALVE	RHRSW	C	280	054	2-RHRSW-A
HV-51-2F068B	RHR HEAT EXCHANGER TUBE SIDE OUTLET VALVE	RHRSW	D	281	055	2-RHRSW-B
HV-51-2F073	RHRSW TO RHR INTERTIE LINE SHUTOFF VALVE	RHR	A	280	054	2-RHRSW-A
HV-51-2F074	RHR SW CROSS TIE DRAIN VALVE	RHR	A	173	054	2-RHRSW-A
HV-51-2F075	RHRSW TO RHR INTERTIE SHUTOFF VALVE	RHR	A	280	054	2-RHRSW-A
HV-52-139	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	118	039	
HV-52-1F005	CORE SPRAY INBD ISO VALVE "A" LOOP	CS/ HILOW	A	523	047W	1-HI/LOW
HV-52-1F037	CORE SPRAY INBD ISO VALVE "B" LOOP	CS/ HPCI	B	523	047W	1-HPCI
HV-52-1F039A	1A LOOP CHECK EQUALIZING PCIV	HI/LOW	A	400	030	1-HI/LOW
HV-52-239	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	189	062	
HV-52-2F005	CORE SPRAY INBD ISO VALVE "A" LOOP	CS/ HILOW	A	593	070E	2-HI/LOW
HV-52-2F037	CORE SPRAY INBD ISO VALVE "B" LOOP	CS/ HPCI	B	593	070E	2-HPCI
HV-52-2F039A	2A LOOP CHECK EQUALIZING PCIV	HI/LOW	A	473	053	2-HI/LOW
HV-55-120	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	204	031	
HV-55-121	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	204	031	
HV-55-124	CST TO SAFEGUARD SYSTEM ISOLATING VALVE (OUTLET)	HPCI RCIC	A	CST DIKED AREA	YARD	1-HPCI 1-RCIC
HV-55-125	CST TO SAFEGUARD SYSTEM ISOLATING VALVE (OUTLET)	HPCI RCIC	B	CST DIKED	YARD	1-HPCI 1-RCIC

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-55-126	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	204	031	
HV-55-1F001	STEAM SUPPLY LINE INLET VALVE TO TURBINE	HPCI	B	109	034	1-HPCITRIP 1-HPCI
HV-55-1F002	STEAM SUPPLY LINE INBD CTMT ISO VALVE	HPCI	D	400	030	1-HPCITRIP 1-HPCI
HV-55-1F003	STEAM SUPPLY LINE OUTBD CTMT ISO VALVE	HPCI	B	309W	043W	1-HPCI 1-HPCITRIP
HV-55-1F004	PUMP SUCTION VALVE FROM CONDENSATE STORAGE TANK	HPCI	B	109	034	1-HPCI
HV-55-1F006	INJECTION VALVE TO CORE SPRAY LINE	HPCI	B	500	047E	1-HPCI
HV-55-1F007	PUMP DISCHARGE VALVE	HPCI	B	200	042	1-HPCI
HV-55-1F008	FULL FLOW TEST THROTTLE VALVE	HPCI	B	200	042	1-HPCI
HV-55-1F012	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	HPCI	B	288	034	1-HPCI
HV-55-1F041	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	HPCI	B	109	034	1-HPCI
HV-55-1F042	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER CTMT ISO VALVE	HPCI	B	109	034	1-HPCI
HV-55-1F072	TURBINE EXHAUST LINE CTMT ISO VALVE	HPCI	B	288	034	1-HPCI
HV-55-1F093	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	HPCI	B	200	042	1-HPCI
HV-55-1F095	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	HPCI	D	288	034	1-HPCI
HV-55-1F105	HPCI PUMP DISCHARGE VALVE TO FEEDWATER	HPCI	B	518	046	1-HPCI
HV-55-220	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	280	054	
HV-55-221	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	B	280	054	
HV-55-224	CST TO SAFEGUARD SYSTEM ISOLATING VALVE (OUTLET)	HPCI RCIC	A	CST DIKED AREA	YARD	2-HPCI 2-RCIC
HV-55-225	CST TO SAFEGUARD SYSTEM ISOLATING VALVE (OUTLET)	HPCI RCIC	B	CST DIKED AREA	YARD	2-HPCI 2-RCIC

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-55-2F001	STEAM SUPPLY LINE INLET VALVE TO TURBINE	HPCI	B	180	057	2-HPCI 2-RCICTRIP
HV-55-2F002	STEAM SUPPLY LINE INBD CTMT ISO VALVE	HPCI	D	473	053	2-HPCI 2-HPCITRIP
HV-55-2F003	STEAM SUPPLY LINE OUTBD CTMT ISO VALVE	HPCI	B	376W	066W	2-HPCI 2-HPCITRIP
HV-55-2F004	PUMP SUCTION VALVE FROM CONDENSATE STORAGE TANK	HPCI	B	180	057	2-HPCI
HV-55-2F006	INJECTION VALVE TO CORE SPRAY LINE	HPCI	B	580E	070E	2-HPCI
HV-55-2F007	PUMP DISCHARGE VALVE	HPCI	B	279	065	2-HPCI
HV-55-2F008	FULL FLOW TEST THROTTLE VALVE	HPCI	B	279	065	2-HPCI
HV-55-2F012	MINIMUM FLOW BYPASS LINE CTMT ISO VALVE	HPCI	B	283	057	2-HPCI
HV-55-2F041	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER	HPCI	B	180	057	2-HPCI
HV-55-2F042	PUMP SUCTION VALVE FROM SUPPRESSION CHAMBER CTMT ISO VALVE	HPCI	B	180	057	2-HPCI
HV-55-2F072	TURBINE EXHAUST LINE CTMT ISO VALVE	HPCI	B	283	057	2-HPCI
HV-55-2F093	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	HPCI	B	279	065	2-HPCI
HV-55-2F095	TURBINE EXHAUST LINE VACUUM BREAKER VALVE	HPCI	D	283	057	2-HPCI
HV-55-2F105	HPCI PUMP DISCHARGE VALVE TO FEEDWATER	HPCI	B	587	069	2-HPCI
HV-56-1F059	COOLING WATER LINE SHUTOFF VALVE	HPCI	B	109	034	1-HPCI
HV-56-2F059	COOLING WATER LINE SHUTOFF VALVE	HPCI	B	180	057	2-HPCI
HV-59-129B	INST GAS OUTBD PCIV	PCIG	B	306	043W	1-MSRV
HV-59-151A	CTMT ISO VALVE	PCIG	C	306	043W	1-RHRASC-C 1-RHRASC-D 1-RHRASC-B 1-RHRASC-A
HV-59-151B	CTMT ISO VALVE	PCIG	D	307	043E	1-RHRASC-B 1-RHRASC-C 1-RHRASC-D 1-RHRASC-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
HV-59-229B	INST GAS OUTBD PCIV	PCIG	B	375	066W	2-MSRV
HV-59-251A	CTMT ISO VALVE	PCIG	C	375	066W	2-RHRASC-D 2-RHRASC-C 2-RHRASC-A 2-RHRASC-B
HV-59-251B	CTMT ISO VALVE	PCIG	D	374	066E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D
HV-C41-1F020	MAIN STEAM LINE PRESSURE EQUALIZING VALVE	HI/LOW	A	407	046	1-HI/LOW
HV-C41-2F020	MAIN STEAM LINE PRESSURE EQUALIZING VALVE	HI/LOW	A	480	069	2-HI/LOW
HV-C44-1F033	RWCU DUMP FLOW CONTROL VALVE	HI/LOW	0	510	047W	1-HI/LOW
HV-C44-2F033	RWCU DUMP FLOW CONTROL VALVE	HI/LOW	0	584	070E	2-HI/LOW
HV-C51-1F048A	HEAT EXCHANGER BYPASS VALVE FROM PUMP DISCHARGE	RHR	A	309W	043W	1-RHRASC-A 1-RHRSPC-C 1-RHRSPC-A 1-RHRSC-C 1-RHRASC-C 1-RHRLPCI-A 1-RHRSC-A
HV-C51-1F048B	HEAT EXCHANGER BYPASS VALVE FROM PUMP DISCHARGE	RHR	B	309E	043E	1-RHRASC-B 1-RHRASC-D 1-RHRLPCI-B 1-RHRSC-B 1-RHRSC-D 1-RHRSPC-B 1-RHRSPC-D
HV-C51-2F048A	HEAT EXCHANGER BYPASS VALVE FROM PUMP DISCHARGE	RHR	A	376W	066W	2-RHRSC-C 2-RHRSPC-A 2-RHRSC-A 2-RHRSPC-C 2-RHRASC-C 2-RHRASC-A 2-RHRLPCI-A
HV-C51-2F048B	HEAT EXCHANGER BYPASS VALVE FROM PUMP DISCHARGE	RHR	B	376E	066E	2-RHRSC-D 2-RHRSPC-B 2-RHRSC-B 2-RHRLPCI-B 2-RHRASC-D 2-RHRASC-B 2-RHRSPC-D

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
KS-81-101A	CELL "A" TIMER	DGEV	A	311A	079	
KS-81-101B	CELL "B" TIMER	DGEV	B	311B	081	
KS-81-101C	CELL "C" TIMER	DGEV	C	311C	080	
KS-81-101D	CELL "D" TIMER	DGEV	D	311D	082	
KS-81-101E	CELL "A" TIMER	DGEV	A	311A	079	
KS-81-101F	CELL "B" TIMER	DGEV	B	311B	081	
KS-81-101G	CELL "C" TIMER	DGEV	C	311C	080	
KS-81-101H	CELL "D" TIMER	DGEV	D	311D	082	
KS-81-201A	CELL "A" TIMER	DGEV	A	315A	083	
KS-81-201B	CELL "B" TIMER	DGEV	B	315B	085	
KS-81-201C	CELL "C" TIMER	DGEV	C	315C	084	
KS-81-201D	CELL "D" TIMER	DGEV	D	315D	086	
KS-81-201E	CELL "A" TIMER	DGEV	A	315A	083	
KS-81-201F	CELL "B" TIMER	DGEV	B	315B	085	
KS-81-201G	CELL "C" TIMER	DGEV	C	315C	084	
KS-81-201H	CELL "D" TIMER	DGEV	D	315D	086	
LI-42-1R010	REACTOR VESSEL WATER LEVEL INDICATOR	RVI	A	540	026	1-RVI
LI-42-2R010	REACTOR VESSEL WATER LEVEL INDICATOR	RVI	A	540	026	2-RVI
LI-52-140A	SUPPRESSION POOL LEVEL INDICATOR	SPI	A	533	024	1-SPI
LI-52-140B	SUPPRESSION POOL LEVEL INDICATOR	SPI	B	533	024	1-SPI
LI-52-240A	SUPPRESSION POOL LEVEL INDICATOR	SPI	A	533	024	2-SPI
LI-52-240B	SUPPRESSION POOL LEVEL INDICATOR	SPI	B	533	024	2-SPI
LI-52-241	SUPPRESSION POOL LEVEL INDICATOR	SPI	A	540	026	2-SPI
LI-55-115-1	SUPPRESSION POOL LEVEL INDICATOR	SPI	0(A)	533	024	1-SPI
LI-55-115-2	SUPPRESSION POOL LEVEL INDICATOR	SPI	0(A)	540	026	1-SPI
LI-55-141	SUPPRESSION POOL LEVEL INDICATOR	SPI	A	540	026	1-SPI
LI-55-215-2	SUPPRESSION POOL LEVEL INDICATOR	SPI	0(A)	540	026	2-SPI
LI-55-217	SUPPRESSION POOL LEVEL INDICATOR	SPI	B	533	024	2-SPI

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
LIS-42-1N691A	LEVEL INDICATING SWITCH	CS	A	542	025	
LIS-42-1N691B	LEVEL INDICATING SWITCH	CS	B	542	025	
LIS-42-1N691C	LEVEL INDICATING SWITCH	CS	C	542	025	
LIS-42-1N691D	LEVEL INDICATING SWITCH	CS	D	542	025	
LIS-42-1N691E	LEVEL INDICATING SWITCH	CS	A	542	025	
LIS-42-1N691F	LEVEL INDICATING SWITCH	CS	B	542	025	
LIS-42-1N691G	LEVEL INDICATING SWITCH	CS	C	542	025	
LIS-42-1N691H	LEVEL INDICATING SWITCH	CS	D	542	025	
LIS-42-1N695A	LEVEL INDICATING SWITCH	ADS	A	542	025	
LIS-42-1N695C	LEVEL INDICATING SWITCH	ADS	C	542	025	
LIS-42-1N697A	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-42-1N697E	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-42-2N691A	LEVEL INDICATING SWITCH	CS	A	542	025	
LIS-42-2N691B	LEVEL INDICATING SWITCH	CS	B	542	025	
LIS-42-2N691C	LEVEL INDICATING SWITCH	CS	C	542	025	
LIS-42-2N691D	LEVEL INDICATING SWITCH	CS	D	542	025	
LIS-42-2N691E	LEVEL INDICATING SWITCH	CS	A	542	025	
LIS-42-2N691F	LEVEL INDICATING SWITCH	CS	B	542	025	
LIS-42-2N691G	LEVEL INDICATING SWITCH	CS	C	542	025	
LIS-42-2N691H	LEVEL INDICATING SWITCH	CS	D	542	025	
LIS-42-2N695A	LEVEL INDICATING SWITCH	ADS	A	542	025	
LIS-42-2N695C	LEVEL INDICATING SWITCH	ADS	C	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
LIS-42-2N697A	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-42-2N697E	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-49-1N635A	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-49-1N635E	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-49-2N635A	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-49-2N635E	LEVEL INDICATING SWITCH	RCIC	A	542	025	
LIS-55-1N661B	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-1N661F	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-1N662B	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-1N662F	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-2N661B	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-2N661F	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-2N662B	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LIS-55-2N662F	LEVEL INDICATING SWITCH	HPCI	B	542	025	
LS-42-1N692A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-1N692B	LEVEL SWITCH	HPCI	B	542	025	
LS-42-1N692D	LEVEL SWITCH	HPCI	D	542	025	
LS-42-1N692E	LEVEL SWITCH	RCIC	A	542	025	
LS-42-1N692F	LEVEL SWITCH	HPCI	B	542	025	
LS-42-1N692H	LEVEL SWITCH	HPCI	D	542	025	
LS-42-1N693A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-1N693B	LEVEL SWITCH	HPCI	B	542	025	
LS-42-1N693D	LEVEL SWITCH	HPCI	D	542	025	
LS-42-1N693E	LEVEL SWITCH	RCIC	A	542	025	
LS-42-1N693F	LEVEL SWITCH	HPCI	B	542	025	
LS-42-1N693H	LEVEL SWITCH	HPCI	D	542	025	
LS-42-1N698A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-1N698E	LEVEL SWITCH	RCIC	A	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
LS-42-2N692A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-2N692B	LEVEL SWITCH	HPCI	B	542	025	
LS-42-2N692D	LEVEL SWITCH	HPCI	D	542	025	
LS-42-2N692E	LEVEL SWITCH	RCIC	A	542	025	
LS-42-2N692F	LEVEL SWITCH	HPCI	B	542	025	
LS-42-2N692H	LEVEL SWITCH	HPCI	D	542	025	
LS-42-2N693A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-2N693B	LEVEL SWITCH	HPCI	B	542	025	
LS-42-2N693D	LEVEL SWITCH	HPCI	D	542	025	
LS-42-2N693E	LEVEL SWITCH	RCIC	A	542	025	
LS-42-2N693F	LEVEL SWITCH	HPCI	B	542	025	
LS-42-2N693H	LEVEL SWITCH	HPCI	D	542	025	
LS-42-2N698A	LEVEL SWITCH	RCIC	A	542	025	
LS-42-2N698E	LEVEL SWITCH	RCIC	A	542	025	
LSHL-20-121A	LEVEL SWITCH	SDG	A	312A	079	
LSHL-20-121B	LEVEL SWITCH	SDG	B	312B	081	
LSHL-20-121C	LEVEL SWITCH	SDG	C	312C	080	
LSHL-20-121D	LEVEL SWITCH	SDG	D	312D	082	
LSHL-20-122A	LEVEL SWITCH	SDG	A	312A	079	
LSHL-20-122B	LEVEL SWITCH	SDG	B	312B	081	
LSHL-20-122C	LEVEL SWITCH	SDG	C	312C	080	
LSHL-20-122D	LEVEL SWITCH	SDG	D	312D	082	
LSHL-20-221A	LEVEL SWITCH	SDG	A	316A	083	
LSHL-20-221B	LEVEL SWITCH	SDG	B	316B	085	
LSHL-20-221C	LEVEL SWITCH	SDG	C	316C	084	
LSHL-20-221D	LEVEL SWITCH	SDG	D	316D	086	
LSHL-20-222A	LEVEL SWITCH	SDG	A	316A	083	
LSHL-20-222B	LEVEL SWITCH	SDG	B	316B	085	
LSHL-20-222C	LEVEL SWITCH	SDG	C	316C	084	
LSHL-20-222D	LEVEL SWITCH	SDG	D	316D	086	
LSL-20-127A	LEVEL SWITCH	SDG	A	311A	079	
LSL-20-127B	LEVEL SWITCH	SDG	B	311B	081	
LSL-20-127C	LEVEL SWITCH	SDG	C	311C	080	
LSL-20-127D	LEVEL SWITCH	SDG	D	311D	082	
LSL-20-227A	LEVEL SWITCH	SDG	A	315A	083	
LSL-20-227B	LEVEL SWITCH	SDG	B	315B	085	
LSL-20-227C	LEVEL SWITCH	SDG	C	315C	084	
LSL-20-227D	LEVEL SWITCH	SDG	D	315D	086	
LT-42-115A	LEVEL TRANSMITTER	RVI	A	402W	045W	
LT-42-115B	LEVEL TRANSMITTER	RVI	B	402E	045E	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
LT-42-1N010	LEVEL TRANSMITTER	RVI	A	402W	045W	
LT-42-1N091A	LEVEL TRANSMITTER	CS	A	402W	045W	
LT-42-1N091B	LEVEL TRANSMITTER	HPCI	B	402E	045E	
LT-42-1N091C	LEVEL TRANSMITTER 402W	CS 045W	C	402E	045E	
LT-42-1N091D	LEVEL TRANSMITTER 402W	CS 045W	D	402E	045E	
LT-42-1N091E	LEVEL TRANSMITTER	CS	A	402W	045W	
LT-42-1N091F	LEVEL TRANSMITTER	HPCI	B	402E	045E	
LT-42-1N091G	LEVEL TRANSMITTER 402W	CS 045W	C	402E	045E	
LT-42-1N091H	LEVEL TRANSMITTER 402W	CS 045W	D	402E	045E	
LT-42-1N095A	LEVEL TRANSMITTER	ADS	A	402W	045W	
LT-42-1N095C	LEVEL TRANSMITTER 402W	ADS 045W	C	402E	045E	
LT-42-1N097A	LEVEL TRANSMITTER	RCIC	A	402W	045W	
LT-42-1N097E	LEVEL TRANSMITTER	RCIC	A	402W	045W	
LT-42-215A	LEVEL TRANSMITTER	RVI	A	475W	068W	
LT-42-215B	LEVEL TRANSMITTER	RVI	B	475E	068E	
LT-42-2N010	LEVEL TRANSMITTER	RVI	A	475W	068W	
LT-42-2N091A	LEVEL TRANSMITTER	CS	A	475W	068W	
LT-42-2N091B	LEVEL TRANSMITTER	CS	B	475E	068E	
LT-42-2N091C	LEVEL TRANSMITTER 475W	CS 068W	C	475E	068E	
LT-42-2N091D	LEVEL TRANSMITTER 475W	CS 068W	D	475E	068E	
LT-42-2N091E	LEVEL TRANSMITTER	CS	A	475W	068W	
LT-42-2N091F	LEVEL TRANSMITTER	CS	B	475E	068E	
LT-42-2N091G	LEVEL TRANSMITTER 475W	CS 068W	C	475E	068E	
LT-42-2N091H	LEVEL TRANSMITTER 475W	CS 068W	D	475E	068E	
LT-42-2N095A	LEVEL TRANSMITTER	ADS	A	475W	068W	
LT-42-2N095C	LEVEL TRANSMITTER 475W	ADS 068W	C	475E	068E	
LT-42-2N097A	LEVEL TRANSMITTER	RCIC	A	475W	068W	
LT-42-2N097E	LEVEL TRANSMITTER	RCIC	A	475W	068W	
LT-49-1N035A	LEVEL TRANSMITTER	RCIC	A	200	042	
LT-49-1N035E	LEVEL TRANSMITTER	RCIC	A	200	042	
LT-49-2N035A	LEVEL TRANSMITTER	RCIC	A	279	065	
LT-49-2N035E	LEVEL TRANSMITTER	RCIC	A	279	065	
LT-52-140A	LEVEL TRANSMITTER	SPI	A	118	039	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
LT-52-140B	LEVEL TRASNMITTER	SPI	B	118	039	
LT-52-240A	LEVEL TRANSMITTER	SPI	A	189	062	
LT-52-240B	LEVEL TRANSMITTER	SPI	B	189	062	
LT-52-241	LEVEL TRANSMITTER	SPI	A	189	062	
LT-55-115	LEVEL TRANSMITTER	SPI	0(A)	204	031	
LT-55-141	LEVEL TRANSMITTER	SPI	A	203	032	
LT-55-1N061B	LEVEL TRANSMITTER	HPCI	B	200	042	
LT-55-1N061F	LEVEL TRANSMITTER	HPCI	B	200	042	
LT-55-1N062B	LEVEL TRANSMITTER	HPCI	B	204	031	
LT-55-1N062F	LEVEL TRANSMITTER	HPCI	B	204	031	
LT-55-215	LEVEL TRANSMITTER	SPI	0(A)	280	054	
LT-55-217	LEVEL TRANSMITTER	SPI	B	174	055	
LT-55-2N061B	LEVEL TRANSMITTER	HPCI	B	279	065	
LT-55-2N061F	LEVEL TRANSMITTER	HPCI	B	279	065	
LT-55-2N062B	LEVEL TRANSMITTER	HPCI	B	280	054	
LT-55-2N062F	LEVEL TRANSMITTER	HPCI	B	280	054	
PCV-59-152A-1	PRESSURE CONTROL VALVE	PCIG	N/A	304W	044W	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D
PCV-59-152A-2	PRESSURE CONTROL VALVE	PCIG	N/A	304W	044W	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D
PCV-59-152A-3	PRESSURE CONTROL VALVE	PCIG	N/A	304W	044W	1-RHRASC-B 1-RHRASC-C 1-RHRASC-A 1-RHRASC-D
PCV-59-152B-1	PRESSURE CONTROL VALVE	PCIG	N/A	304E	044E	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D
PCV-59-152B-2	PRESSURE CONTROL VALVE	PCIG	N/A	304E	044E	1-RHRASC-B 1-RHRASC-C 1-RHRASC-A 1-RHRASC-D
PCV-59-152B-3	PRESSURE CONTROL VALVE	PCIG	N/A	304E	044E	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D
PCV-59-252A-1	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-B 2-RHRASC-C 2-RHRASC-A 2-RHRASC-D

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PCV-59-252A-2	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D
PCV-59-252A-3	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-B 2-RHRASC-C 2-RHRASC-A 2-RHRASC-D
PCV-59-252B-1	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D
PCV-59-252B-2	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-D 2-RHRASC-B 2-RHRASC-C
PCV-59-252B-3	PRESSURE CONTROL VALVE	PCIG	N/A	370E	067E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D
PDIS-49-1N657A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RCIC	A	542	025	
PDIS-49-1N657C	PRESSURE DIFFERENTIAL INDICATING SWITCH	RCIC	C	542	025	
PDIS-49-2N657A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RCIC	A	542	025	
PDIS-49-2N657C	PRESSURE DIFFERENTIAL INDICATING SWITCH	RCIC	C	542	025	
PDIS-55-1N657B	STEAM SUPPLY LINE DIFFERENTIAL PRESURE INDICATING SWITCH	HPCI	B	542	025	
PDIS-55-1N657D	STEAM SUPPLY LINE DIFFERENTIAL PRESURE INDICATING SWITCH	HPCI	D	542	025	
PDIS-55-2N657B	STEAM SUPPLY LINE DIFFERENTIAL PRESURE INDICATING SWITCH	HPCI	B	533	024	
PDIS-55-2N657D	STEAM SUPPLY LINE DIFFERENTIAL PRESURE INDICATING SWITCH	HPCI	D	533	024	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PDISH-51-1N660A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	A	542	025	
PDISH-51-1N660B	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	B	542	025	
PDISH-51-2N660A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	A	542	025	
PDISH-51-2N660B	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	B	542	025	
PDISL-51-1N658A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	A	542	025	
PDISL-51-1N658B	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	B	542	025	
PDISL-51-1N658C	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	C	542	025	
PDISL-51-1N658D	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	D	542	025	
PDISL-51-2N658A	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	A	542	025	
PDISL-51-2N658B	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	B	542	025	
PDISL-51-2N658C	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	C	542	025	
PDISL-51-2N658D	PRESSURE DIFFERENTIAL INDICATING SWITCH	RHR	D	542	025	
PDS-49-1N660A	PRESSURE DIFFERENTIAL SWITCH	RCIC	A	542	025	
PDS-49-1N660C	PRESSURE DIFFERENTIAL SWITCH	RCIC	C	542	025	
PDS-49-2N660A	PRESSURE DIFFERENTIAL SWITCH	RCIC	A	542	025	
PDS-49-2N660C	PRESSURE DIFFERENTIAL SWITCH	RCIC	C	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PDS-55-1N660B	DIFFERENTIAL PRESSURE SWITCH	HPCI	B	542	025	
PDS-55-1N660D	DIFFERENTIAL PRESSURE SWITCH	HPCI	D	542	025	
PDS-55-2N660B	DIFFERENTIAL PRESSURE SWITCH	HPCI	B	542	025	
PDS-55-2N660D	PRESSURE DIFFERENTIAL SWITCH	HPCI	D	542	025	
PDS-59-106A	PRESSURE DIFFERENTIAL SWITCH	PCIG	C	402W	045W	
PDS-59-106B	PRESSURE DIFFERENTIAL SWITCH	PCIG	D	402E	045E	
PDS-59-206A	PRESSURE DIFFERENTIAL SWITCH	PCIG	C	475W	068W	
PDS-59-206B	PRESSURE DIFFERENTIAL SWITCH	PCIG	D	475E	068E	
PDSH-20-122A	PRESSURE DIFFERENTIAL SWITCH	SDG	A	311A	079	
PDSH-20-122B	PRESSURE DIFFERENTIAL SWITCH	SDG	B	311B	081	
PDSH-20-122C	PRESSURE DIFFERENTIAL SWITCH	SDG	C	311C	080	
PDSH-20-122D	PRESSURE DIFFERENTIAL SWITCH	SDG	D	311D	082	
PDSH-20-222A	PRESSURE DIFFERENTIAL SWITCH	SDG	A	315A	083	
PDSH-20-222B	PRESSURE DIFFERENTIAL SWITCH	SDG	B	315B	085	
PDSH-20-222C	PRESSURE DIFFERENTIAL SWITCH	SDG	C	315C	084	
PDSH-20-222D	PRESSURE DIFFERENTIAL SWITCH	SDG	D	315D	086	
PDSH-50-101	PRESSURE DIFFERENTIAL SWITCH	RCIC	A	108	033	
PDSH-50-201	PRESSURE DIFFERENTIAL SWITCH	RCIC	A	179	056	
PDSL-51-1N661A	PRESSURE DIFFERENTIAL SWITCH	RHR	A	542	025	
PDSL-51-1N661B	PRESSURE DIFFERENTIAL SWITCH	RHR	B	542	025	
PDSL-51-2N661A	PRESSURE DIFFERENTIAL SWITCH	RHR	A	542	025	
PDSL-51-2N661B	PRESSURE DIFFERENTIAL SWITCH	RHR	B	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PDT-49-1N057A	DIFFERENTIAL PRESSURE TRANSMITTER	RCIC	A	304E	044E	
PDT-49-1N057C	DIFFERENTIAL PRESSURE TRANSMITTER	RCIC	C	304E	044E	
PDT-49-2N057A	DIFFERENTIAL PRESSURE TRANSMITTER	RCIC	A	370E	067E	
PDT-49-2N057C	DIFFERENTIAL PRESSURE TRANSMITTER	RCIC	C	370E	067E	
PDT-51-1N058A	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	A	402W	045W	
PDT-51-1N058B	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	B	402E	045E	
PDT-51-1N058C	DIFFERENTIAL PRESSURE TRANSMITTER	RHR 402W	C 045W	402E	045E	
PDT-51-1N058D	DIFFERENTIAL PRESSURE TRANSMITTER	RHR 402W	D 045W	402E	045E	
PDT-51-1N060A	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	A	506E	047E	
PDT-51-1N060B	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	B	402E	045E	
PDT-51-2N058A	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	A	475W	068W	
PDT-51-2N058B	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	B	475E	068E	
PDT-51-2N058C	DIFFERENTIAL PRESSURE TRANSMITTER	RHR 475W	C 068W	475E	068E	
PDT-51-2N058D	DIFFERENTIAL PRESSURE TRANSMITTER	RHR 475W	D 068W	475E	068E	
PDT-51-2N060A	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	A	580W	070W	
PDT-51-2N060B	DIFFERENTIAL PRESSURE TRANSMITTER	RHR	B	475E	068E	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PDT-55-1N057B	DIFFERENTIAL PRESSURE TRANSMITTER	HPCI	B	304W	044W	
PDT-55-1N057D	DIFFERENTIAL PRESSURE TRANSMITTER	HPCI	D	304W	044W	
PDT-55-2N057B	DIFFERENTIAL PRESSURE TRANSMITTER	HPCI	B	370W	067W	
PDT-55-2N057D	DIFFERENTIAL PRESSURE TRANSMITTER	HPCI	D	370W	067W	
PI-11-003A-1	ESW PUMP A DISCHARGE HEADER	ESW	A	533	024	0-ESW-A
PI-11-003A-2	ESW PUMP A DISCHARGE HEADER	ESW	A	540	026	0-ESW-R
PI-11-003B	ESW PUMP B DISCHARGE HEADER	ESW	B	533	024	0-ESW-B
PI-12-001A-1	RHRSW LOOP A HEADER PRESSURE	RHRSW	A	533	024	2-RHRSW-A 1-RHRSW-A
PI-12-001A-2	RHRSW LOOP A HEADER PRESSURE	RHRSW	A	540	026	1-RHRSW-A
PI-12-001A-3	RHRSW LOOP A HEADER PRESSURE	RHRSW	A	540	026	2-RHRSW-A
PI-12-001B	RHRSW LOOP B HEADER PRESSURE	RHRSW	B	533	024	1-RHRSW-B 2-RHRSW-B
PI-42-1R011	REACTOR VESSEL PRESSURE INDICATOR	RVI	A	540	026	1-RVI
PI-42-2R011	REACTOR VESSEL PRESSURE INDICATOR	RVI	A	540	026	2-RVI
PI-51-105A-1	RHR HEAT EXCHANGER 1AE205 SERVICE WATER DISCHARGE	RHRSW	A	533	024	1-RHRSW-A
PI-51-105A-2	RHR HEAT EXCHANGER 1AE205 SERVICE WATER DISCHARGE	RHRSW	A	540	026	1-RHRSW-A
PI-51-105B	RHR HEAT EXCHANGER 1BE205 SERVICE WATER DISCHARGE	RHRSW	B	533	024	1-RHRSW-B
PI-51-1R003A	RHR PUMP A DISCHARGE PRESSURE (LOCAL)	RHR	N/A	200	042	1-RHRSC-A 1-RHRSPC-A

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PI-51-205A-1	RHR HEAT EXCHANGER 2AE205 SERVICE WATER DISCHARGE	RHRSW	A	533	024	2-RHRSW-A
PI-51-205A-2	RHR HEAT EXCHANGER 2AE205 SERVICE WATER DISCHARGE	RHRSW	A	540	026	2-RHRSW-A
PI-51-205B	RHR HEAT EXCHANGER 2BE205 SERVICE WATER DISCHARGE	RHRSW	B	533	024	2-RHRSW-B
PI-55-1R601	PUMP DISCHARGE LINE PRESSURE INDICATOR	HPCI	B	533	024	1-HPCI
PI-55-2R601	PUMP DISCHARGE LINE PRESSURE INDICATOR	HPCI	B	533	024	2-HPCI
PIS-42-1N690A	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-1N690B	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-1N690C	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-1N690D	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-1N690E	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-1N690F	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-1N690G	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-1N690H	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-1N694A	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-1N694B	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-1N694C	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-1N694D	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-1N694E	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-1N694F	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-1N694G	PRESSURE INDICATING SWITCH	CS	C	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PIS-42-1N694H	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-2N690A	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-2N690B	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-2N690C	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-2N690D	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-2N690E	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-2N690F	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-2N690G	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-2N690H	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-2N694A	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-2N694B	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-2N694C	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-2N694D	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-42-2N694E	PRESSURE INDICATING SWITCH	CS	A	542	025	
PIS-42-2N694F	PRESSURE INDICATING SWITCH	CS	B	542	025	
PIS-42-2N694G	PRESSURE INDICATING SWITCH	CS	C	542	025	
PIS-42-2N694H	PRESSURE INDICATING SWITCH	CS	D	542	025	
PIS-49-1N650	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-1N658A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-1N658C	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-49-1N658E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-1N658G	PRESSURE INDICATING SWITCH	RCIC	C	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PIS-49-2N650	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-2N658A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-2N658C	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-49-2N658E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-49-2N658G	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-50-1N652	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-1N653	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-1N655A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-1N655C	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-50-1N655E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-1N655G	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-50-1N656A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-1N656E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N652	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N653	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N655A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N655C	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-50-2N655E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N655G	PRESSURE INDICATING SWITCH	RCIC	C	542	025	
PIS-50-2N656A	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-50-2N656E	PRESSURE INDICATING SWITCH	RCIC	A	542	025	
PIS-51-1N655A	PRESSURE INDICATING SWITCH	ADS	A	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PIS-51-1N655C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-1N655E	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-1N655G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-1N656A	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-1N656C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-1N656E	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-1N656G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-2N655A	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-2N655C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-2N655E	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-2N655G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-2N656A	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-2N656C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-51-2N656E	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-51-2N656G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-52-1N655A	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-52-1N655C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-52-1N655E	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-52-1N655G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-52-2N655A	PRESSURE INDICATING SWITCH	ADS	A	542	025	
PIS-52-2N655C	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-52-2N655E	PRESSURE INDICATING SWITCH	ADS	A	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PIS-52-2N655G	PRESSURE INDICATING SWITCH	ADS	C	542	025	
PIS-55-1N650	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-1N658B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-1N658D	PRESSURE DIFFERENTIAL INDICATING SWITCH	HPCI	D	542	025	
PIS-55-1N658F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-1N658H	PRESSURE DIFFERENTIAL INDICATING SWITCH	HPCI	D	542	025	
PIS-55-2N650	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-2N658B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-2N658D	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-55-2N658F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-55-2N658H	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-56-1N652	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-1N653	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-1N655B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-1N655D	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-56-1N655F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-1N655H	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-56-1N656B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-1N656F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-2N652	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-2N653	PRESSURE INDICATING SWITCH	HPCI	B	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PIS-56-2N655B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-2N655D	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-56-2N655F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-2N655H	PRESSURE INDICATING SWITCH	HPCI	D	542	025	
PIS-56-2N656B	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PIS-56-2N656F	PRESSURE INDICATING SWITCH	HPCI	B	542	025	
PISH-51-1N653A	PRESSURE INDICATING SWITCH	RHR	A	542	025	
PISH-51-1N653B	PRESSURE INDICATING SWITCH	RHR	B	542	025	
PISH-51-1N653C	PRESSURE INDICATING SWITCH	RHR	C	542	025	
PISH-51-1N653D	PRESSURE SWITCH INDICATING	RHR	D	542	025	
PISH-51-1N657	PRESSURE INDICATING SWITCH	RHR	B	542	025	
PISH-51-2N653A	PRESSURE INDICATING SWITCH	RHR	A	542	025	
PISH-51-2N653B	PRESSURE INDICATING SWITCH	RHR	B	542	025	
PISH-51-2N653C	PRESSURE INDICATING SWITCH	RHR	C	542	025	
PISH-51-2N657	PRESSURE INDICATING SWITCH	RHR	B	542	025	
PIT-51-105A	RHR HEAT EXCHANGER 1AE205 SERVICE WATER DISCHARGE	RHRSW	A	200	042	
PIT-51-105B	RHR HEAT EXCHANGER 1BE205 SERVICE WATER DISCHARGE	RHRSW	B	207	041	
PIT-51-205A	RHR HEAT EXCHANGER 2AE205 SERVICE WATER DISCHARGE	RHRSW	A	284	064	
PIT-51-205B	RHR HEAT EXCHANGER 2BE205 SERVICE WATER DISCHARGE	RHRSW	B	179	056	
PSH-12-004A	PRESSURE SWITCH - HIGH	RHRSW	A	1000	122	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PSH-12-004B	PRESSURE SWITCH - HIGH	RHRSW	B	1005	123	
PSH-12-004C	PRESSURE SWITCH - HIGH	RHRSW	A	1000	122	
PSH-12-004D	PRESSURE SWITCH - HIGH	RHRSW	B	1005	123	
PSL-11-002A	PRESSURE SWITCH - LOW	ESW	A	1000	122	
PSL-11-002B	PRESSURE SWITCH - LOW	ESW	B	1005	123	
PSL-11-002C	PRESSURE SWITCH - LOW	ESW	C	1000	122	
PSL-11-002D	PRESSURE SWITCH - LOW	ESW	D	1005	123	
PSL-12-001A	PRESSURE SWITCH - LOW	RHRSW	A	1000	122	
PSL-12-001B	PRESSURE SWITCH - LOW	RHRSW	B	1005	123	
PSL-12-001C	PRESSURE SWITCH - LOW	RHRSW	A	1000	122	
PSL-12-001D	PRESSURE SWITCH - LOW	RHRSW	B	1005	123	
PSL-12-102A	PRESSURE SWITCH - LOW	RHRSW	A	202	075	
PSL-12-102B	PRESSURE SWITCH - LOW	RHRSW	B	202	075	
PSL-12-202A	PRESSURE SWITCH - LOW	RHRSW	A	202	075	
PSL-12-202B	PRESSURE SWITCH - LOW	RHRSW	B	202	075	
PSL-42-101	PRESSURE SWITCH - LOW	RHR/ HILOW	B	402E	045E	
PSL-42-201	PRESSURE SWITCH - LOW	RHR/ HILOW	B	475E	068E	
PSL-50-101	PRESSURE SWITCH - LOW	RCIC	A	108	033	
PSL-50-201	PRESSURE SWITCH - LOW	RCIC	A	179	056	
PSL-51-1N654A	PRESSURE SWITCH - LOW	RHR	A	542	025	
PSL-51-1N654B	PRESSURE SWITCH - LOW	RHR	B	542	025	
PSL-51-1N654C	PRESSURE SWITCH - LOW	RHR	C	542	025	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PSL-51-1N654D	PRESSURE SWITCH - LOW	RHR	D	542	025	
PSL-51-2N653D	PRESSURE SWITCH - LOW	RHR	D	542	025	
PSL-51-2N654A	PRESSURE SWITCH - LOW	RHR	A	542	025	
PSL-51-2N654B	PRESSURE SWITCH - LOW	RHR	B	542	025	
PSL-51-2N654C	PRESSURE SWITCH - LOW	RHR	C	542	025	
PSL-51-2N654D	PRESSURE SWITCH - LOW	RHR	D	542	025	
PSV-41-1F013A	MAIN STEAM RELIEF VALVE "A"	MSRV	A	400	030	1-MSRV
PSV-41-1F013C	MAIN STEAM RELIEF VALVE "C"	MSRV	A	400	030	1-MSRV
PSV-41-1F013E	MAIN STEAM RELIEF VALVE "E" (ADS)	ADS	A,C	400	030	1-ADS
PSV-41-1F013H	MAIN STEAM RELIEF VALVE "H" (ADS)	ADS	A,C	400	030	1-ADS
PSV-41-1F013K	MAIN STEAM RELIEF VALVE "K" (ADS)	ADS	A,C	400	030	1-ADS
PSV-41-1F013M	MAIN STEAM RELIEF VALVE "M" (ADS)	ADS	A,C	400	030	1-ADS
PSV-41-1F013N	MAIN STEAM RELIEF VALVE "N"	MSRV	A	400	030	1-MSRV
PSV-41-1F013S	MAIN STEAM RELIEF VALVE "S" (ADS)	ADS	A,C	400	030	1-ADS
PSV-41-2F013A	MAIN STEAM RELIEF VALVE "A"	MSRV	A	473	053	2-MSRV
PSV-41-2F013C	MAIN STEAM RELIEF VALVE "C"	MSRV	A	473	053	2-MSRV
PSV-41-2F013E	MAIN STEAM RELIEF VALVE "E" (ADS)	ADS	A,C	473	053	2-ADS
PSV-41-2F013H	MAIN STEAM RELIEF VALVE "H" (ADS)	ADS	A,C	473	053	2-ADS
PSV-41-2F013K	MAIN STEAM RELIEF VALVE "K" (ADS)	ADS	A,C	473	053	2-ADS
PSV-41-2F013M	MAIN STEAM RELIEF VALVE "M" (ADS)	ADS	A,C	473	053	2-ADS
PSV-41-2F013N	MAIN STEAM RELIEF VALVE "N"	MSRV	A	473	053	2-MSRV
PSV-41-2F013S	MAIN STEAM RELIEF VALVE "S" (ADS)	ADS	A,C	473	053	2-ADS

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-11-003A	ESW PUMP A DISCHARGE HEADER	ESW	A	1011	122	
PT-11-003B	ESW PUMP B DISCHARGE HEADER	ESW	B	1016	123	
PT-12-001A	RHRSW LOOP A HEADER PRESSURE	RHRSW	A	1011	122	
PT-12-001B	RHRSW LOOP B HEADER PRESSURE	RHRSW	B	1016	123	
PT-42-103A	PRESSURE TRANSMITTER	RVI	A	402W	045W	
PT-42-103B	PRESSURE TRANSMITTER	RVI	B	402E	045E	
PT-42-1N006	PRESSURE TRANSMITTER	RVI	A	402W	045W	
PT-42-1N090A	PRESSURE TRANSMITTER	CS	A	402W	045W	
PT-42-1N090B	PRESSURE TRANSMITTER	CS	B	402E	045E	
PT-42-1N090C	PRESSURE TRANSMITTER	CS	C	402E 402W	045E 045W	
PT-42-1N090D	PRESSURE TRANSMITTER	CS	D	402E 402W	045E 045W	
PT-42-1N090E	PRESSURE TRANSMITTER	CS	A	402W	045W	
PT-42-1N090F	PRESSURE TRANSMITTER	CS	B	402E	045E	
PT-42-1N090G	PRESSURE TRANSMITTER	CS	C	402E 402W	045E 045W	
PT-42-1N090H	PRESSURE TRANSMITTER	CS	D	402E 402W	045E 045W	
PT-42-1N094A	PRESSURE TRANSMITTER	CS	A	402W	045W	
PT-42-1N094B	PRESSURE TRANSMITTER	CS	B	402E	045E	
PT-42-1N094C	PRESSURE TRANSMITTER	CS	C	402E 402W	045E 045W	
PT-42-1N094D	PRESSURE TRANSMITTER	CS	D	402E 402W	045E 045W	
PT-42-1N094E	PRESSURE TRANSMITTER	CS	A	402W	045W	
PT-42-1N094F	PRESSURE TRANSMITTER	CS	B	402E	045E	
PT-42-1N094G	PRESSURE TRANSMITTER	CS	C	402E 402W	045E 045W	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-42-1N094H	PRESSURE TRANSMITTER	CS	D	402E 402W	045E 045W	
PT-42-203A	PRESSURE TRANSMITTER	RVI	A	475W	068W	
PT-42-203B	PRESSURE TRANSMITTER	RVI	B	475E	068E	
PT-42-2N006	PRESSURE TRANSMITTER	RVI	A	475W	068W	
PT-42-2N090A	PRESSURE TRANSMITTER	CS	A	475W	068W	
PT-42-2N090B	PRESSURE TRANSMITTER	CS	B	475E	068E	
PT-42-2N090C	PRESSURE TRANSMITTER	CS	C	475E 475W	068E 068W	
PT-42-2N090D	PRESSURE TRANSMITTER	CS	D	475E 475W	068E 068W	
PT-42-2N090E	PRESSURE TRANSMITTER	CS	A	475W	068W	
PT-42-2N090F	PRESSURE TRANSMITTER	CS	B	475E	068E	
PT-42-2N090G	PRESSURE TRANSMITTER	CS	C	475E 475W	068E 068W	
PT-42-2N090H	PRESSURE TRANSMITTER	CS	D	475E 475W	068E 068W	
PT-42-2N094A	PRESSURE TRANSMITTER	CS	A	475W	068W	
PT-42-2N094B	PRESSURE TRANSMITTER	CS	B	475E	068E	
PT-42-2N094C	PRESSURE TRANSMITTER	CS	C	475E 475W	068E 068W	
PT-42-2N094D	PRESSURE TRANSMITTER	CS	D	475E 475W	068E 068W	
PT-42-2N094E	PRESSURE TRANSMITTER	CS	A	475W	068W	
PT-42-2N094F	PRESSURE TRANSMITTER	CS	B	475E	068E	
PT-42-2N094G	PRESSURE TRANSMITTER	CS	C	475E 475W	068E 068W	
PT-42-2N094H	PRESSURE TRANSMITTER	CS	D	475E 475W	068E 068W	
PT-49-1N050	PRESSURE TRANSMITTER	RCIC	A	200	042	
PT-49-1N058A	PRESSURE TRANSMITTER	RCIC	A	304E	044E	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-49-1N058C	PRESSURE TRANSMITTER	RCIC	C	304E	044E	
PT-49-1N058E	PRESSURE TRANSMITTER	RCIC	A	304E	044E	
PT-49-1N058G	PRESSURE TRANSMITTER	RCIC	C	304E	044E	
PT-49-2N050	PRESSURE TRANSMITTER	RCIC	A	279	065	
PT-49-2N058A	PRESSURE TRANSMITTER	RCIC	A	370E	067E	
PT-49-2N058C	PRESSURE TRANSMITTER	RCIC	C	370E	067E	
PT-49-2N058E	PRESSURE TRANSMITTER	RCIC	A	370E	067E	
PT-49-2N058G	PRESSURE TRANSMITTER	RCIC	C	370E	067E	
PT-50-1N052	PRESSURE TRANSMITTER	RCIC	A	108	033	
PT-50-1N053	PRESSURE TRANSMITTER	RCIC	A	108	033	
PT-50-1N055A	PRESSURE TRANSMITTER	RCIC	A	200	042	
PT-50-1N055C	PRESSURE TRANSMITTER	RCIC	C	108	033	
PT-50-1N055E	PRESSURE TRANSMITTER	RCIC	A	200	042	
PT-50-1N055G	PRESSURE TRANSMITTER	RCIC	C	108	033	
PT-50-1N056A	PRESSURE TRANSMITTER	RCIC	A	200	042	
PT-50-1N056E	PRESSURE TRANSMITTER	RCIC	A	200	042	
PT-50-2N052	PRESSURE TRANSMITTER	RCIC	A	179	056	
PT-50-2N053	PRESSURE TRANSMITTER	RCIC	A	179	056	
PT-50-2N055A	PRESSURE TRANSMITTER	RCIC	A	279	065	
PT-50-2N055C	PRESSURE TRANSMITTER	RCIC	C	179	056	
PT-50-2N055E	PRESSURE TRANSMITTER	RCIC	A	279	065	
PT-50-2N055G	PRESSURE TRANSMITTER	RCIC	C	179	056	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-50-2N056A	PRESSURE TRANSMITTER	RCIC	A	279	065	
PT-50-2N056E	PRESSURE TRANSMITTER	RCIC	A	279	065	
PT-51-1N053A	PRESSURE TRANSMITTER	RHR	A	200	042	
PT-51-1N053B	PRESSURE TRANSMITTER	RHR	B	118	039	
PT-51-1N053C	PRESSURE TRANSMITTER	RHR	C	200	042	
PT-51-1N053D	PRESSURE TRANSMITTER	RHR	D	118	039	
PT-51-1N055A	PRESSURE TRANSMITTER	ADS	A	200	042	
PT-51-1N055C	PRESSURE TRANSMITTER	ADS	C	118	039	
PT-51-1N055E	PRESSURE TRANSMITTER	ADS	A	200	042	
PT-51-1N055G	PRESSURE TRANSMITTER	ADS	C	118	039	
PT-51-1N056A	PRESSURE TRANSMITTER	ADS	A	200	042	
PT-51-1N056C	PRESSURE TRANSMITTER	ADS	C	118	039	
PT-51-1N056E	PRESSURE TRANSMITTER	ADS	A	200	042	
PT-51-1N056G	PRESSURE TRANSMITTER	ADS	C	118	039	
PT-51-1N057	PRESSURE TRANSMITTER	RHR	B	304E	044E	
PT-51-2N053A	PRESSURE TRANSMITTER	RHR	A	189	062	
PT-51-2N053B	PRESSURE TRANSMITTER	RHR	B	279	065	
PT-51-2N053C	PRESSURE TRANSMITTER	RHR	C	189	062	
PT-51-2N053D	PRESSURE TRANSMITTER	RHR	D	279	065	
PT-51-2N055A	PRESSURE TRANSMITTER	ADS	A	189	062	
PT-51-2N055C	PRESSURE TRANSMITTER	ADS	C	279	065	
PT-51-2N055E	PRESSURE TRANSMITTER	ADS	A	189	062	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-51-2N055G	PRESSURE TRANSMITTER	ADS	C	279	065	
PT-51-2N056A	PRESSURE TRANSMITTER	ADS	A	189	062	
PT-51-2N056C	PRESSURE TRANSMITTER	ADS	C	279	065	
PT-51-2N056E	PRESSURE TRANSMITTER	ADS	A	189	062	
PT-51-2N056G	PRESSURE TRANSMITTER	ADS	C	279	065	
PT-51-2N057	PRESSURE TRANSMITTER	RHR	B	370W	067W	
PT-52-1N055A	PRESSURE TRANSMITTER	ADS	A	110	035	
PT-52-1N055C	PRESSURE TRANSMITTER	ADS	C	117	038	
PT-52-1N055E	PRESSURE TRANSMITTER	ADS	A	113	036	
PT-52-1N055G	PRESSURE TRANSMITTER	ADS	C	114	037	
PT-52-2N055A	PRESSURE TRANSMITTER	ADS	A	188	061	
PT-52-2N055C	PRESSURE TRANSMITTER	ADS	C	181	058	
PT-52-2N055E	PRESSURE TRANSMITTER	ADS	A	185	060	
PT-52-2N055G	PRESSURE TRANSMITTER	ADS	C	184	059	
PT-55-1N050	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-55-1N058B	PRESSURE TRANSMITTER	HPCI	B	304W	044W	
PT-55-1N058D	PRESSURE TRANSMITTER	HPCI	D	304W	044W	
PT-55-1N058F	PRESSURE TRANSMITTER	HPCI	B	304W	044W	
PT-55-1N058H	PRESSURE TRANSMITTER	HPCI	D	304W	044W	
PT-55-2N050	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-55-2N058B	PRESSURE TRANSMITTER	HPCI	B	370W	067W	
PT-55-2N058D	PRESSURE TRANSMITTER	HPCI	D	370W	067W	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
PT-55-2N058F	PRESSURE TRANSMITTER	HPCI	B	370W	067W	
PT-55-2N058H	PRESSURE TRANSMITTER	HPCI	D	370W	067W	
PT-56-1N052	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-1N053	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-1N055B	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-1N055D	PRESSURE TRANSMITTER	HPCI	D	200	042	
PT-56-1N055F	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-1N055H	PRESSURE TRANSMITTER	HPCI	D	200	042	
PT-56-1N056B	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-1N056F	PRESSURE TRANSMITTER	HPCI	B	109	034	
PT-56-2N052	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-56-2N053	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-56-2N055B	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-56-2N055D	PRESSURE TRANSMITTER	HPCI	D	279	065	
PT-56-2N055F	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-56-2N055H	PRESSURE TRANSMITTER	HPCI	D	279	065	
PT-56-2N056B	PRESSURE TRANSMITTER	HPCI	B	180	057	
PT-56-2N056F	PRESSURE TRANSMITTER	HPCI	B	180	057	
SI-50-101	SPEED INDICATOR	RCIC	A	533	024	
SI-50-1R003	SPEED INDICATOR	RCIC	A	540	026	
SI-50-201	SPEED INDICATOR	RCIC	A	533	024	
SI-50-2R003	SPEED INDICATOR	RCIC	A	540	026	
SI-56-161	SPEED INDICATOR	HPCI	B	533	024	
SI-56-261	SPEED INDICATOR	HPCI	B	533	024	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
SV-52-139	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	118	039	
SV-52-239	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	189	062	
SV-57-101	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	207	041	
SV-57-183	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	309W	043W	
SV-57-201	CTMT ISO VALVE FOR LEVEL SENSING LINES	SPI	A	284	064	
SV-59-150A	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	C	304W	044W	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D
SV-59-150B	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	D	304E	044E	1-RHRASC-B 1-RHRASC-A 1-RHRASC-D 1-RHRASC-C
SV-59-152A	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	C	304W	044W	1-RHRASC-A 1-RHRASC-B 1-RHRASC-C 1-RHRASC-D 1-MSRV
SV-59-152B	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	D	304E	044E	1-RHRASC-B 1-RHRASC-C 1-RHRASC-A 1-RHRASC-D
SV-59-250A	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	C	370E	067E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D
SV-59-250B	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	D	370E	067E	2-RHRASC-B 2-RHRASC-A 2-RHRASC-D 2-RHRASC-C
SV-59-252A	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	C	370E	067E	2-RHRASC-A 2-RHRASC-B 2-RHRASC-C 2-RHRASC-D 2-MSRV

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
SV-59-252B	COMPRESSED GAS SUPPLY SELECT VALVE	PCIG	D	370E	067E	2-RHRASC-B 2-RHRASC-C 2-RHRASC-A 2-RHRASC-D
TD-81-102A	CELL "A" AIR EXHAUST DAMPER	DGEV	A	311A	079	
TD-81-102B	CELL "B" AIR EXHAUST DAMPER	DGEV	B	311B	081	
TD-81-102C	CELL "C" AIR EXHAUST DAMPER	DGEV	C	311C	080	
TD-81-102D	CELL "D" AIR EXHAUST DAMPER	DGEV	D	311D	082	
TD-81-102E	CELL "A" AIR EXHAUST DAMPER	DGEV	A	311A	079	
TD-81-102F	CELL "B" AIR EXHAUST DAMPER	DGEV	B	311B	081	
TD-81-102G	CELL "C" AIR EXHAUST DAMPER	DGEV	C	311C	080	
TD-81-102H	CELL "D" AIR EXHAUST DAMPER	DGEV	D	311D	082	
TD-81-202A	CELL "A" AIR EXHAUST DAMPER	DGEV	A	315A	083	
TD-81-202B	CELL "B" AIR EXHAUST DAMPER	DGEV	B	315B	085	
TD-81-202C	CELL "C" AIR EXHAUST DAMPER	DGEV	C	315C	084	
TD-81-202D	CELL "D" AIR EXHAUST DAMPER	DGEV	D	315D	086	
TD-81-202E	CELL "A" AIR EXHAUST DAMPER	DGEV	A	315A	083	
TD-81-202F	CELL "B" AIR EXHAUST DAMPER	DGEV	B	315B	085	
TD-81-202G	CELL "C" AIR EXHAUST DAMPER	DGEV	C	315C	084	
TD-81-202H	CELL "D" AIR EXHAUST DAMPER	DGEV	D	315D	086	
TE-41-101A	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101B	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101C	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101D	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101E	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101F	TEMPERATURE ELEMENT	SPI	A	101	029	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TE-41-101G	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-101H	TEMPERATURE ELEMENT	SPI	A	101	029	
TE-41-103A	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103B	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103C	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103D	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103E	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103F	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103G	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-103H	TEMPERATURE ELEMENT	SPI	B	101	029	
TE-41-201A	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201B	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201C	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201D	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201E	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201F	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201G	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-201H	TEMPERATURE ELEMENT	SPI	A	172	052	
TE-41-203A	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203B	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203C	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203D	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203E	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203F	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203G	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-41-203H	TEMPERATURE ELEMENT	SPI	B	172	052	
TE-76-121A	TEMPERATURE ELEMENT	REV	A	108	033	
TE-76-121B	TEMPERATURE ELEMENT	REV	A	108	033	
TE-76-122A	TEMPERATURE ELEMENT	REV	B	109	034	
TE-76-122B	TEMPERATURE ELEMENT	REV	B	109	034	
TE-76-123A	TEMPERATURE ELEMENT	REV	A	102	032	
TE-76-123B	TEMPERATURE ELEMENT	REV	B	103	031	
TE-76-123C	TEMPERATURE ELEMENT	REV	C	102	032	
TE-76-123D	TEMPERATURE ELEMENT	REV	D	103	031	
TE-76-123E	TEMPERATURE ELEMENT	REV	A	102	032	
TE-76-123F	TEMPERATURE ELEMENT	REV	B	103	031	
TE-76-123G	TEMPERATURE ELEMENT	REV	C	102	032	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TE-76-123H	TEMPERATURE ELEMENT	REV	D	103	031	
TE-76-221A	TEMPERATURE ELEMENT	REV	A	179	056	
TE-76-221B	TEMPERATURE ELEMENT	REV	A	179	056	
TE-76-222A	TEMPERATURE ELEMENT	REV	B	180	057	
TE-76-222B	TEMPERATURE ELEMENT	REV	B	180	057	
TE-76-223A	TEMPERATURE ELEMENT	REV	A	173	054	
TE-76-223B	TEMPERATURE ELEMENT	REV	B	174	055	
TE-76-223C	TEMPERATURE ELEMENT	REV	C	173	054	
TE-76-223D	TEMPERATURE ELEMENT	REV	D	174	055	
TE-76-223E	TEMPERATURE ELEMENT	REV	A	173	054	
TE-76-223F	TEMPERATURE ELEMENT	REV	B	174	055	
TE-76-223G	TEMPERATURE ELEMENT	REV	C	173	054	
TE-76-223H	TEMPERATURE ELEMENT	REV	D	174	055	
TE-81-040A	TEMPERATURE ELEMENT	SPPV	A	1000	122	
TE-81-040B	TEMPERATURE ELEMENT	SPPV	B	1005	123	
TE-81-040C	TEMPERATURE ELEMENT	SPPV	C	1000	122	
TE-81-040D	TEMPERATURE ELEMENT	SPPV	D	1005	123	
TE-81-041A	TEMPERATURE ELEMENT	SPPV	A	1000	122	
TE-81-041B	TEMPERATURE ELEMENT	SPPV	B	1005	123	
TE-81-041C	TEMPERATURE ELEMENT	SPPV	C	1000	122	
TE-81-041D	TEMPERATURE ELEMENT	SPPV	D	1005	123	
TE-81-101A	TEMPERATURE ELEMENT	DGEV	A	311A	079	
TE-81-101B	TEMPERATURE ELEMENT	DGEV	B	311B	081	
TE-81-101C	TEMPERATURE ELEMENT	DGEV	C	311C	080	
TE-81-101D	TEMPERATURE ELEMENT	DGEV	D	311D	082	
TE-81-101E	TEMPERATURE ELEMENT	DGEV	A	311A	079	
TE-81-101F	TEMPERATURE ELEMENT	DGEV	B	311B	081	
TE-81-101G	TEMPERATURE ELEMENT	DGEV	C	311C	080	
TE-81-101H	TEMPERATURE ELEMENT	DGEV	D	311D	082	
TE-81-201A	TEMPERATURE ELEMENT	DGEV	A	315A	083	
TE-81-201B	TEMPERATURE ELEMENT	DGEV	B	315B	085	
TE-81-201C	TEMPERATURE ELEMENT	DGEV	C	315C	084	
TE-81-201D	TEMPERATURE ELEMENT	DGEV	D	315D	086	
TE-81-201E	TEMPERATURE ELEMENT	DGEV	A	315A	083	
TE-81-201F	TEMPERATURE ELEMENT	DGEV	B	315B	085	
TE-81-201G	TEMPERATURE ELEMENT	DGEV	C	315C	084	
TE-81-201H	TEMPERATURE ELEMENT	DGEV	D	315D	086	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TI-41-101	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	A	533	024	1-SPI
TI-41-102	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	A	540	026	1-SPI
TI-41-103	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	B	533	024	1-SPI
TI-41-201	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	A	533	024	2-SPI
TI-41-202	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	A	540	026	2-SPI
TI-41-203	SUPPRESSION POOL TEMPERATURE INDICATOR	SPI	B	533	024	2-SPI
TI-50-140B	TEMPERATURE INDICATOR	RCIC	A	108	033	
TI-50-240B	TEMPERATURE INDICATOR	RCIC	A	179	056	
TISH-20-121A	TEMPERATURE INDICATING SWITCH	SDG	A	312A	079	
TISH-20-121B	TEMPERATURE INDICATING SWITCH	SDG	B	312B	081	
TISH-20-121C	TEMPERATURE INDICATING SWITCH	SDG	C	312C	080	
TISH-20-121D	TEMPERATURE INDICATING SWITCH	SDG	D	312D	082	
TISH-20-221A	TEMPERATURE INDICATING SWITCH	SDG	A	316A	083	
TISH-20-221B	TEMPERATURE INDICATING SWITCH	SDG	B	316B	085	
TISH-20-221C	TEMPERATURE INDICATING SWITCH	SDG	C	316C	084	
TISH-20-221D	TEMPERATURE INDICATING SWITCH	SDG	D	316D	086	
TISL-81-040A	TEMPERATURE INDICATING SWITCH	SPPV	A	1000	122	
TISL-81-040B	TEMPERATURE INDICATING SWITCH	SPPV	B	1005	123	
TISL-81-040C	TEMPERATURE INDICATING SWITCH	SPPV	C	1000	122	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TISL-81-040D	TEMPERATURE INDICATING SWITCH	SPPV	D	1005	123	
TIT-76-121A	RCIC COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	200	042	
TIT-76-121B	RCIC COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	200	042	
TIT-76-122A	HPCI COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	207	041	
TIT-76-122B	HPCI COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	207	041	
TIT-76-123A	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	200	042	
TIT-76-123B	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	207	041	
TIT-76-123C	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	C	200	042	
TIT-76-123D	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	D	207	041	
TIT-76-123E	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	200	042	
TIT-76-123F	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	207	041	
TIT-76-123G	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	C	200	042	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TIT-76-123H	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	D	207	041	
TIT-76-221A	RCIC COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	284	064	
TIT-76-221B	RCIC COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	284	064	
TIT-76-222A	HPCI COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	279	065	
TIT-76-222B	HPCI COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	279	065	
TIT-76-223A	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	284	064	
TIT-76-223B	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	279	065	
TIT-76-223C	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	C	284	064	
TIT-76-223D	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	D	279	065	
TIT-76-223E	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	A	284	064	
TIT-76-223F	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	B	279	065	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TIT-76-223G	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	C	284	064	
TIT-76-223H	RHR COMPARTMENT TEMPERATURE INDICATING TRANSMITTER	REV	D	279	065	
TRS-41-101	DIV. I SUPPRESSION POOL TEMPERATURE MONITORING SYSTEM	SPI	A	533	024	
TRS-41-103	DIV. II SUPPRESSION POOL TEMPERATURE MONITORING SYSTEM	SPI	B	533	024	
TRS-41-201	DIV. I SUPPRESSION POOL TEMPERATURE MONITORING SYSTEM	SPI	A	533	024	
TRS-41-203	DIV. II SUPPRESSION POOL TEMPERATURE MONITORING SYSTEM	SPI	B	533	024	
TSH-HH76-121A	TEMPERATURE SWITCH	REV	A	200	042	
TSH-HH76-121B	TEMPERATURE SWITCH	REV	B	200	042	
TSH-HH76-122A	TEMPERATURE SWITCH	REV	A	207	041	
TSH-HH76-122B	TEMPERATURE SWITCH	REV	B	207	041	
TSH-HH76-123A	TEMPERATURE SWITCH	REV	A	200	042	
TSH-HH76-123B	TEMPERATURE SWITCH	REV	B	207	041	
TSH-HH76-123C	TEMPERATURE SWITCH	REV	C	200	042	
TSH-HH76-123D	TEMPERATURE SWITCH	REV	D	207	041	
TSH-HH76-123E	TEMPERATURE SWITCH	REV	A	200	042	
TSH-HH76-123F	TEMPERATURE SWITCH	REV	B	207	041	
TSH-HH76-123G	TEMPERATURE SWITCH	REV	C	200	042	
TSH-HH76-123H	TEMPERATURE SWITCH	REV	D	207	041	
TSH-HH76-221A	TEMPERATURE SWITCH	REV	A	284	064	
TSH-HH76-221B	TEMPERATURE SWITCH	REV	B	284	064	
TSH-HH76-222A	TEMPERATURE SWITCH	REV	A	279	065	
TSH-HH76-222B	TEMPERATURE SWITCH	REV	B	279	065	
TSH-HH76-223A	TEMPERATURE SWITCH	REV	A	284	064	
TSH-HH76-223B	TEMPERATURE SWITCH	REV	B	279	065	
TSH-HH76-223C	TEMPERATURE SWITCH	REV	C	284	064	
TSH-HH76-223D	TEMPERATURE SWITCH	REV	D	279	065	
TSH-HH76-223E	TEMPERATURE SWITCH	REV	A	284	064	
TSH-HH76-223F	TEMPERATURE SWITCH	REV	B	279	065	
TSH-HH76-223G	TEMPERATURE SWITCH	REV	C	284	064	
TSH-HH76-223H	TEMPERATURE SWITCH	REV	D	279	065	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TSH-HH81-101A	TEMPERATURE SWITCH	DGEV	A	311A	079	
TSH-HH81-101B	TEMPERATURE SWITCH	DGEV	B	311B	081	
TSH-HH81-101C	TEMPERATURE SWITCH	DGEV	C	311C	080	
TSH-HH81-101D	TEMPERATURE SWITCH	DGEV	D	311D	082	
TSH-HH81-101E	TEMPERATURE SWITCH	DGEV	A	311A	079	
TSH-HH81-101F	TEMPERATURE SWITCH	DGEV	B	311B	081	
TSH-HH81-101G	TEMPERATURE SWITCH	DGEV	C	311C	080	
TSH-HH81-101H	TEMPERATURE SWITCH	DGEV	D	311D	082	
TSH-HH81-201A	TEMPERATURE SWITCH	DGEV	A	315A	083	
TSH-HH81-201B	TEMPERATURE SWITCH	DGEV	B	315B	085	
TSH-HH81-201C	TEMPERATURE SWITCH	DGEV	C	315C	084	
TSH-HH81-201D	TEMPERATURE SWITCH	DGEV	D	315D	086	
TSH-HH81-201E	TEMPERATURE SWITCH	DGEV	A	315A	083	
TSH-HH81-201F	TEMPERATURE SWITCH	DGEV	B	315B	085	
TSH-HH81-201G	TEMPERATURE SWITCH	DGEV	C	315C	084	
TSH-HH81-201H	TEMPERATURE SWITCH	DGEV	D	315D	086	
TSHL-76-121A	TEMPERATURE SWITCH	REV	A	200	042	
TSHL-76-121B	TEMPERATURE SWITCH	REV	B	200	042	
TSHL-76-122A	TEMPERATURE SWITCH	REV	A	207	041	
TSHL-76-122B	TEMPERATURE SWITCH	REV	B	207	041	
TSHL-76-123A	TEMPERATURE SWITCH	REV	A	200	042	
TSHL-76-123B	TEMPERATURE SWITCH	REV	B	207	041	
TSHL-76-123C	TEMPERATURE SWITCH	REV	C	200	042	
TSHL-76-123D	TEMPERATURE SWITCH	REV	D	207	041	
TSHL-76-123E	TEMPERATURE SWITCH	REV	A	200	042	
TSHL-76-123F	TEMPERATURE SWITCH	REV	B	207	041	
TSHL-76-123G	TEMPERATURE SWITCH	REV	C	200	042	
TSHL-76-123H	TEMPERATURE SWITCH	REV	D	207	041	
TSHL-76-221A	TEMPERATURE SWITCH	REV	A	284	064	
TSHL-76-221B	TEMPERATURE SWITCH	REV	B	284	064	
TSHL-76-222A	TEMPERATURE SWITCH	REV	A	279	065	
TSHL-76-222B	TEMPERATURE SWITCH	REV	B	279	065	
TSHL-76-223A	TEMPERATURE SWITCH	REV	A	284	064	
TSHL-76-223B	TEMPERATURE SWITCH	REV	B	279	065	
TSHL-76-223C	TEMPERATURE SWITCH	REV	C	284	064	
TSHL-76-223D	TEMPERATURE SWITCH	REV	D	279	065	
TSHL-76-223E	TEMPERATURE SWITCH	REV	A	284	064	
TSHL-76-223F	TEMPERATURE SWITCH	REV	B	279	065	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TSHL-76-223G	TEMPERATURE SWITCH	REV	C	284	064	
TSHL-76-223H	TEMPERATURE SWITCH	REV	D	279	065	
TSHL-81-341A	TEMPERATURE SWITCH	SPPV	A	1000	122	
TSHL-81-341B	TEMPERATURE SWITCH	SPPV	B	1005	123	
TSHL-81-341C	TEMPERATURE SWITCH	SPPV	C	1000	122	
TSHL-81-341D	TEMPERATURE SWITCH	SPPV	D	1005	123	
TTICSL-81-041A	SYSTEM "A" FAN CABINET TEMPERATURE INDICATING CONTROLLER	SPPV	A	1000	122	
TTICSL-81-041B	SYSTEM "B" FAN CABINET TEMPERATURE INDICATING CONTROLLER	SPPV	B	1005	123	
TTICSL-81-041C	SYSTEM "C" FAN CABINET TEMPERATURE INDICATING CONTROLLER	SPPV	C	1000	122	
TTICSL-81-041D	SYSTEM "D" FAN CABINET TEMPERATURE INDICATING CONTROLLER	SPPV	D	1005	123	
TTICSHL-81-101A	CELL "A" EXHAUST FAN CONTROLLER	DGEV	A	311A	079	
TTICSHL-81-101B	CELL "B" EXHAUST FAN CONTROLLER	DGEV	B	311B	081	
TTICSHL-81-101C	CELL "C" EXHAUST FAN CONTROLLER	DGEV	C	311C	080	
TTICSHL-81-101D	CELL "D" EXHAUST FAN CONTROLLER	DGEV	D	311D	082	
TTICSHL-81-101E	CELL "A" EXHAUST FAN CONTROLLER	DGEV	A	311A	079	
TTICSHL-81-101F	CELL "B" EXHAUST FAN CONTROLLER	DGEV	B	311B	081	
TTICSHL-81-101G	CELL "C" EXHAUST FAN CONTROLLER	DGEV	C	311C	080	
TTICSHL-81-101H	CELL "D" EXHAUST FAN CONTROLLER	DGEV	D	311D	082	
TTICSHL-81-201A	CELL "A" EXHAUST FAN CONTROLLER	DGEV	A	315A	083	
TTICSHL-81-201B	CELL "B" EXHAUST FAN CONTROLLER	DGEV	B	315B	085	

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
TTICSHL-81-201C	CELL "C" EXHAUST FAN CONTROLLER	DGEV	C	315C	084	
TTICSHL-81-201D	CELL "D" EXHAUST FAN CONTROLLER	DGEV	D	315D	086	
TTICSHL-81-201E	CELL "A" EXHAUST FAN CONTROLLER	DGEV	A	315A	083	
TTICSHL-81-201F	CELL "B" EXHAUST FAN CONTROLLER	DGEV	B	315B	085	
TTICSHL-81-201G	CELL "C" EXHAUST FAN CONTROLLER	DGEV	C	315C	084	
TTICSHL-81-201H	CELL "D" EXHAUST FAN CONTROLLER	DGEV	D	315D	086	
TY-41-102	TEMPERATURE CONVERTER	SPI	A	540	026	
TY-41-202	TEMPERATURE CONVERTER	SPI	A	540	026	
TY-81-101A	TEMPERATURE SIGNAL SELECTOR	DGEV	A	311A	079	
TY-81-101B	TEMPERATURE SIGNAL SELECTOR	DGEV	B	311B	081	
TY-81-101C	TEMPERATURE SIGNAL SELECTOR	DGEV	C	311C	080	
TY-81-101D	TEMPERATURE SIGNAL SELECTOR	DGEV	D	311D	082	
TY-81-201A	TEMPERATURE SIGNAL SELECTOR	DGEV	A	315A	083	
TY-81-201B	TEMPERATURE SIGNAL SELECTOR	DGEV	B	315B	085	
TY-81-201C	TEMPERATURE SIGNAL SELECTOR	DGEV	C	315C	084	
TY-81-201D	TEMPERATURE SIGNAL SELECTOR	DGEV	D	315D	086	
XR-42-1R623A	REACTOR VESSEL PRESSURE AND WATER LEVEL RECORDER	RVI	A	533	024	1-RVI
XR-42-1R623B	REACTOR VESSEL PRESSURE AND WATER LEVEL RECORDER	RVI	B	533	024	1-RVI
XR-42-2R623A	REACTOR VESSEL PRESSURE AND WATER LEVEL RECORDER	RVI	A	533	024	2-RVI
XR-42-2R623B	REACTOR VESSEL PRESSURE AND WATER LEVEL RECORDER	RVI	B	533	024	2-RVI

Table 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Component	Description	Plant Sys.	Sfgd. Chan.	Room	Fire Area	FSSD Sys. Design.
ZC-81-102A	POSITION CONTROLLER	DGEV	A	311A	079	
ZC-81-102B	POSITION CONTROLLER	DGEV	B	311B	081	
ZC-81-102C	POSITION CONTROLLER	DGEV	C	311C	080	
ZC-81-102D	POSITION CONTROLLER	DGEV	D	311D	082	
ZC-81-102E	POSITION CONTROLLER	DGEV	A	311A	079	
ZC-81-102F	POSITION CONTROLLER	DGEV	B	311B	081	
ZC-81-102G	POSITION CONTROLLER	DGEV	C	311C	080	
ZC-81-102H	POSITION CONTROLLER	DGEV	D	311D	082	
ZC-81-202A	POSITION CONTROLLER	DGEV	A	315A	083	
ZC-81-202B	POSITION CONTROLLER	DGEV	B	315B	085	
ZC-81-202C	POSITION CONTROLLER	DGEV	C	315C	084	
ZC-81-202D	POSITION CONTROLLER	DGEV	D	315D	086	
ZC-81-202E	POSITION CONTROLLER	DGEV	A	315A	083	
ZC-81-202F	POSITION CONTROLLER	DGEV	B	315B	085	
ZC-81-202G	POSITION CONTROLLER	DGEV	C	315C	084	
ZC-81-202H	POSITION CONTROLLER	DGEV	D	315D	086	

LEGEND FOR TABLE 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

The information presented in each column of Table 9A-4 is explained as follows.

Component	Major Safe Shutdown Components NOTE: Components identified with an asterix (*) designate associations of equipment and cables that perform common functions. These designations are used for analysis purposes only, and do not represent plant identification.
Description	Brief description of the component
Plant Sys.	General FSSD system designation for the component, based on the function the component provides

KEY:

ADS	Automatic Depressurization System
APS	13kV Power Supply to the 4kV Safeguard Busses
CS	Core Spray
DGEV	Diesel Generator Enclosure Ventilation
EPS	Class 1E Power Distribution System
ESW	Emergency Service Water System
HI/LOW	Selected Reactor Coolant Pressure Boundaries and High Low Pressure Interfaces
HPCI	High Pressure Coolant Injection System
MSRV	Main Steam Relief Valves
PCIG	Primary Containment Instrument Gas System
RCIC	Reactor Core Isolation Cooling System
REV	Reactor Enclosure Ventilation
RHR	Residual Heat Removal System
RHRSW	Residual Heat Removal Service Water System
RVI	Reactor Vessel Instrumentation
SDG	Standby Diesel Generators and Auxiliaries
SPI	Suppression Pool Instrumentation
SPPV	Spray Pond Pump Structure Ventilation

LEGEND FOR TABLE 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

Sfgd. Chan.	Safeguard Channel designation for electrical components NOTE: Components identified with a letter in parenthesis are not designated as safeguard, but are energized from the Safeguard Channel indicated.
Room	Room location for the component Components located in rooms which are subdivided by Combustible Free Zones have an East or West suffix provided to more precisely identify their location.
Fire Area	Fire Area location for the component Components located in Fire Areas which are subdivided by Combustible Free Zones have an East or West suffix provided to more precisely identify their location.
FSSD Sys.	Fire Safe Shutdown System/Train Designation
Desig.	Populated for components which directly support a Safe Shutdown Function. KEY: A-BBBBB-C A — Unit (0, 1, 2) BBBBB — System Function Designation (see table below) C — Loop/Train (provided for multi-train systems)

LEGEND FOR TABLE 9A-4 (Cont'd)

MAJOR COMPONENTS ANALYZED FOR FIRE SAFE SHUTDOWN

System Function Designations:

ESW	Emergency Service Water
ADS	Automatic Depressurization System
HI/LOW	Selected Reactor Coolant Pressure Boundaries and High Low Pressure Interfaces
HPCI	High Pressure Coolant Injection System
HPCITRIP	HPCI shutdown capability
MSRV	Main Steam Relief Valves
RCIC	Reactor Core Isolation Cooling System
RCICTRIP	RCIC shutdown capability
RHRASC	RHR Alternate Shutdown Cooling Mode
RHRLPCI	RHR Low Pressure Coolant Injection Mode
RHRSC	RHR Shutdown Cooling Mode
RHRSPC	RHR Suppression Pool Cooling Mode
RHRSW	RHR Service Water
RVI	Reactor Vessel Instrumentation - Direct-reading indication of Reactor parameters
SPI	Suppression Pool Instrumentation - Direct-reading indication of Suppression Pool parameters

Tables 9A-5 through 9A-11

Tables 9A-5 through 9A-11
(Deleted)

Table 9A-12

RCPB VALVES SUSCEPTIBLE TO
FIRE INDUCED SPURIOUS OPERATION

P&ID NUMBER	INTERFACE VALVES[1,2]	REMARKS
M-41	(U) HV-41-1F001 (D) HV-41-1F002 (U) HV-41-2F001 (D) HV-41-2F002	Located in piping from the RPV head vent line to the drywell equipment drain tank. If both valves open due to fire damage, the steam released into the drain tank would be vented into the drywell via the 4 inch vent line. No equipment needed for safe shutdown would be damaged.
M-41	(S) PSV-41-1F013A (S) PSV-41-2F013A	Located in a branch line connected to the main steam piping inside primary containment. Typical for suffix "B", "C", "D", "E", "F", "G", "H", "J", "K", "L", "M", "N", and "S" valves. If this valve opens, steam will be discharged from the reactor vessel to the suppression pool. Released reactor coolant will be retained inside the primary containment, and no equipment needed for safe shutdown will be damaged.
M-41	(U) HV-41-1F016 (D) HV-41-1F019 (U) HV-41-2F016 (D) HV-41-2F019	Located in the main steam drain line. If both of these valves open due to fire damage, various leakage paths downstream of the valves could allow reactor coolant to be discharged to the main condenser or the main steam tunnel. For all of the potential flow paths, this condition is acceptable because (a) the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods, (b) the mass inventory expected to be released is less than that expected for a main steam line break outside primary containment, and (c) the release of reactor coolant will not cause damage to any equipment needed for safe shutdown
M-41	(U) HV-41-1F022A (D) HV-41-1F028A (U) HV-41-2F022A (D) HV-41-2F028A	Located in the main steam lines between the reactor vessel and the turbine-generator. Typical for suffix "B", "C", and "D" valves. If both of these valves open simultaneously due to fire damage, the main steam piping outside primary containment would be pressurized. Although the main steam piping leading to the main turbine is designed as high pressure piping, there are a number of potential leakage paths associated with branch lines from the main steam lines. Because of the high reliability of the MSIVs and because of the fail-safe features of their design, these valves are assumed to retain their capability to close and remain closed during a postulated fire.

Table 9A-12 (Cont'd)

P&ID NUMBER	INTERFACE VALVES[1,2]	REMARKS
M-41	(U) HV-41-1F084 (D) HV-41-1F085	Located in the sample line from main steam line C to sample station 10S292 (20S292). If both valves open due to fire damage, a closed manual valve at the sample station would prevent steam blowdown.
M-41	(U) HV-41-109A (U) HV-41-109B (D) HV-41-110 (U) HV-41-209A (U) HV-41-209B (D) HV-41-210	Located in the feedwater recirculation line between the main feedwater headers and the main condenser. Spurious opening of either of the upstream valves together with the downstream valve as a result of fire-caused damage would allow water from the RWCU return line to be discharged to the main condenser via the feedwater headers. Plant procedures require that the circuit breakers for the upstream valves be locked open at motor control centers 10B213 (20B213) and 10B214 (20B214), with the valves in the fully closed position, after warmup of the feedwater lines has been completed. By de-energizing the breakers, fires which effect the control circuits to the valves are prevented from causing the valves to spuriously open. This action prevents the interface from opening in fire areas where RCIC is relied upon for safe shutdown. For other postulated fires, this condition is acceptable because (a) the reactor vessel inventory can be maintained by the available coolant makeup pumps, (b) the mass inventory expected to be released is less than expected for a main steam line break outside containment, and (c) the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.
M-43	(U) HV-43-1F019 (D) HV-43-1F020 (U) HV-43-2F019 (D) HV-43-2F020	Located in the sample line from recirculation loop B to sample station 10S292 (20S292). This spurious operation or loss of capability to close these valves due to fire damage, will allow the sample line to blowdown to clean radwaste system (CRWS). The leakage is acceptable because the inventory loss is within the RCIC pump make-up capability, the blowdown is limited by the 1/4 inch sample line and the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.

Table 9A-12 (Cont'd)

P&ID NUMBER	INTERFACE VALVES(1,2)	REMARKS
M-44	(U) HV-44-1F031 (U) HV-C44-1F033 (D) HV-44-1F034 (D) HV-44-1F035 (U) HV-44-2F031 (U) HV-C44-2F033 (D) HV-44-2F034 (D) HV-44-2F035	Located in the blowdown line from the RWCU system. If only valve HV-C44-1(2)F033 opens spuriously together with either HV-44-1(2)F034 or HV-44-1(2)F035 valve water from the RWCU system would be discharged to either the main condenser or the equipment drain collection tank. No equipment needed for safe shutdown would be damaged by the discharge of reactor coolant and the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods. To ensure that HV-44-1(2)F031 does not open and the blowdown flow rate is limited to an acceptable value, the power circuit for valve HV- 44-1F031 (2F031) will be isolated (with the valve in the fully closed position) when reactor pressure exceeds 75 psig.
M-44	(S) SV-45-101A (S) SV-45-201A	Located in the RWCU filter/demineralizer sample line. Typical for the suffix "B" valve. The loss of capability to close these valves due to fire damage, will allow the sample line to blowdown to clean radwaste system (CRWS). The leakage is acceptable because the inventory loss is within the RICI pump make-up capability, the blowdaown is limited by the 1/4 inch sample line and the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.
M-47	(U) XV-47-1F010 (D) XV-47-1F180 (U) XV-47-2F010 (D) XV-47-2F180	Located in the vent line from the scram discharge volume to an open floor drain. The SDV would be at high pressure only during the period following a scram and prior to reset of the scram signal. The discharge of water from the SDV into a floor drain during this period would not cause damage to any equipment needed for safe shutdown, and the flow rate would be low enough so that reactor vessel inventory could be maintained by the coolant makeup pumps that are available for each shutdown method.
M-47	(U) XV-47-1F011 (D) XV-47-1F181 (U) XV-47-2F011 (D) XV-47-2F181	Located in the drain line from the scram discharge volume to the equipment drain collection tank (via 8" HBC-133/233). The SDV would be at high pressure only during the period following a scram and prior to reset of the scram signal. The discharge of water from the SDV to the equipment drain collection tank during this period would not cause damage to any equipment needed for safe shutdown, and the flow rate would be low enough so that reactor vessel inventory could be maintained by the coolant makeup pumps that are available for each shutdown method.

Table 9A-12 (Cont'd)

P&ID NUMBER	INTERFACE VALVES[1,2]	REMARKS
M-49	(S) LV-49-1F054 (S) LV-49-2F054	Located in the drain line from the drain pot in the RCIC steam supply line. If this valve opens due to fire damage, main steam would be discharged to the main condenser. This condition is acceptable because (a) the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods, (b) the mass inventory expected to be released is less than that expected for a main steam line break outside primary containment, and (c) the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.
M-50	(S) LV-50-110 (S) LV-50-210	Located in the drain line from the drain pot in the RCIC turbine exhaust line. If this valve opens due to fire damage, at a time when RCIC steam supply line shutoff valve HV-50-1F045 (2F045) is open, main steam could bleed into the RCIC barometric condenser. This condition is acceptable because (a) the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods, (b) the mass inventory expected to be released is less than that expected for a main steam line break outside primary containment, and (c) the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.
M-51	(U) HV-51-1F009 (D) HV-51-1F008 (U) HV-51-2F009 (D) HV-51-2F008	Located in the RHR shutdown cooling suction line. If both valves open due to fire damage, the RHR pump suction lines could be damaged. In order to prevent both the upstream and downstream valves from opening simultaneously, an additional interlock by means of a pressure switch, is added to monitor the reactor vessel pressure for the downstream valve. Whenever the reactor vessel pressure exceeds the design capabilities of the RHR low pressure piping the contacts of the pressure switch will open, thereby isolating the opening relay of the downstream valves and preventing the valve to open.

Table 9A-12 (Cont'd)

P&ID NUMBER	INTERFACE VALVES[1,2]	REMARKS
M-51	(U) HV-51-151A (U) HV-51-1F050A (D) HV-51-1F015A (U) 51-1200A (U) HV-51-251A (U) HV-51-2F050A (D) HV-51-2F015A (U) 51-2200A	Located in the RHR loop A shutdown cooling return line. HV-51-1F050A (2F050A) is a check valve that will close to prevent reverse flow if HV-51-1F015A (2F015A) fails in the open position. The pneumatic operator on HV-51-1F050A (2F050A) is for testing purposes only and cannot unseat the valve disk or hold it open when a differential pressure exists across the valve. However, if bypass valve HV-51-151A (251A) and the outboard containment isolation valve both open due to fire damage, the flow through the bypass line will pressurize the shutdown cooling return piping outside the drywell. The flow through the bypass line will be limited by ¼" flow restricting orifice F0-51-151A (251A) to a value that is less than the capacity of downstream relief valve PSV-51-1F025A (2F025A). The discharged reactor coolant will not overpressurize or overheat the low pressure piping and will not cause damage to any equipment required for safe shutdown. In addition, the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods. (Typical for the loop B shutdown cooling return line.) Outboard isolation valve HV-051-1F015A (2F015A) has an additional piping path from the reactor coolant pressure boundary to penetration X-13A. This small-bore piping path connects the equalizing line of valve HV-51-1F050A (2F050A) to the bonnet vent line of the recirculation pump suction block valve HV-043-1F023A (2F023A). Spring-assisted, check valve 51-1200A (2200A) in this flow path will acts as an inboard isolation valve to penetration X-13A from the recirculation system. Check valve 51-1200A (2200A) performs the same PCIV's/PIV's functions in penetration X-13A as valves HV-051-1F050A (2F050A) and HV-051-151A (251A). (Typical for the loop B shutdown cooling return line.)
M-51	(U) HV-51-142A (U) HV-51-1F041A (D) HV-51-1F017A (U) HV-51-242A (U) HV-51-2F041A (D) HV-51-2F017A	Located in the loop A LPCI injection line. HV-51-1F041A (2F041A) is a check valve that will close to prevent reverse flow if HV-51-1F017A (2F017A) fails in the open position. The pneumatic operator on HV-51-1F041A (2F041A) is for testing purposes only and cannot unseat the valve disk or hold it open when a differential pressure exists across the valve. However, if bypass valve HV-51-142A (242A) and the outboard containment isolation valve both open due to fire damage, the flow through the bypass line will pressurize the LPCI injection piping outside the drywell. The flow through the bypass line will be limited by ¼" flow restricting orifice F0-51- 142A(242A) to a value that is less than the capacity of downstream relief valve PSV-51-1F025A (2F025A). The discharged reactor coolant will not overpressurize or overheat the low pressure piping and will not cause damage to any equipment required for safe shutdown. In addition, the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods. (Typical for LPCI injection lines B, C, and D.)

Table 9A-12 (Cont'd)

P&ID NUMBER	INTERFACE VALVES(1,2)	REMARKS
M-52	(U) HV-52-1F039A (U) HV-52-1F006A (D) HV-52-1F005 (U) HV-52-2F039A (U) HV-52-2F006A (D) HV-52-2F005	Located in the loop A core spray injection line. HV-52-1F006A (2F006A) is a check valve that will close to prevent reverse flow if HV-52-1F005 (2F005) fails in the open position. The pneumatic operator on HV-52-1F006A (2F006A) is for testing purposes only and cannot unseat the valve disk or hold it open when a differential pressure exists across the valve. However, if bypass valve HV-52-1F039A (2F039A) and the outboard containment isolation valve both open due to fire damage, the flow through the bypass line will pressurize the core spray injection piping outside the drywell. The flow through the bypass line will be limited by ¼" flow restricting orifice F0-52-106A (206A) to a value that is less than the capacity of downstream relief valve PSV-52-1F012A (2F012A). The discharged reactor coolant will not overpressurize or overheat the low pressure piping and will not cause damage to any equipment required for safe shutdown. In addition, the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods.
M-52	(U) HV-52-1F039B (U) HV-52-1F006B (D) HV-52-108 (U) HV-52-2F039B (U) HV-52-2F006B (D) HV-52-208	Located in the loop B core spray injection line. The pneumatic operator on check valve HV-52-1F006B (2F006B) is for testing purposes only and cannot unseat the valve disk or hold it open when a differential pressure exists across the valve. If bypass valve HV-52-1F039B (2F039B) opens due to fire damage, reverse flow cannot occur because outboard containment isolation valve HV-52-108 (208) is a check valve.
M-55	(S) HV-55-1F054 (S) HV-55-1F054	Located in the drain line of the HPCI steam supply line drain pot. If this valve opens due to fire damage, main steam could be discharged to the main condenser. This condition is acceptable because (a) the reactor vessel inventory can be maintained by the coolant makeup pumps that are available for each of the shutdown methods, (b) the mass inventory expected to be released is less than expected for a main steam line break outside primary containment, and (c) the release of reactor coolant will not cause damage to any equipment needed for safe shutdown.

(1) Upstream valves are identified by the (U) designation. Downstream valves are identified by the (D) designation. Single valves are identified by the (S) designation. For the purposes of this study, upstream valves are defined as those valves that are closest to the RCPB.

(2) For each entry in this table, two groups of interface valves are listed. The first group consists of valves in Unit 1 and the second group consists of the corresponding valves in Unit 2.

Table 9A-13
has been DELETED.

Table 9A-14

Operations That May Be Required To Be Performed Outside The Control Room

Equipment ID	Action Description
10-A116	Operate Local Control Switches
10-A118	Trip B Control Room Chiller For MHIF
10-C601-X1	Position Valves Using Emergency Control Switches - HV-51-125B, 1F004B, 1F015B, 1F027B, HV-C-51-1F048B
10-C601-X2	Position Valve Using Emergency Control Switch - HV-51-1F017B
10TB-49-1F007	Operate Power Transfer Switch - HV-49-1F007
1A-C514	Start Diesel 1AG501 Generator Using Local Controls
1B-C514	Start Diesel 1BG501 Generator Using Local Controls
20-A116	Operate Local Control Switches
20-C601-X1	Position Valves Using Emergency Control Switches - HV-51-2F015B, 2F027B, HV-C-51-2F048B
20-C601-X2	Position Valve Using Emergency Control Switch - HV-51-2F017B
20TB-49-2F007	Operate Power Transfer Switch - HV-49-2F007
2A-C514	Start Diesel 2AG501 Generator Using Local Controls
2B-C514	Start Diesel 2BG501 Generator Using Local Controls

Table 9A-14 (Cont'd)

Operations That May Be Required To Be Performed Outside The Control Room

Equipment ID	Action Description
ADS Control at 289'	Operate ADS Valves At The PGCC
HS-51-282B	Open Valve Using Local Controls - HV-51-282B
HS-56-162	Operate Switch At 10C201 To Runback HPCI Turbine
HS-56-262	Operate Switch At 20C201 To Runback HPCI Turbine
HV-11-011B	Close Manually To Prevent Long Term ESW Flow Diversion
HV-11-015A	Close Manually To Prevent Long Term ESW Flow Diversion
HV-11-015B	Open Manually
HV-11-132A	Open Manually
HV-11-232A	Open Manually

Table 9A-14 (Cont'd)

Operations That May Be Required To Be Performed Outside The Control Room

Equipment ID	Action Description
HV-12-031B	Close Manually
HV-12-031C	Open Manually
HV-12-032B	Open Manually
HV-12-032C	Open Manually
HV-12-032D	Open / Close Manually
HV-49-1F084	Open Manually
HV-49-2F084	Open Manually
HV-51-1F003B	Open Manually
HV-51-1F006B	Close Manually
HV-51-1F008	Open Manually
HV-51-1F010A	Close Manually
HV-51-1F014B	Open Manually
HV-51-1F015A	Close Manually
HV-51-1F017B	Close Manually
HV-51-1F024B	Open Manually
HV-51-1F047B	Open Manually
HV-51-1F049	Close Manually

Table 9A-14 (Cont'd)

Operations That May Be Required To Be Performed Outside The Control Room

Equipment ID	Action Description
HV-51-1F068A	Open Manually
HV-51-1F068B	Open Manually
HV-51-2F006B	Close Manually
HV-51-2F008	Open Manually
HV-51-2F010A	Close Manually
HV-51-2F015A	Close Manually
HV-51-2F024B	Open Manually
HV-51-2F049	Close Manually
HV-51-2F068A	Open Manually
HV-51-2F068B	Open Manually
HV-51-2F073	Close Manually
HV-55-126	Open Manually
HV-C-51-1F048A	Close Manually
HV-C-51-2F048B	Close Manually
Remote Shutdown Panel (289)	Operate Equipment, Monitor Instruments

SEE FIGURE 1.10-1

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

PIPING AND INSTRUMENT
DIAGRAM LEGEND

FIGURE 9A-1

SEE FIGURE 9.5-1

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

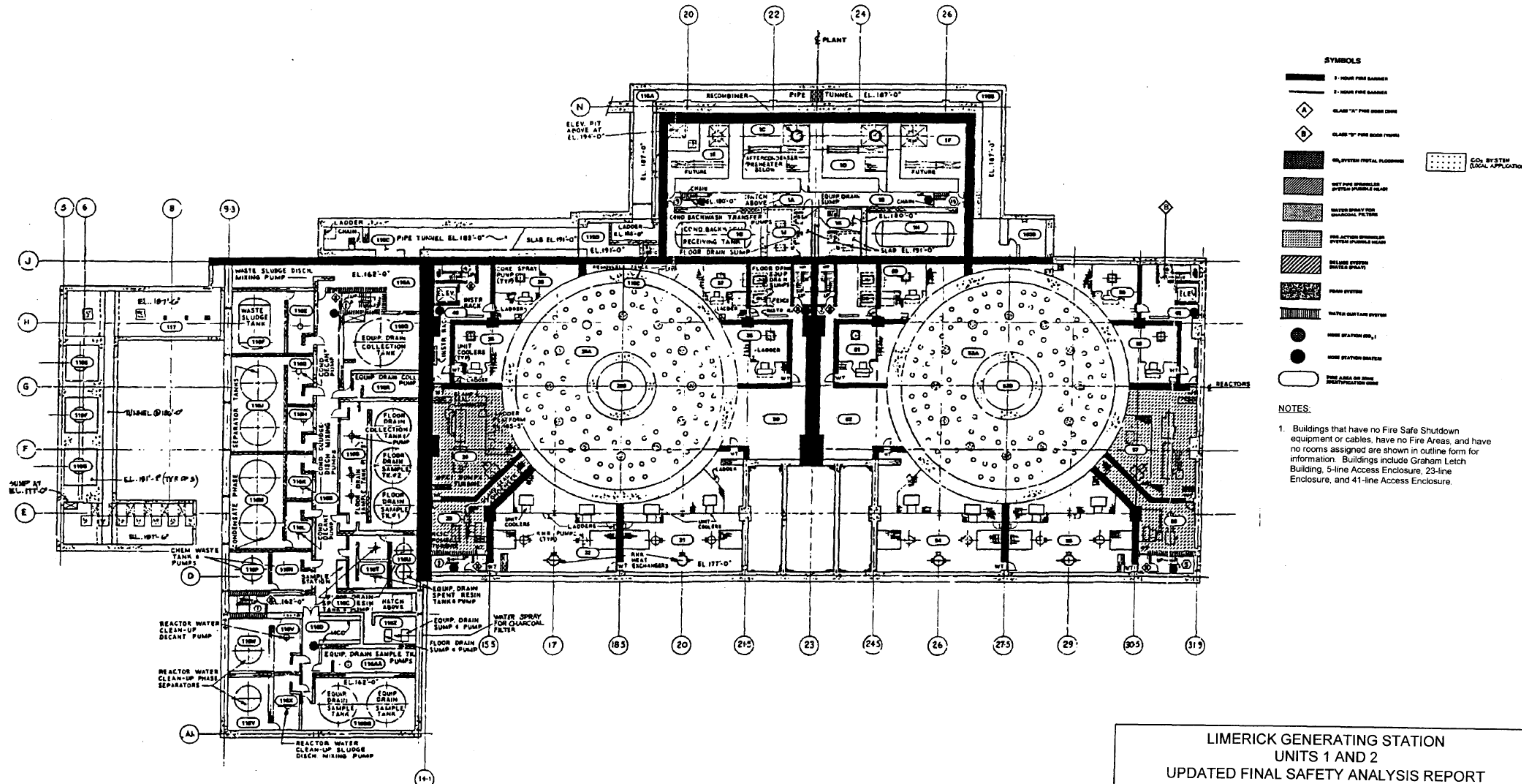
FIRE PROTECTION EVALUATION REPORT

P&ID
FIRE PROTECTION

FIGURE 9A-2

Figure 9A-3

Deleted



NOTES:

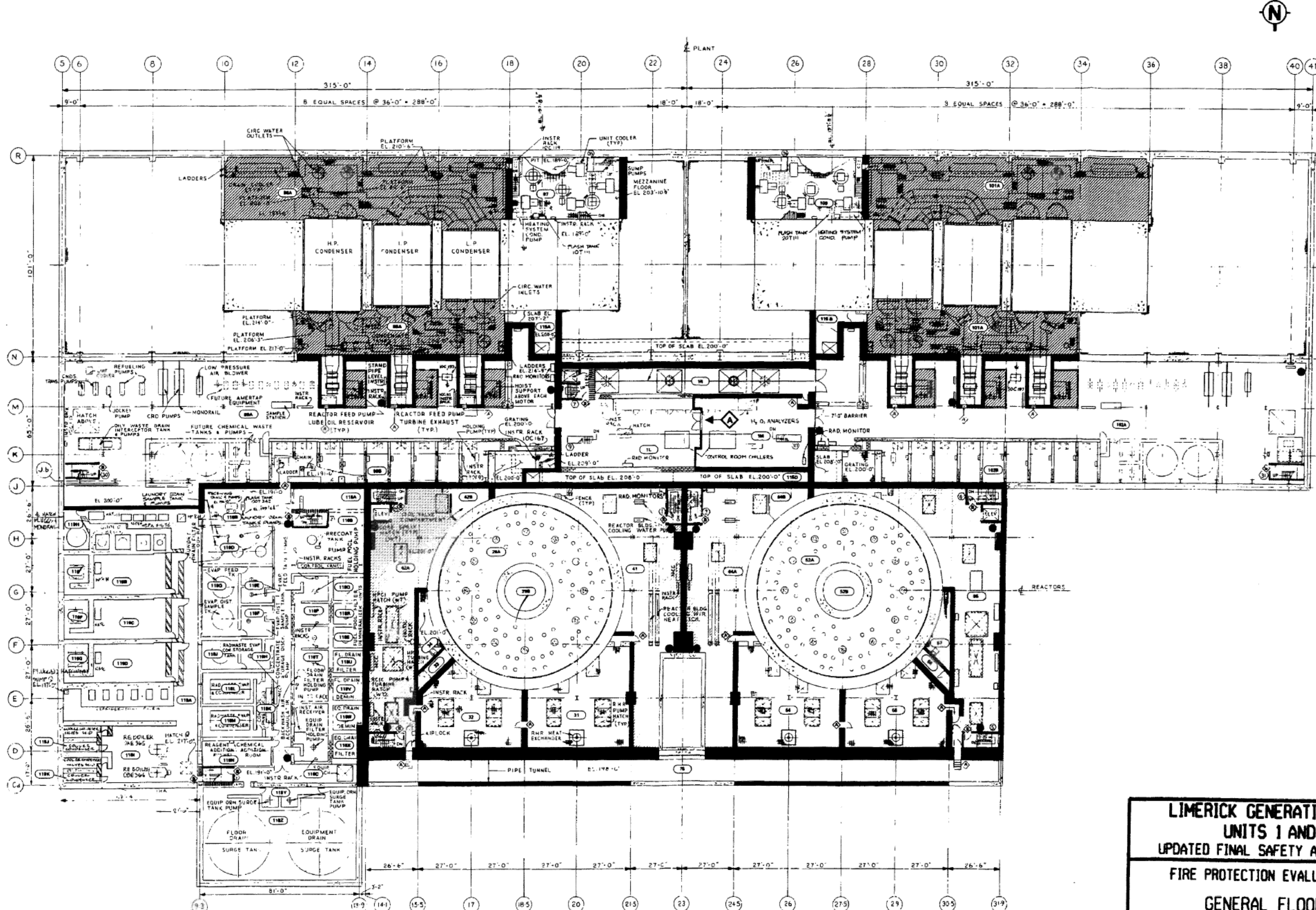
1. Buildings that have no Fire Safe Shutdown equipment or cables, have no Fire Areas, and have no rooms assigned are shown in outline form for information. Buildings include Graham Letch Building, 5-line Access Enclosure, 23-line Enclosure, and 41-line Access Enclosure.

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
GENERAL FLOOR PLAN
EL. 162'-0", 180'-0"

FIGURE 9A-4

Rev. 11 9/02



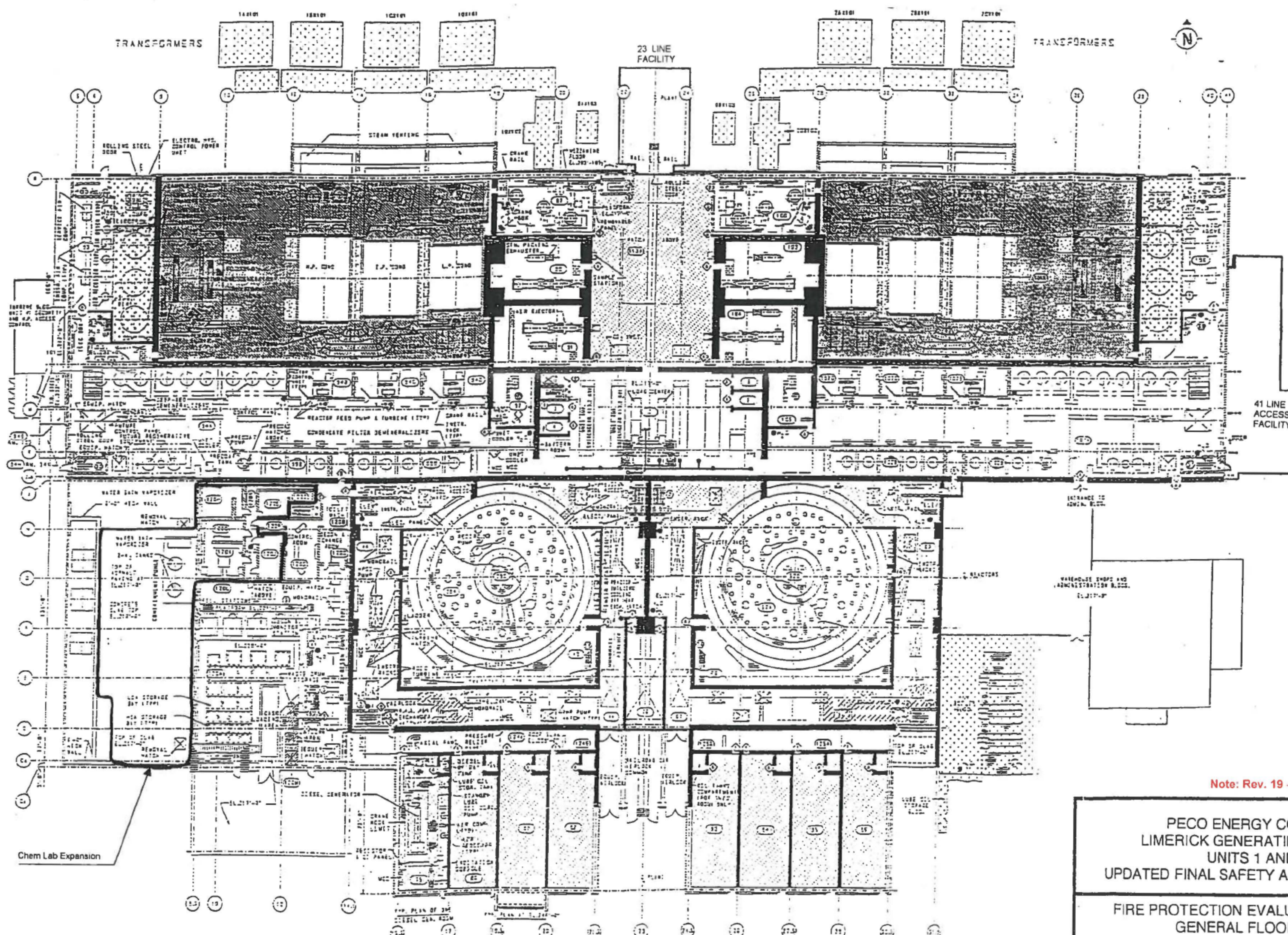
LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

GENERAL FLOOR PLAN,
EL. 191'-0", 195'-0", 200'-0", 201'-0"

FIGURE 9A-5

Rev. 11 9/02

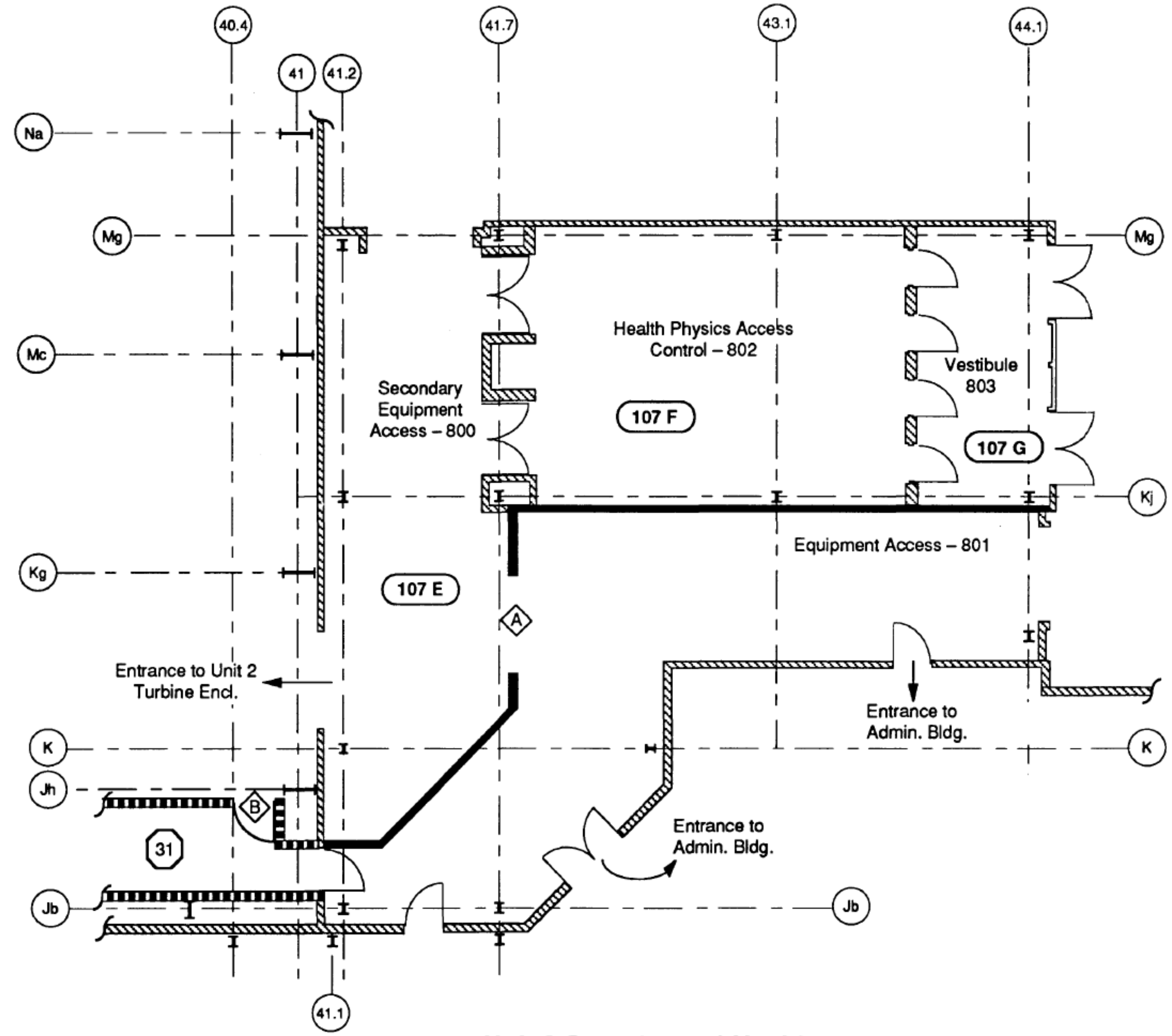


Note: Rev. 19 - CO_2 hose stations deleted.

PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
GENERAL FLOOR PLAN
EL. 217' - 0"

FIGURE 9A-6 Sht. 1 OF 2 Rev. 19 09/18



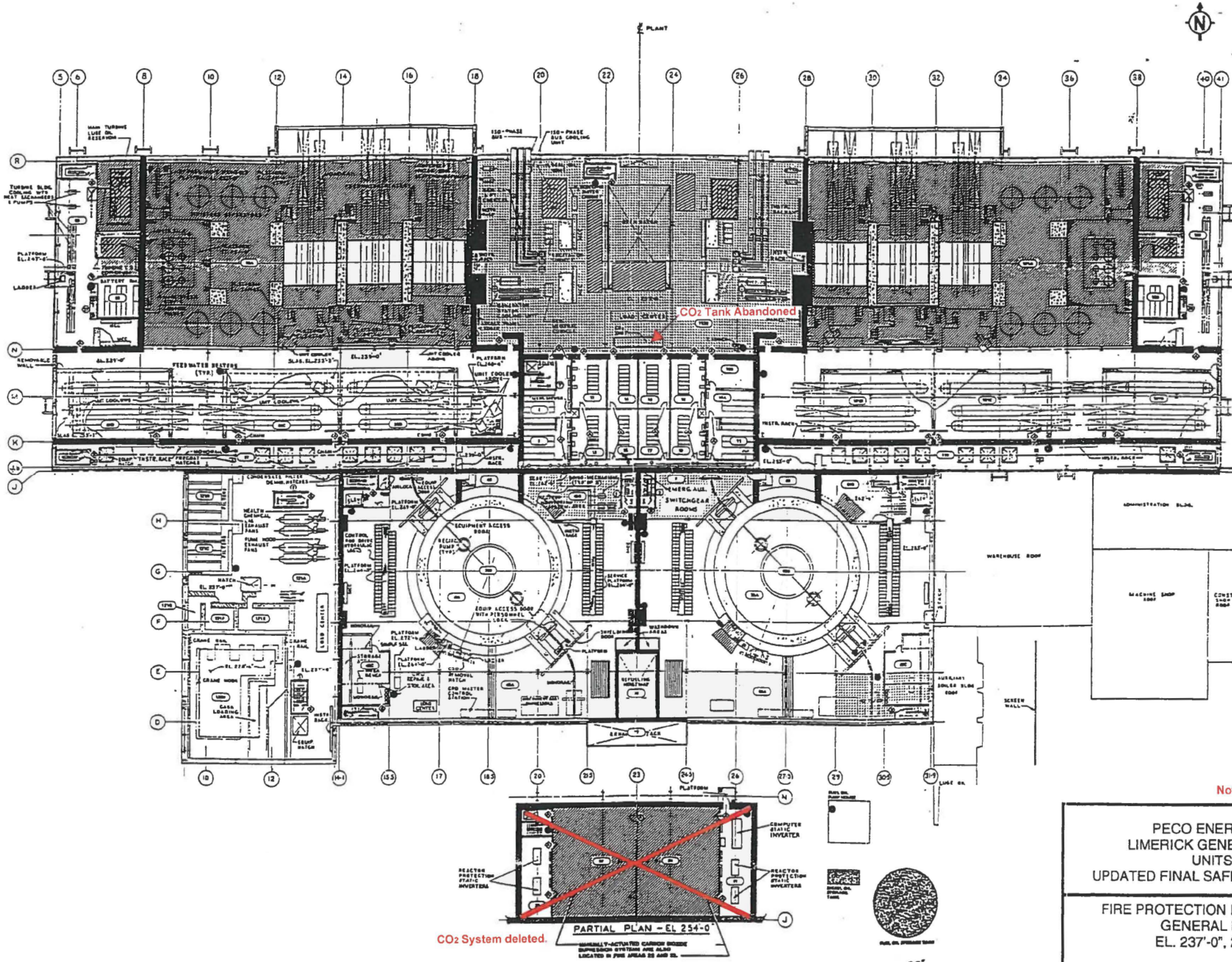
Unit 2 Security and Health Physics Access Control Facility
Floor Plan at Elevation 217' – 0"

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

**GENERAL FLOOR PLAN,
EL. 217'-0"
(SHEET 2 OF 2)**

FIGURE 9A-6

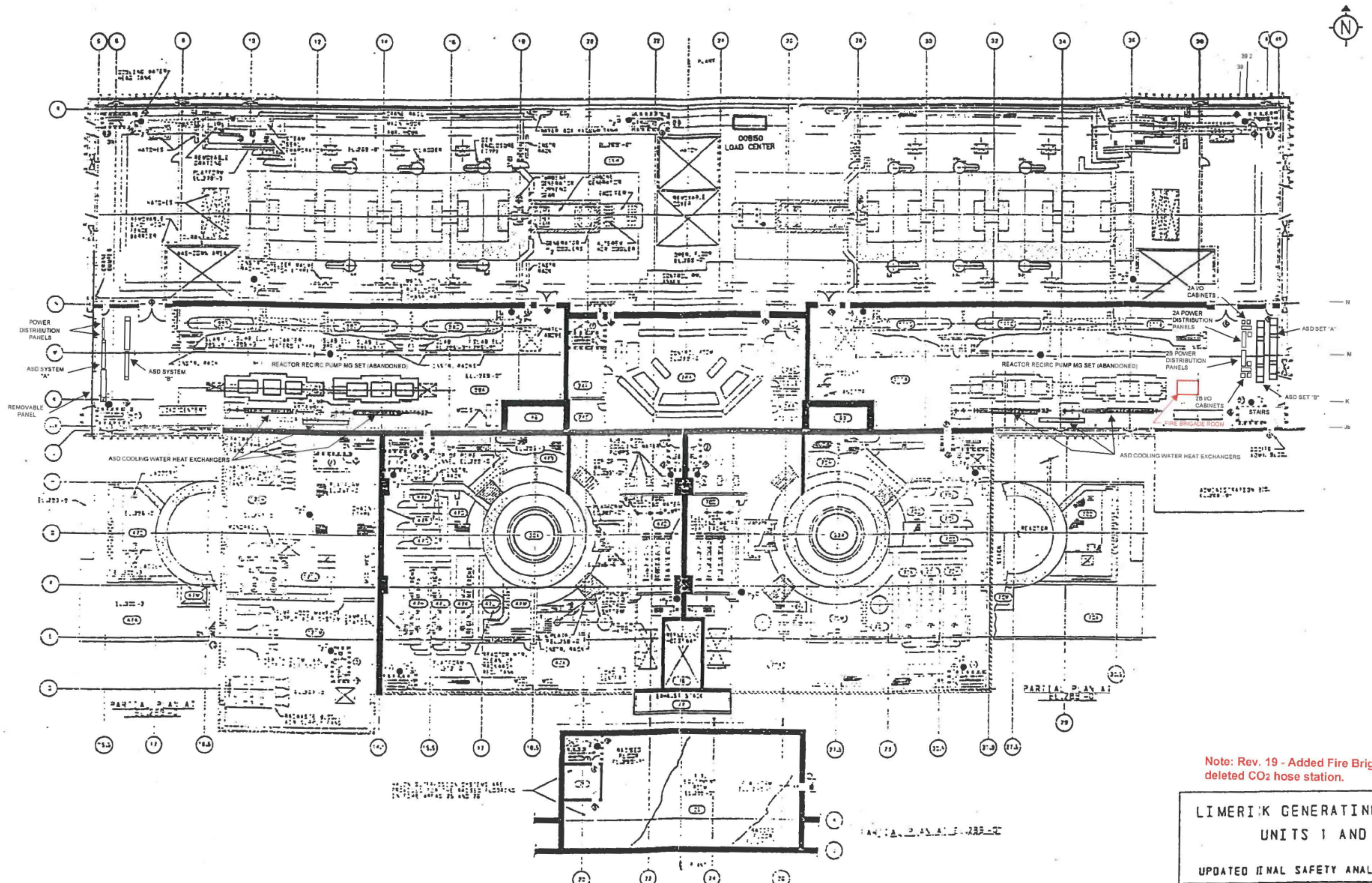


Note: Rev. 19 - CO_2 System deleted.

PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
GENERAL FLOOR PLAN
EL. 237'-0", 253'-0", 254'-0"

FIGURE 9A-7 Rev. 19 09/18



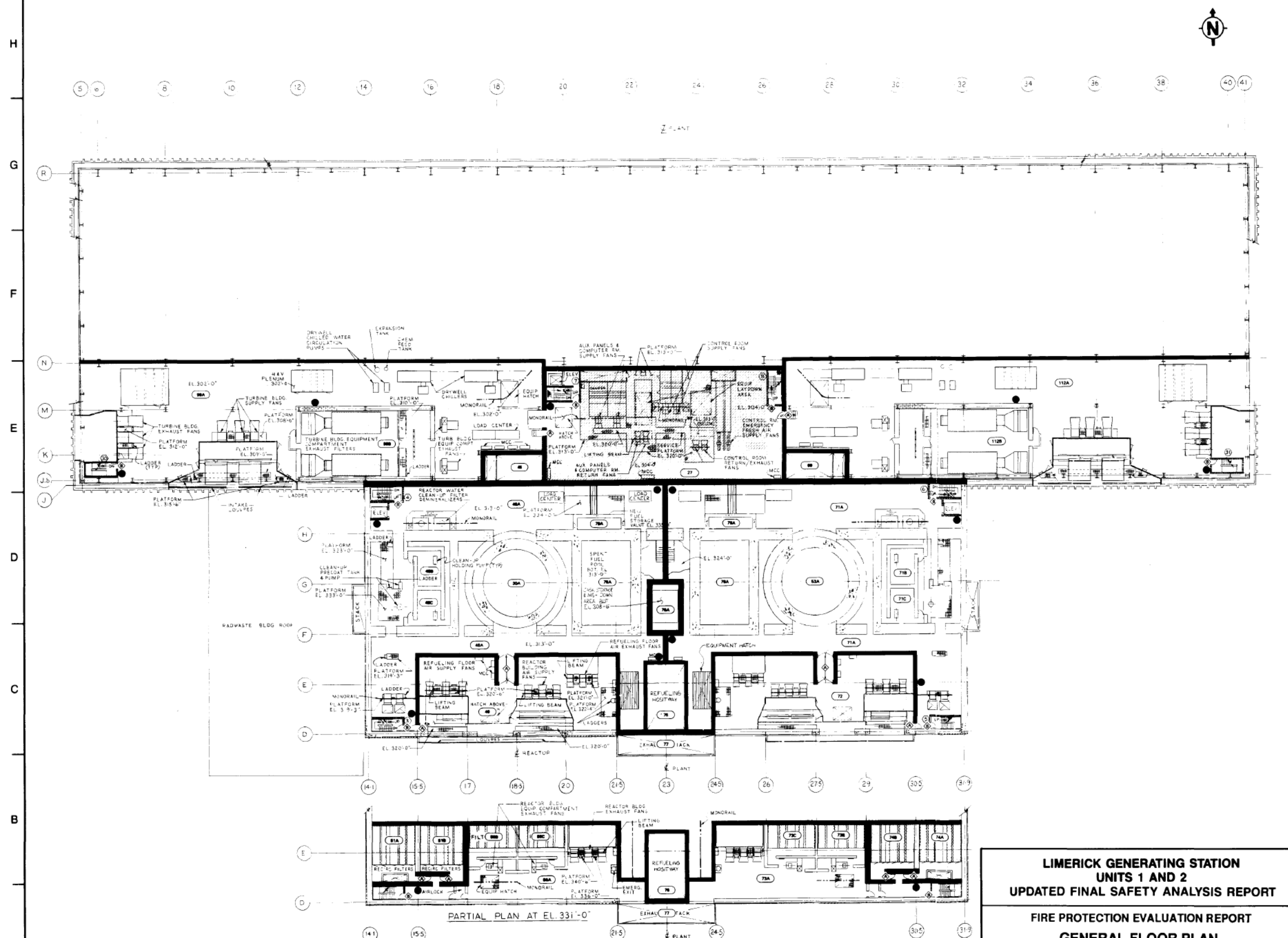
Note: Rev. 19 - Added Fire Brigade Room and deleted CO_2 hose station.

LIMERIK GENERATING STATION
UNITS 1 AND 2

UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE POTECTION EVALUATION REPORT
GENERAL FLOOR PLAN
EL. 257'-",269'-0",283'-0",289'-0", 300'-3"

FIGURE 9A-8 REV. 19 09/18

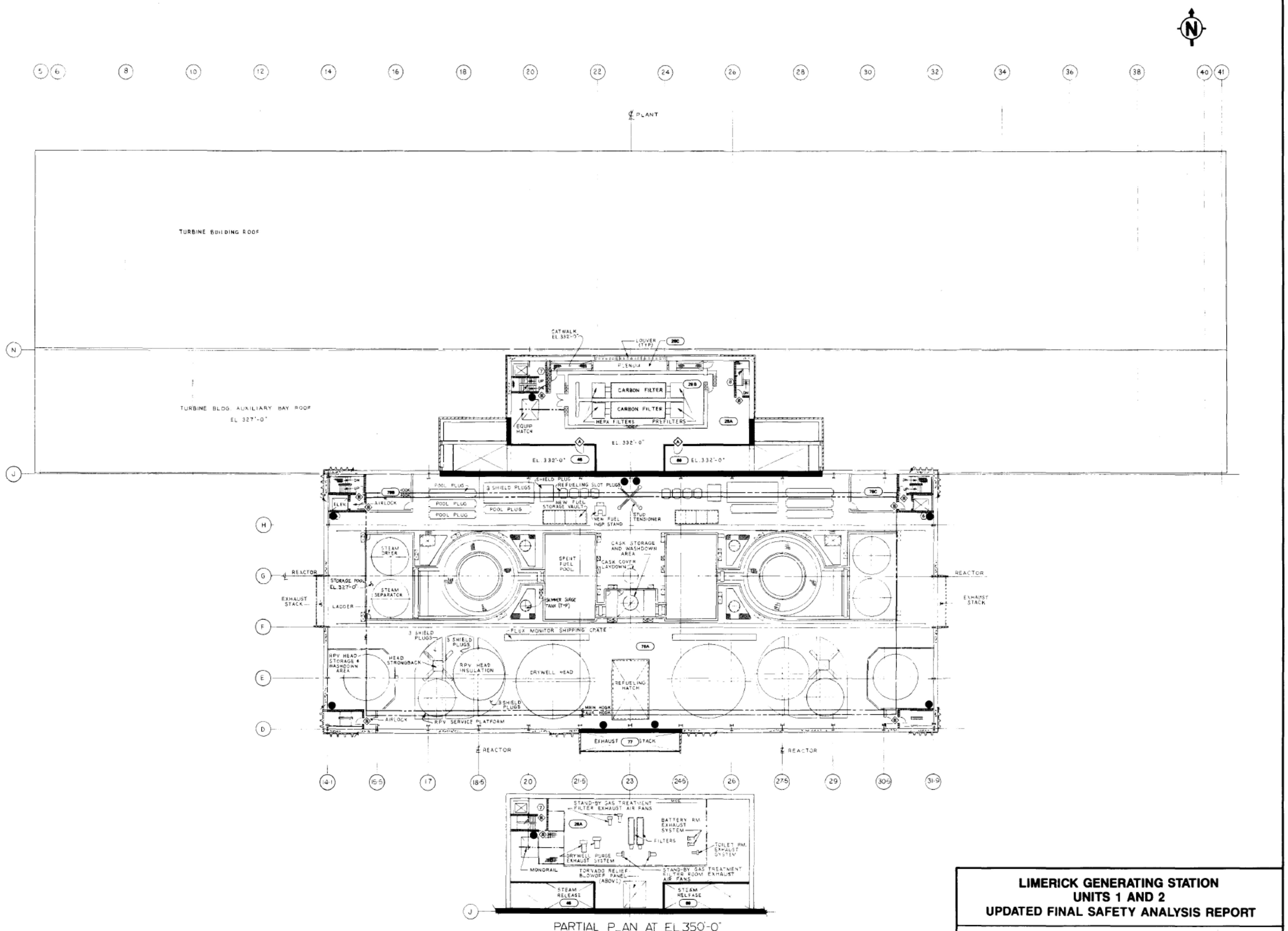


LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

GENERAL FLOOR PLAN,
EL. 302'-0", 304'-0", 313"-0",
331'-0"

FIGURE 9A-9

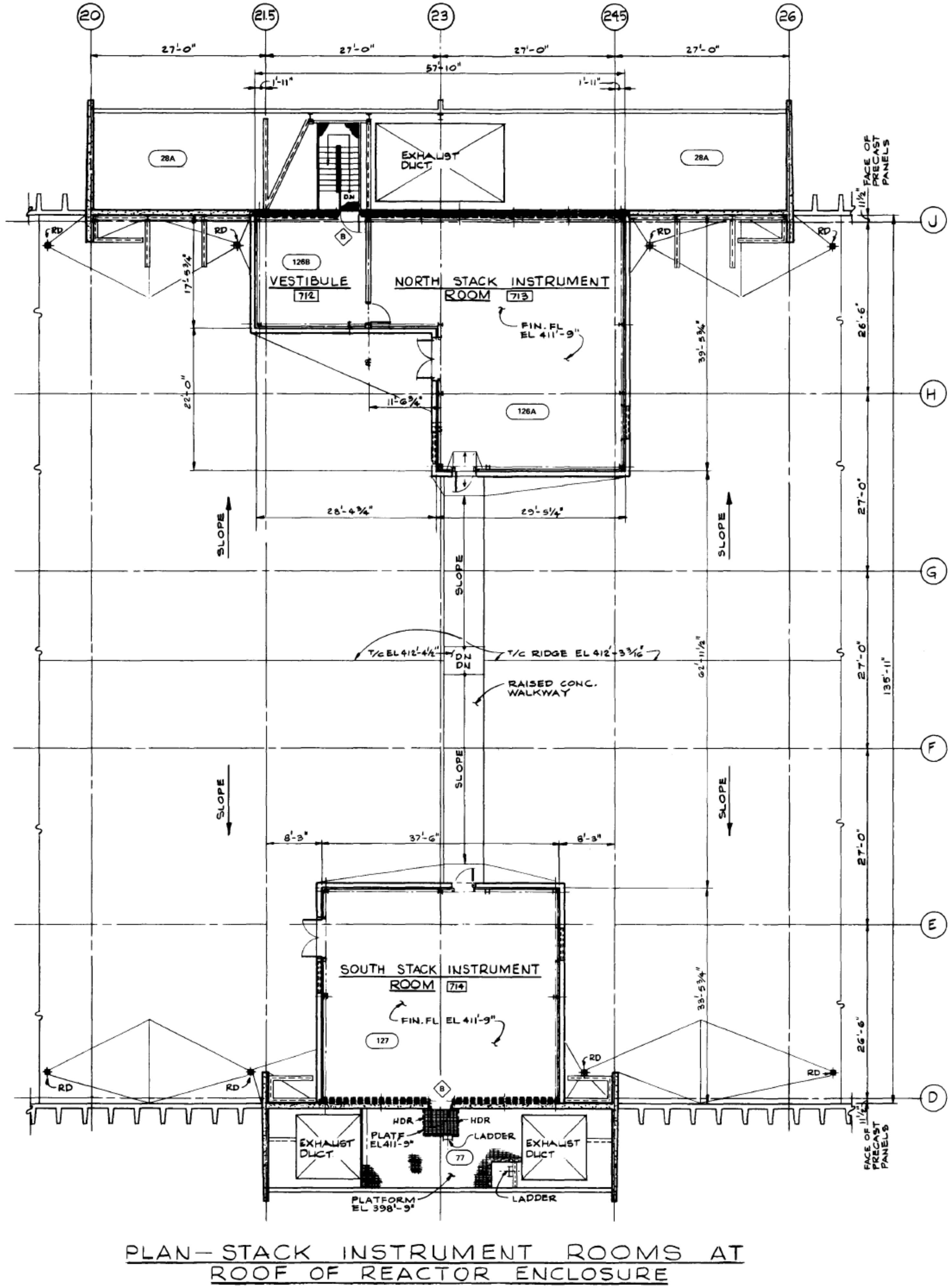


LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

GENERAL FLOOR PLAN,
EL. 332'-0", 350'-0", 352'-0"
(SHEET 1 OF 2)

FIGURE 9A-10

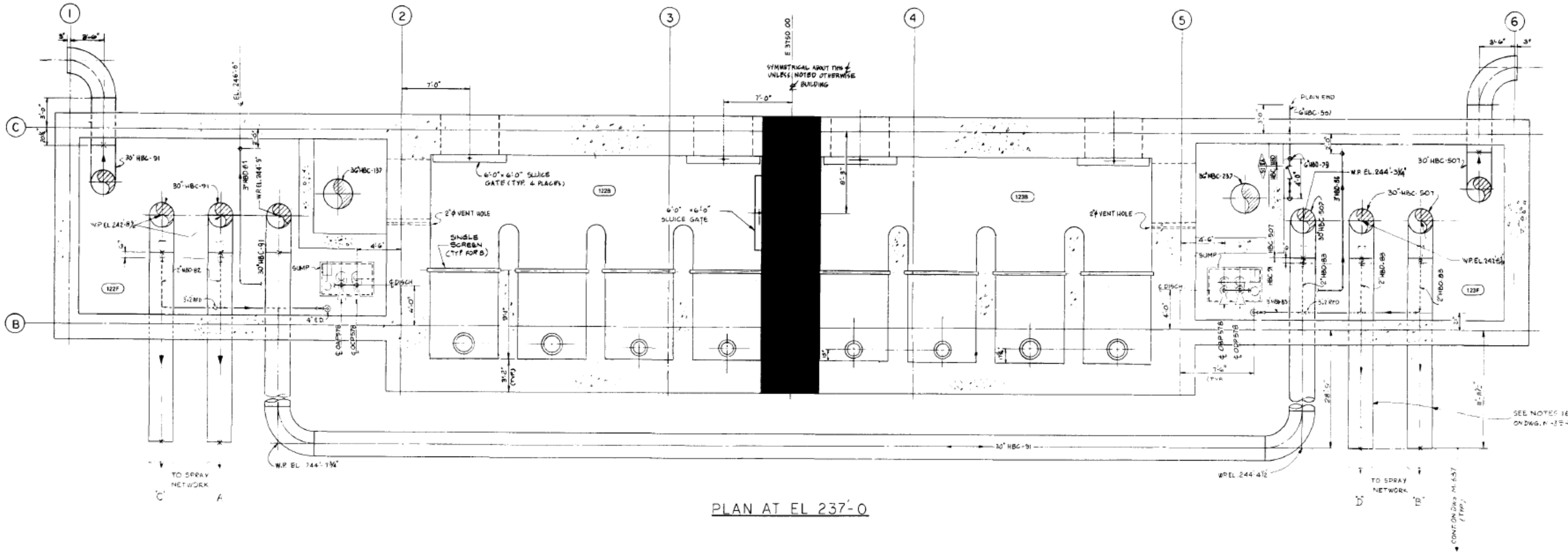


LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

GENERAL FLOOR PLAN
EL. 411'-9"
(SHEET 2 OF 2)

FIGURE 9A-10



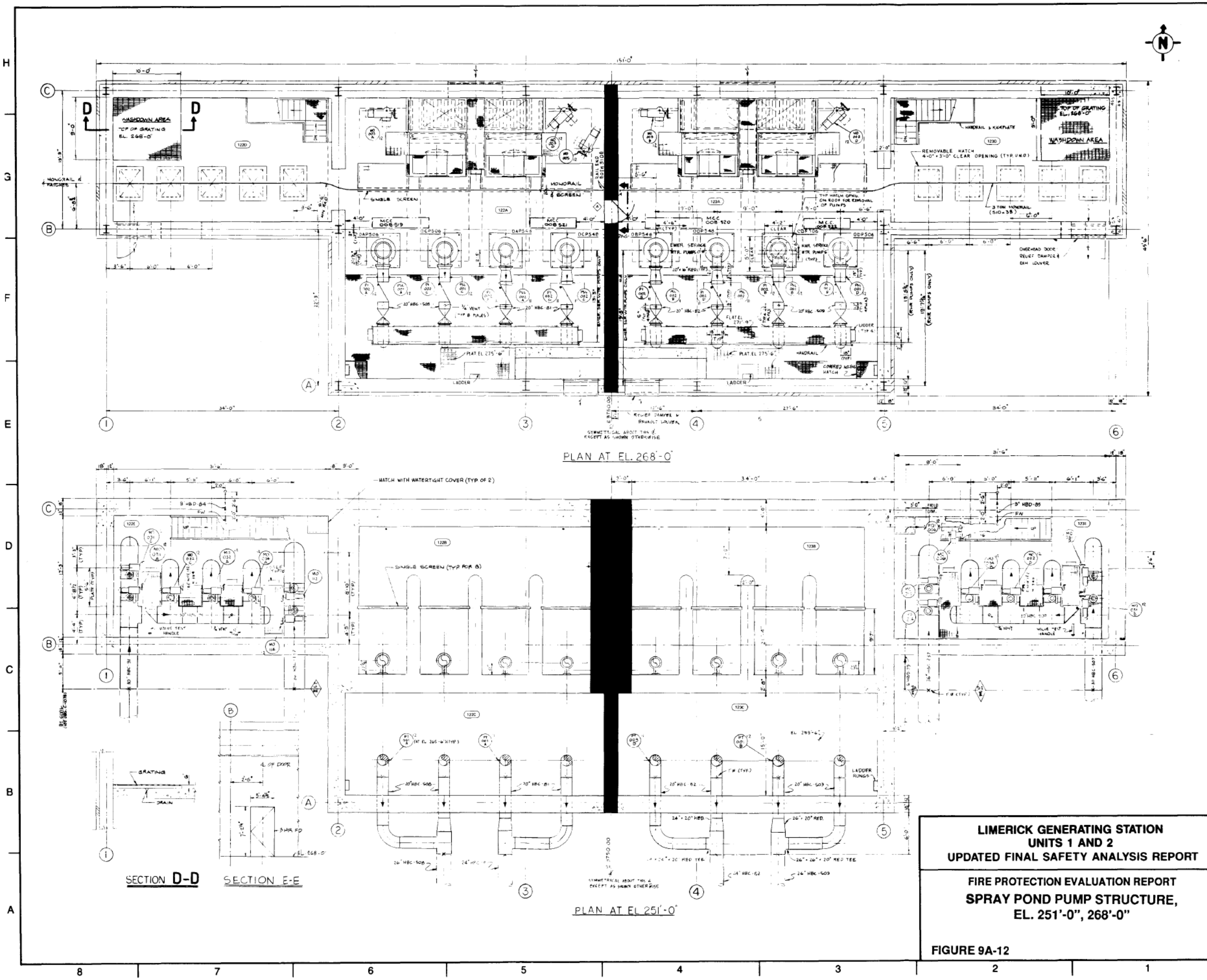
PLAN AT EL 237'-0

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

SPRAY POND PUMP STRUCTURE, EL. 237'-0"

FIGURE 9A-11

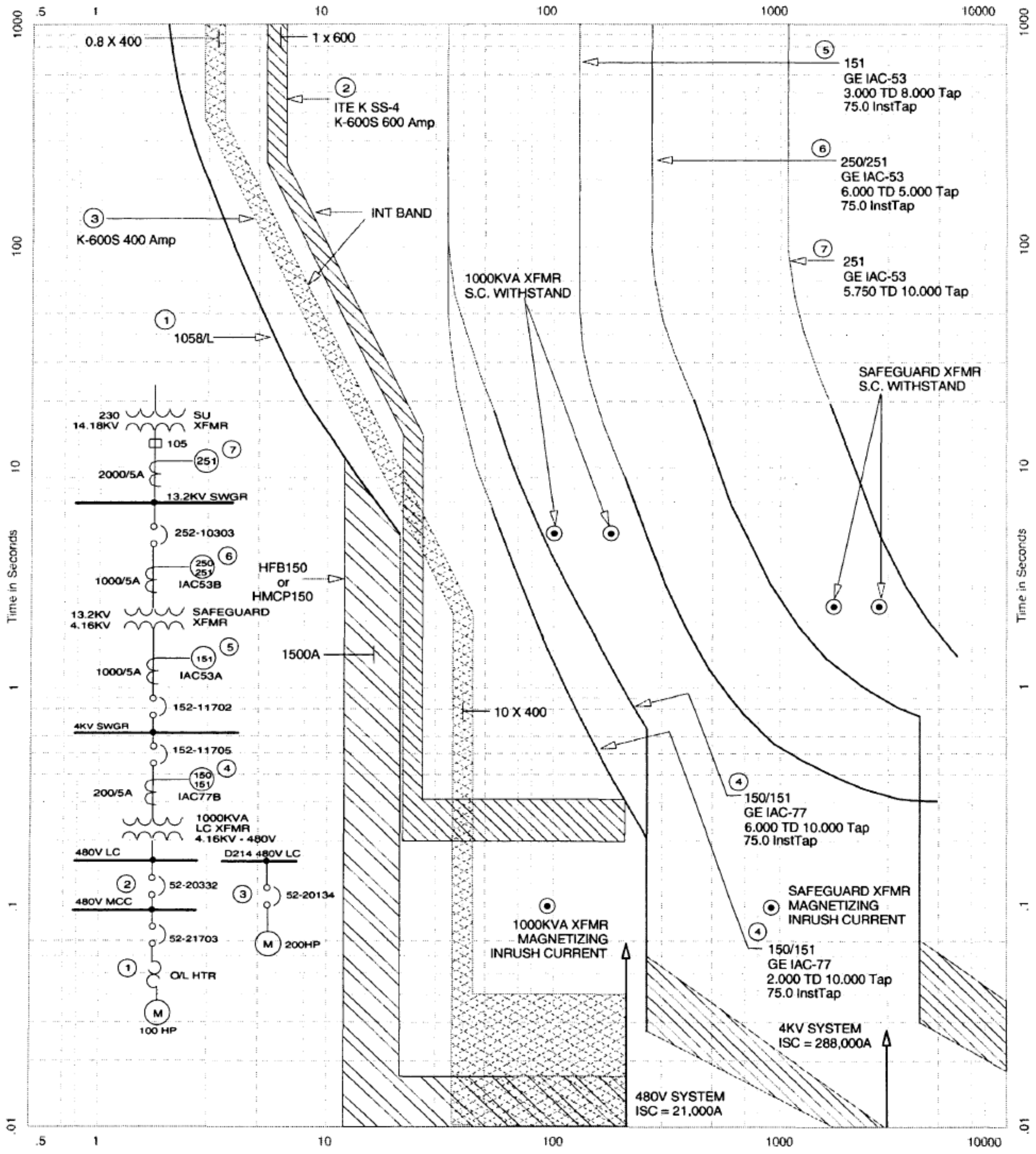


LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

SPRAY POND PUMP STRUCTURE, EL. 251'-0", 268'-0"

FIGURE 9A-12

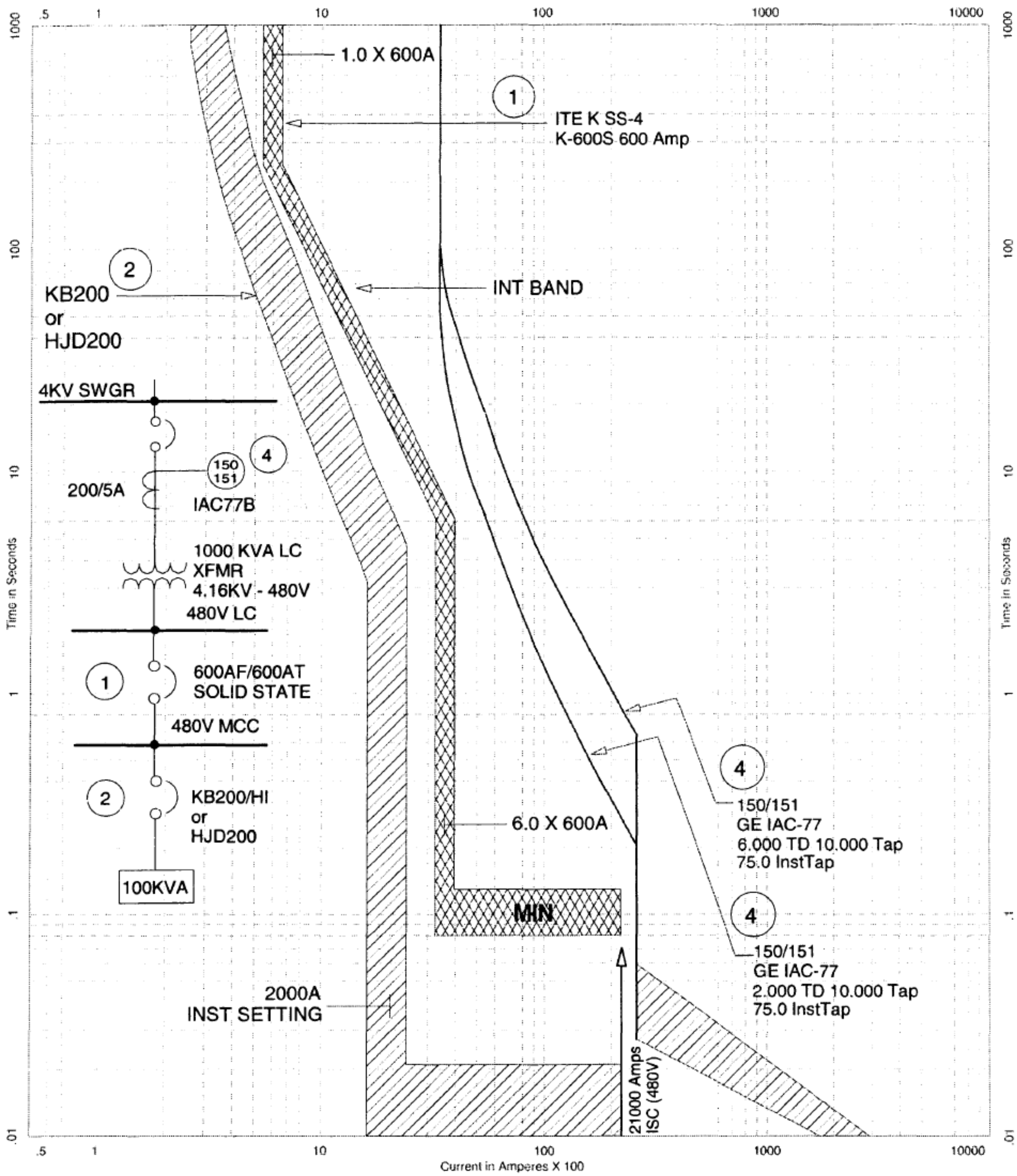


LIMERICK GENERATING STATION
UNITS 1 & 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

SAFEGUARD AUX. SYSTEM
PHASE O.C. PROTECTION
AND COORDINATION

FIGURE 9A-13 Sht. 1 of 2 **Rev. 13 09/06**

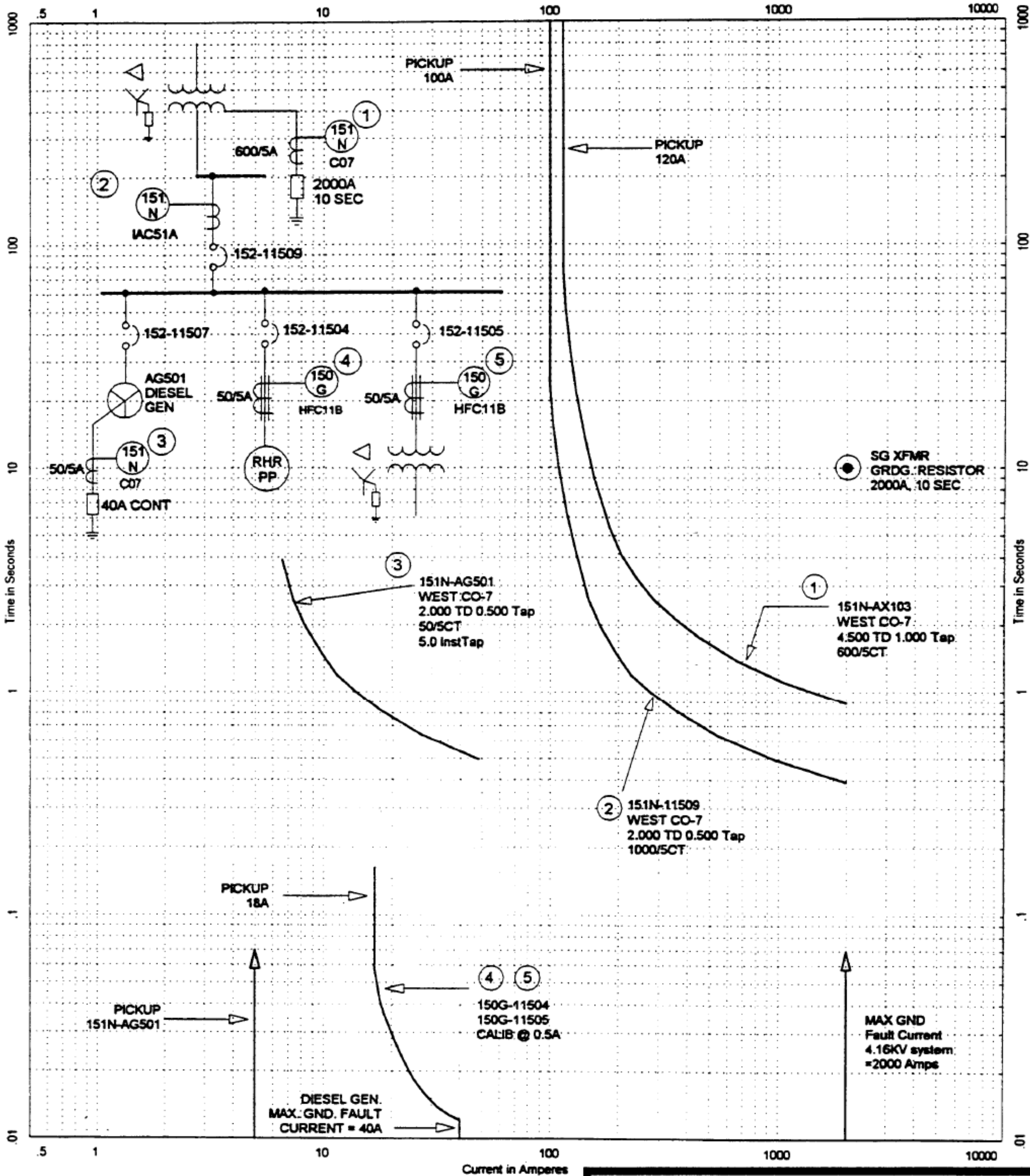


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

SAFEGUARD AUX. SYSTEM
PHASE O.C. PROTECTION
AND COORDINATION

FIGURE 9A-13 Sht. 2 of 2 **Rev. 13 09/06**

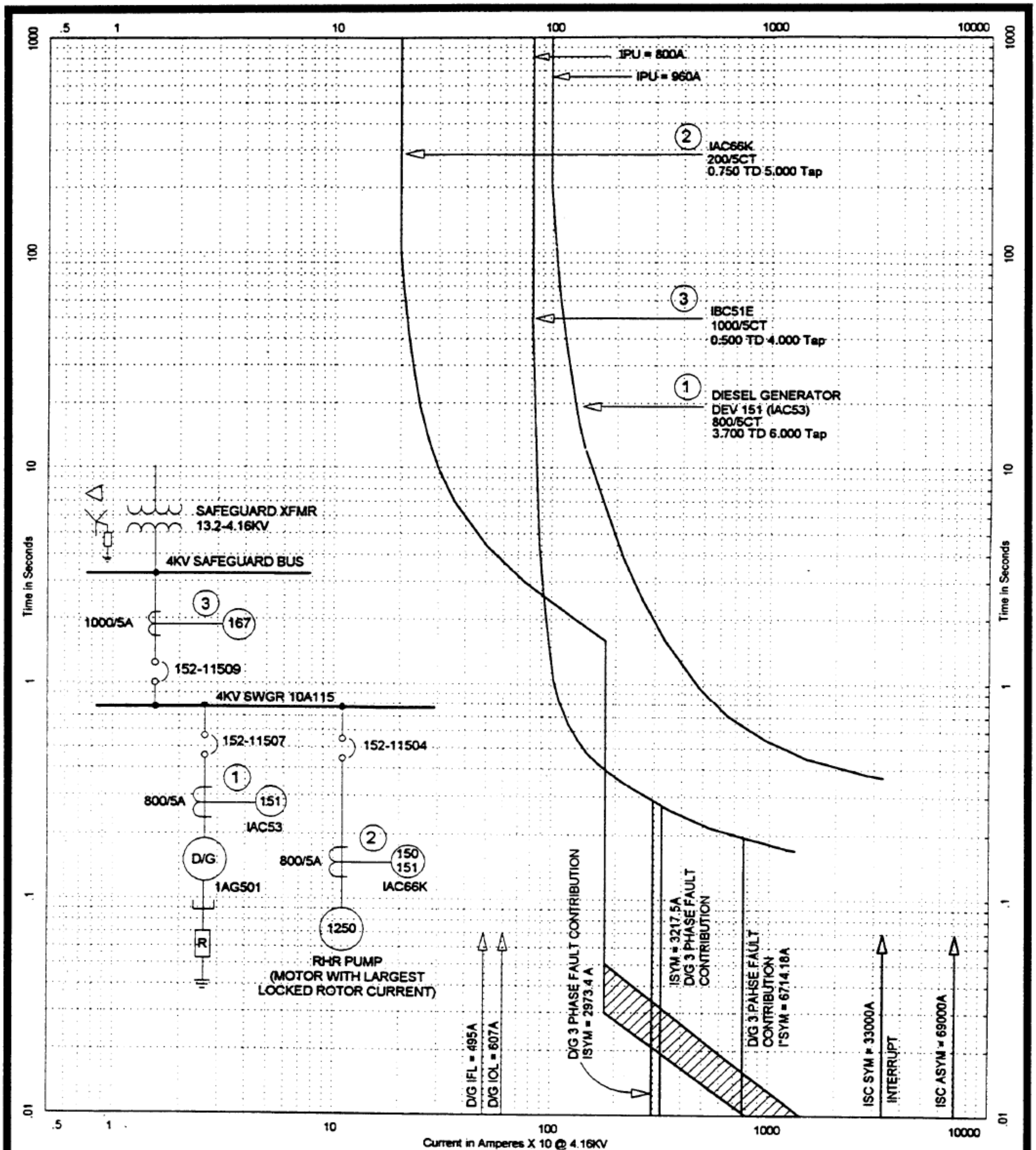


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

SAFEGUARD AC SWITCHGEAR GROUND OVERCURRENT RELAY COORDINATION

FIGURE 9A-14 Sht. 1 of 1 Rev. 09 11/99

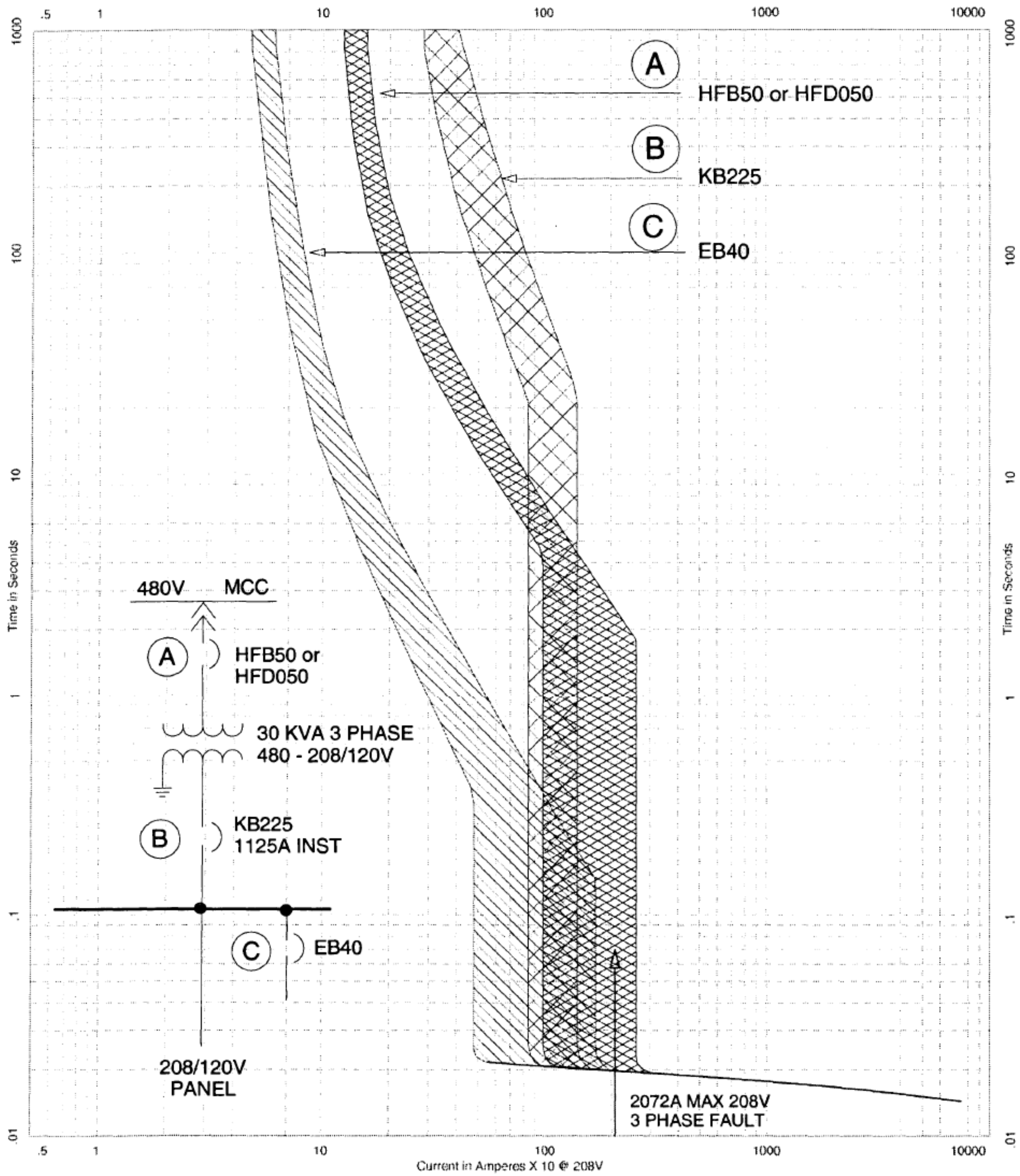


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

DIESEL GENERATOR PROTECTION RELAYS

FIGURE 9A-15 Sht. 1 of 1 Rev. 09 11/99

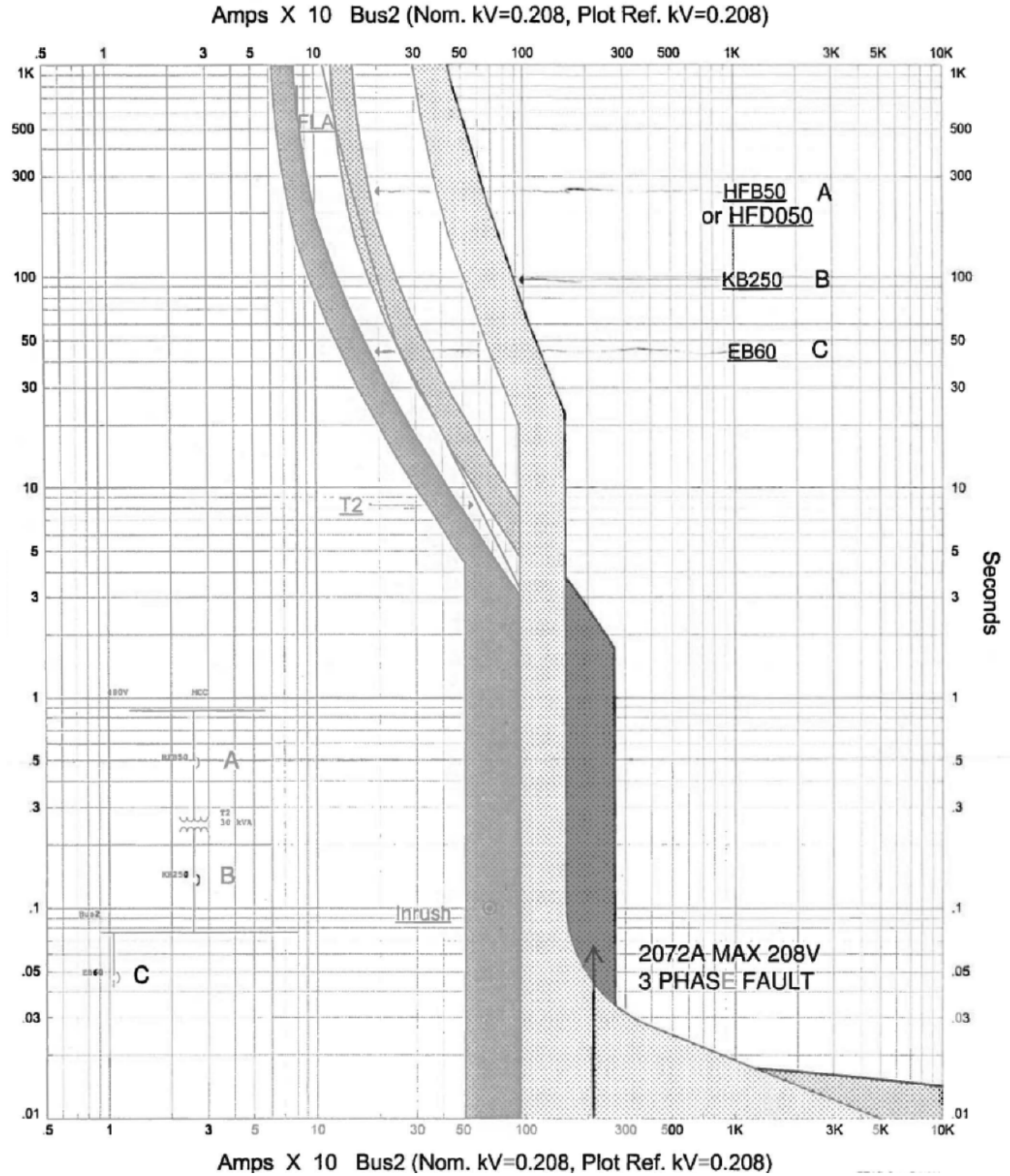


LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

208/120V SAFEGUARD AC CIRCUIT BREAKER COORDINATION

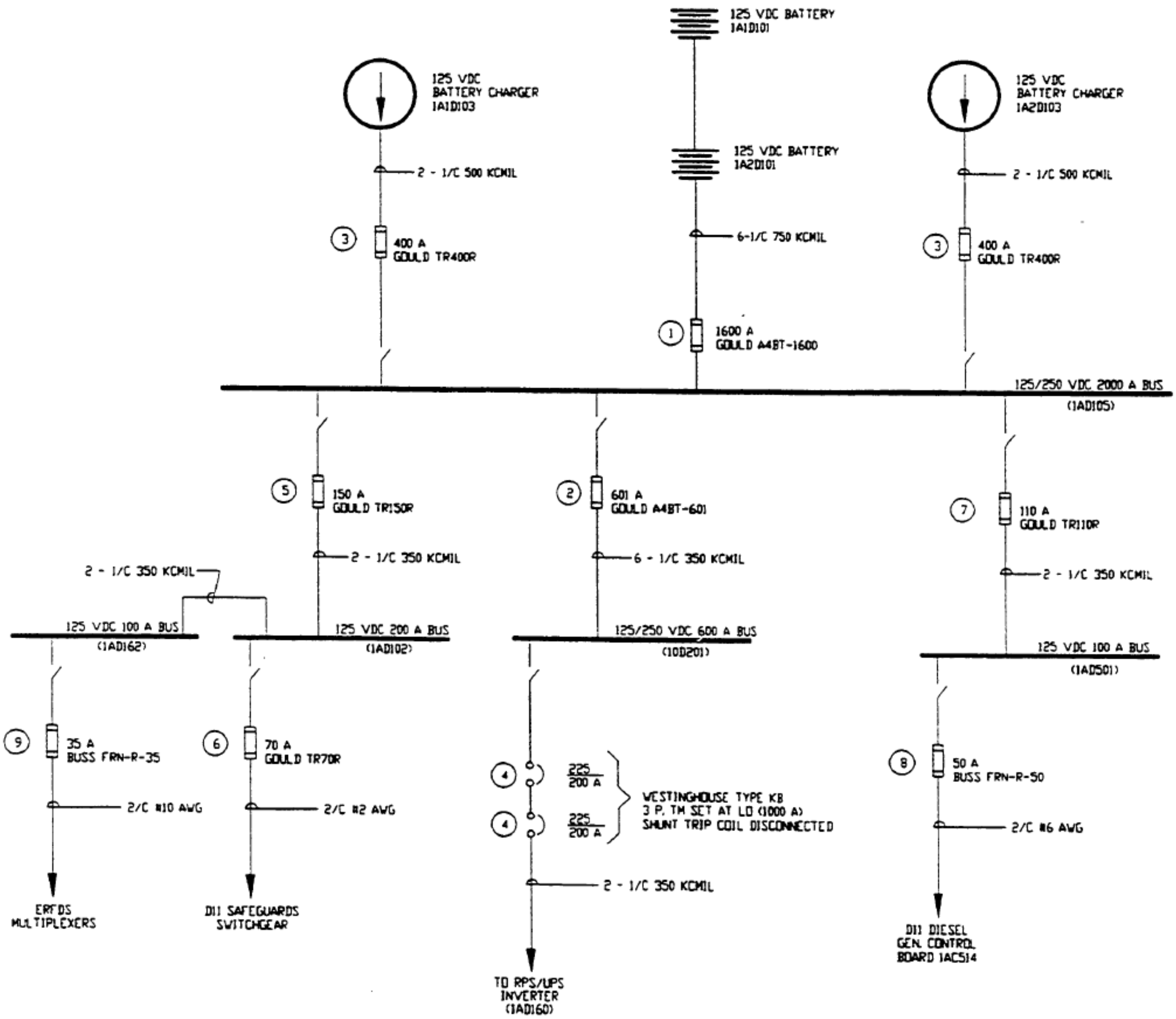
FIGURE 9A-16 **Rev. 13 09/06**



LIMERICK GENERATION STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
208/120V SAFEGUARD AC CIRCUIT
BREAKER COORDINATION

FIGURE 9A-16 Sht. 2 of 2 Rev. 19 09/18

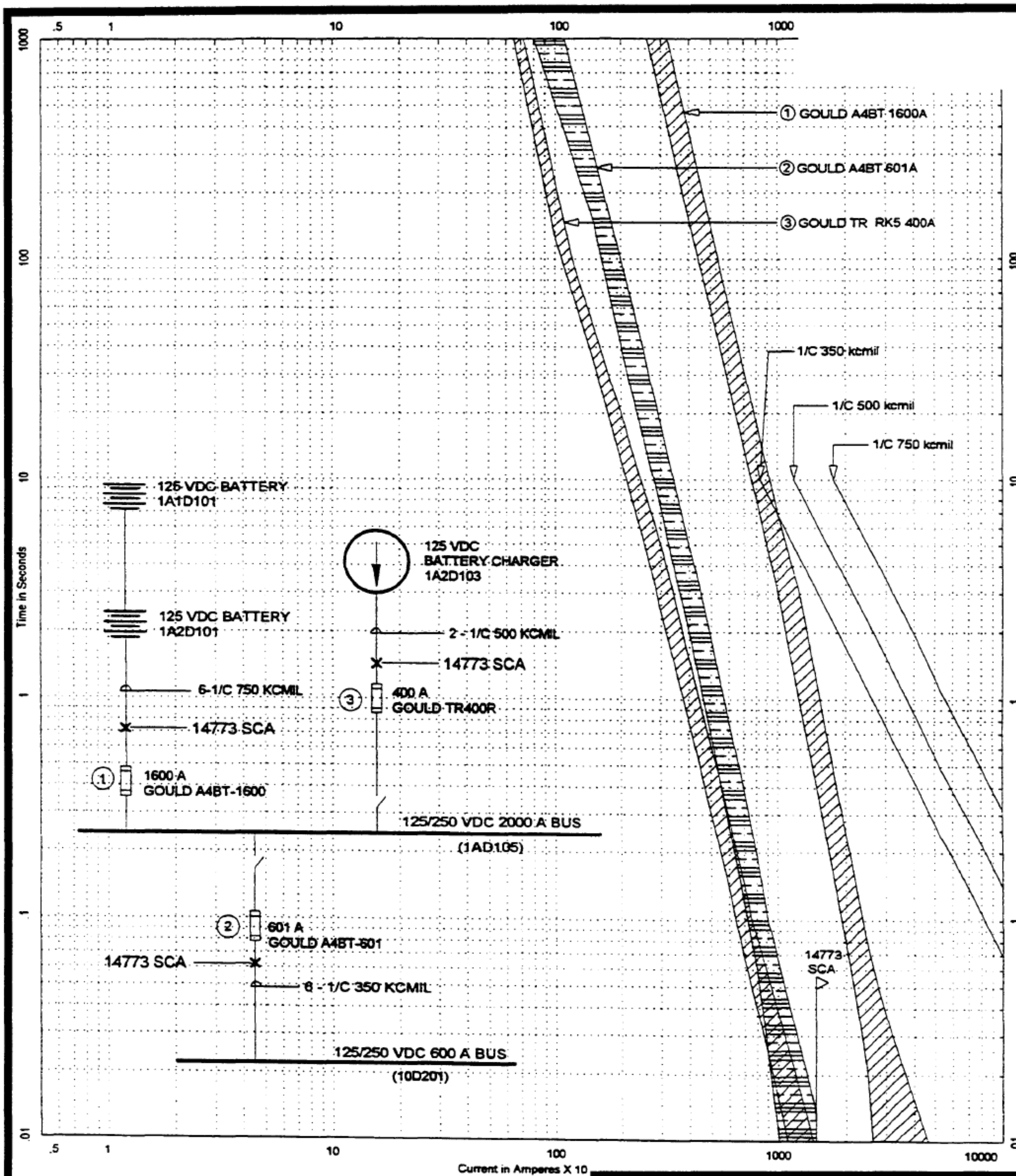


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 1A1D101 & 1A2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht. 1 of 10 Rev. 09 11/99

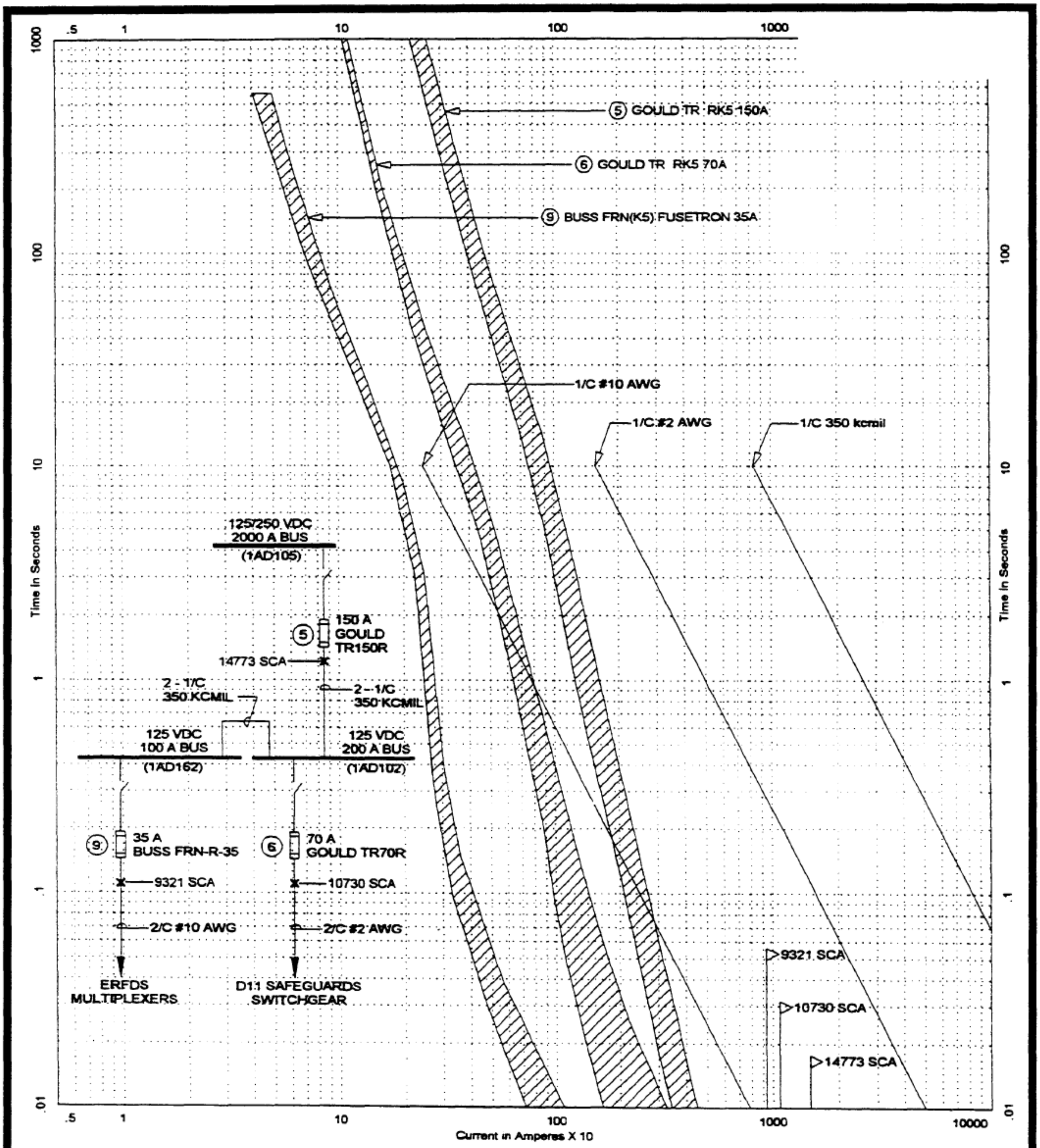


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1A1D101 & 1A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht. 2 of 10 Rev. 09 11/99

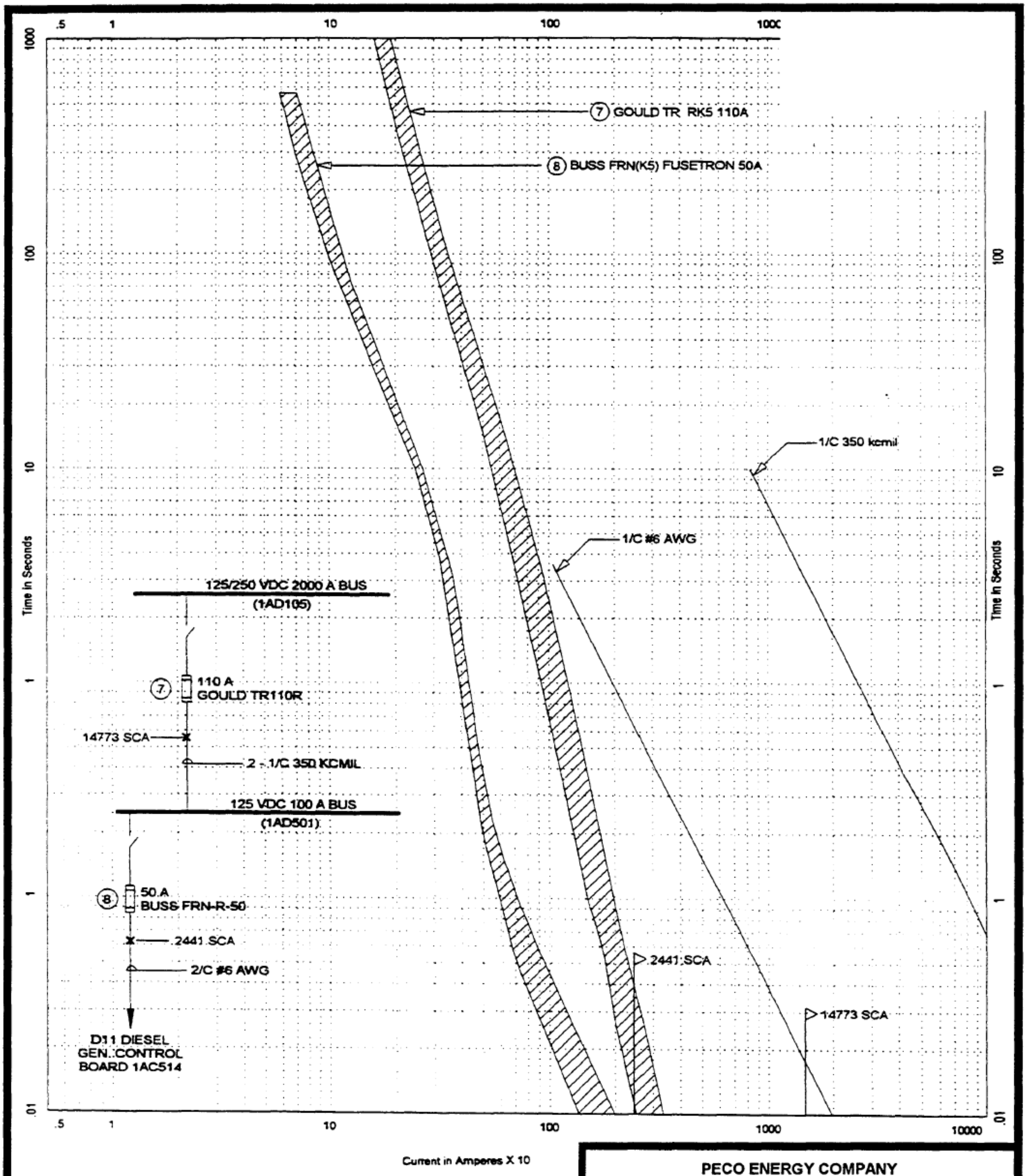


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1A1D101 & 1A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht. 3 of 10 Rev. 09 11/99

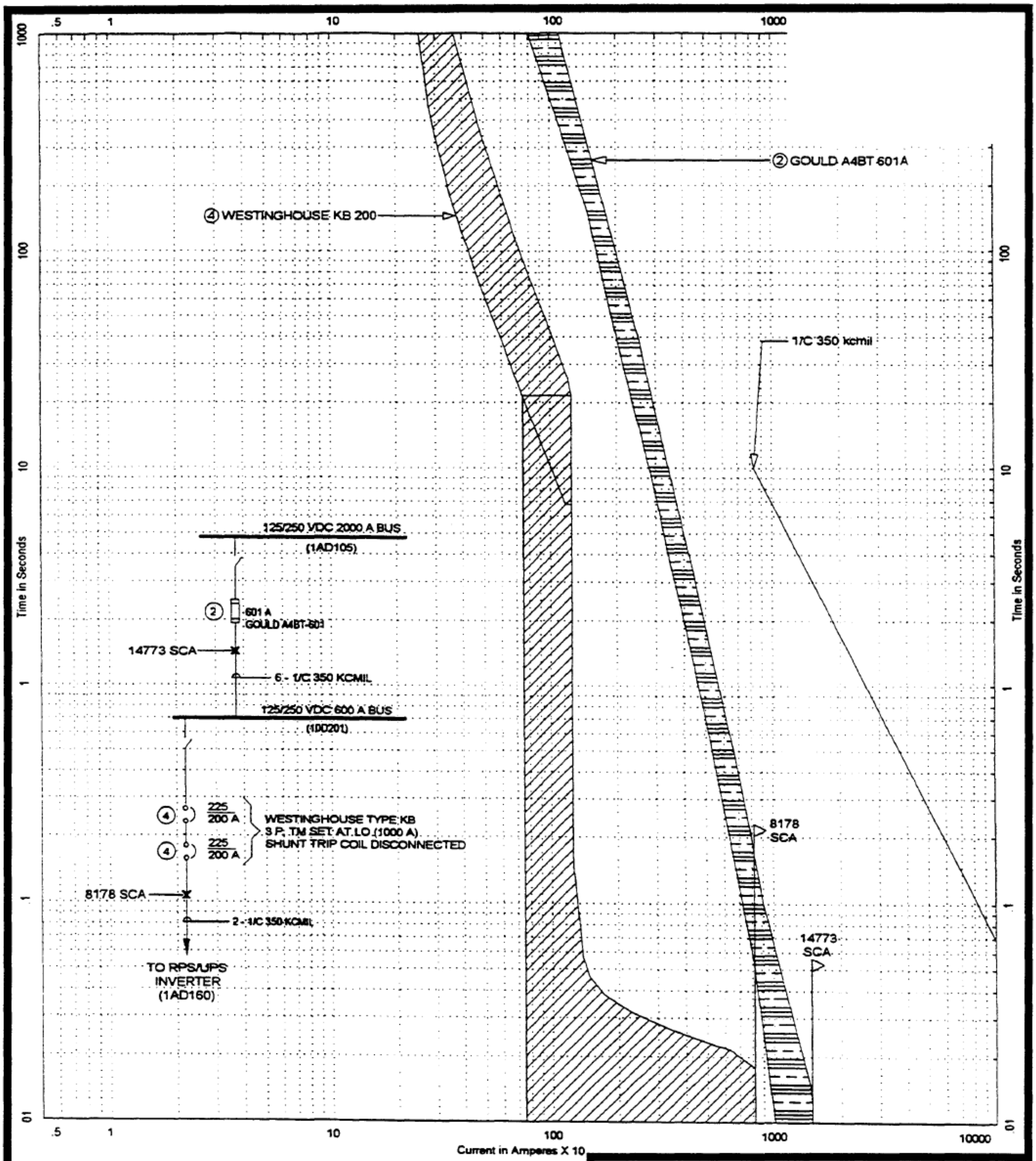


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1A1D101 & 1A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht. 4 of 10 Rev. 09 11/99

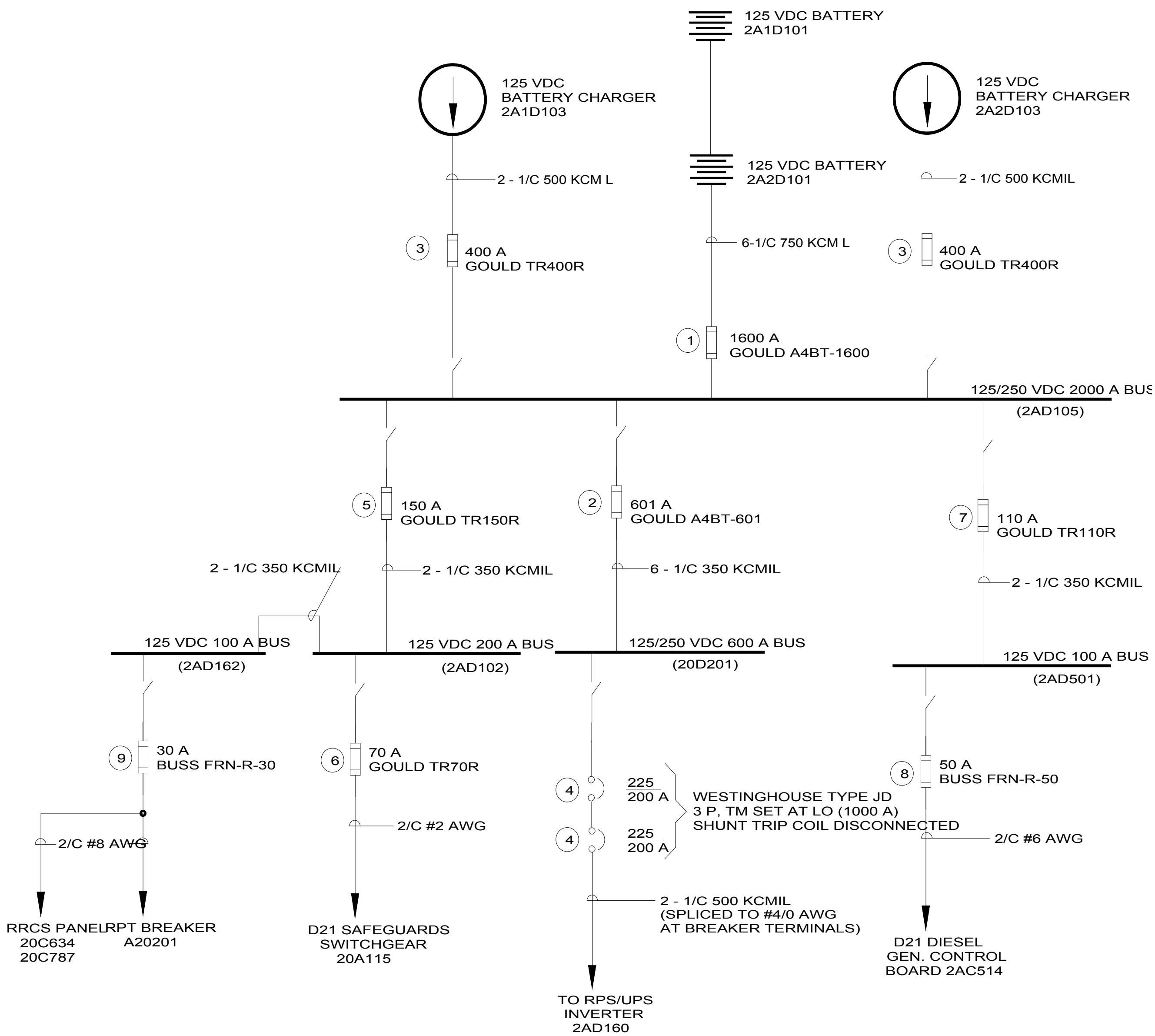


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1A1D101 & 1A2D101
PROTECTIVE DEVICE COORDINATION

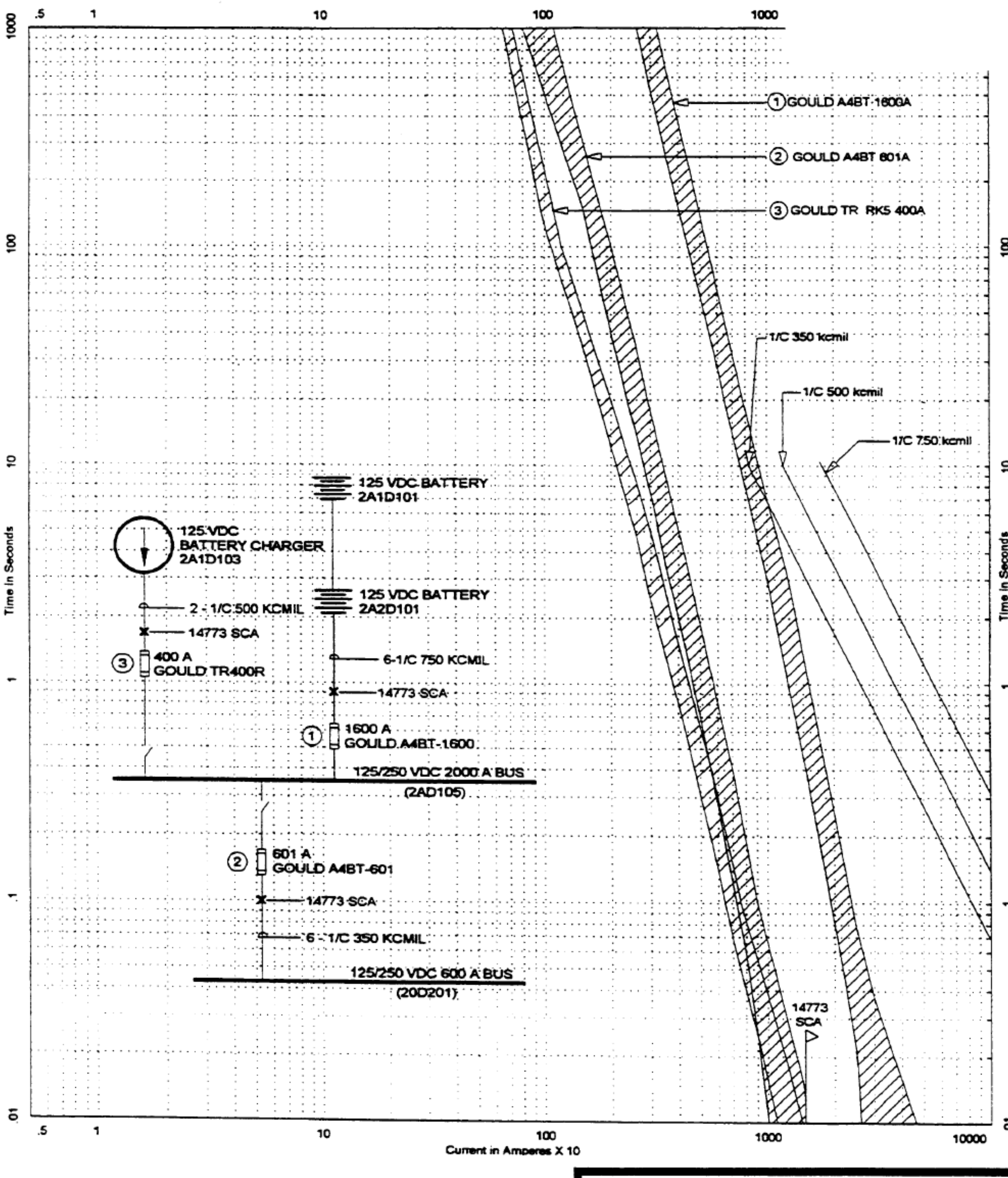
FIGURE 9A-17 Sht. 5 of 10 Rev. 09 11/99



LIMERICK GENERATING STATION
UNIT 2, DIVISION 1
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
125/250 Vdc SYSTEM - BATTERIES
2A1D101 & 2A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht 6 of 10 **REV. 14, 09/08**

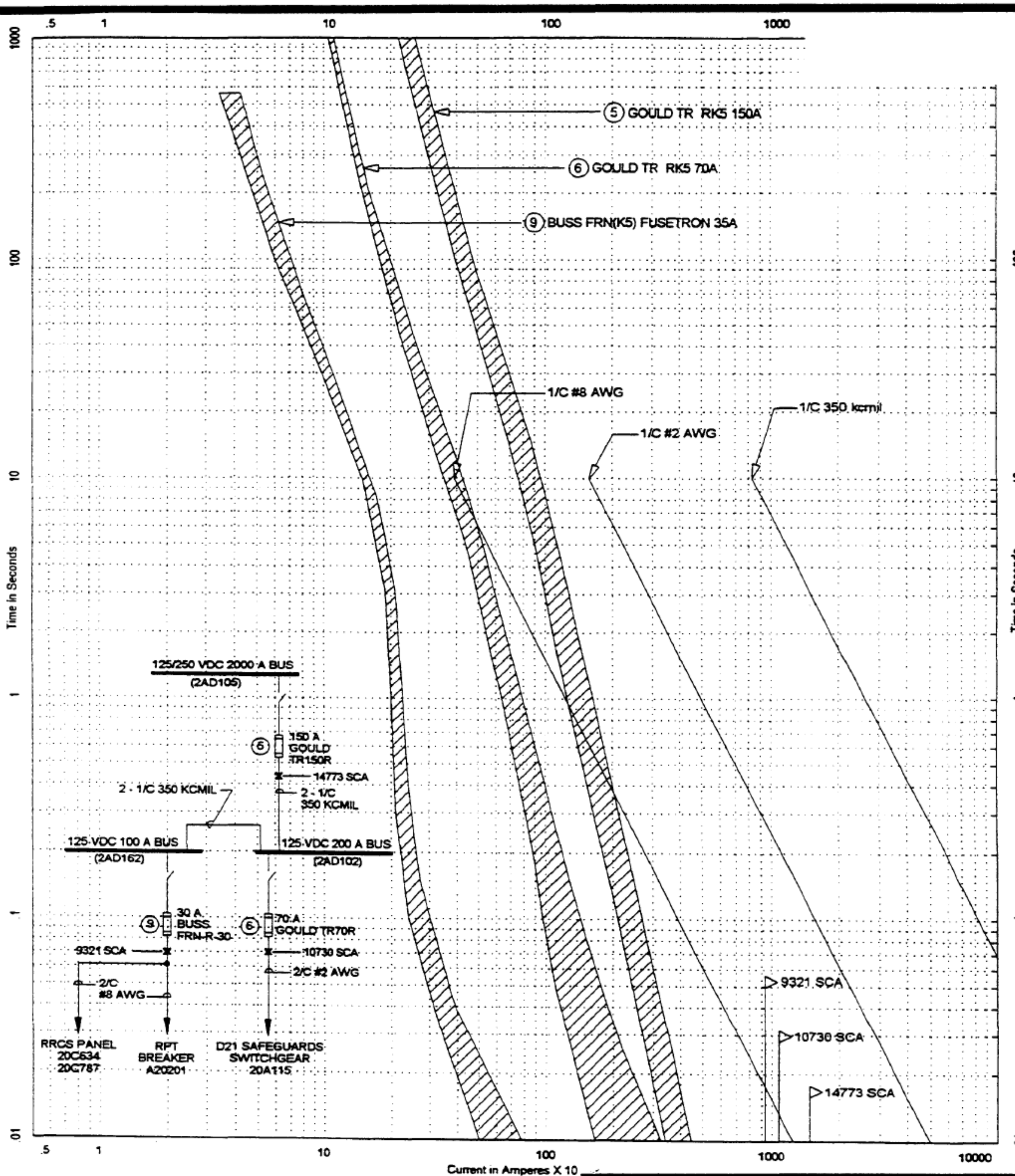


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2A1D101 & 2A2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht. 7 of 10 Rev. 09 11/99

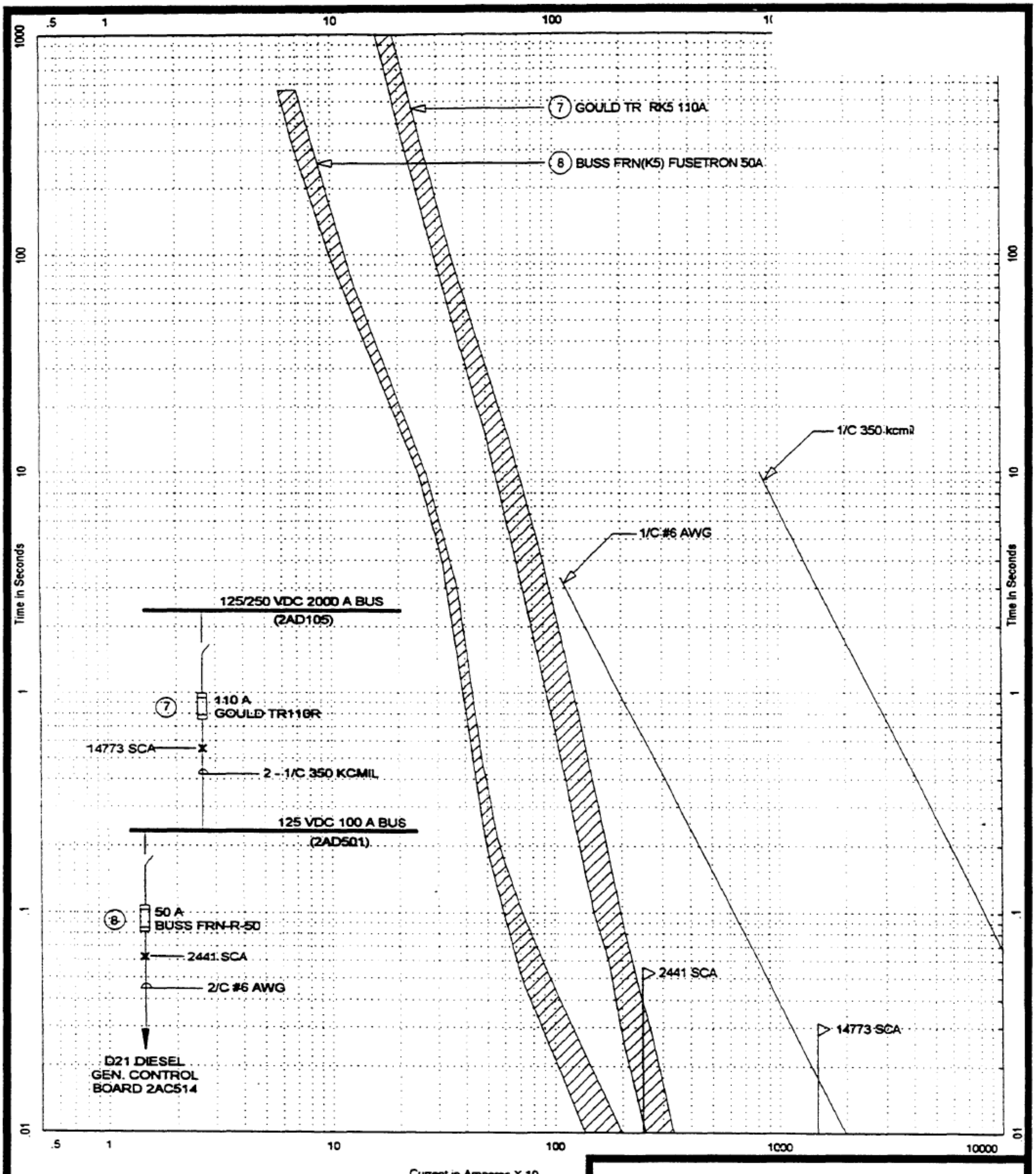


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
2A1D101 & 2A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE **9A-17** Sht. 8 of 10 **Rev. 09 11/99**

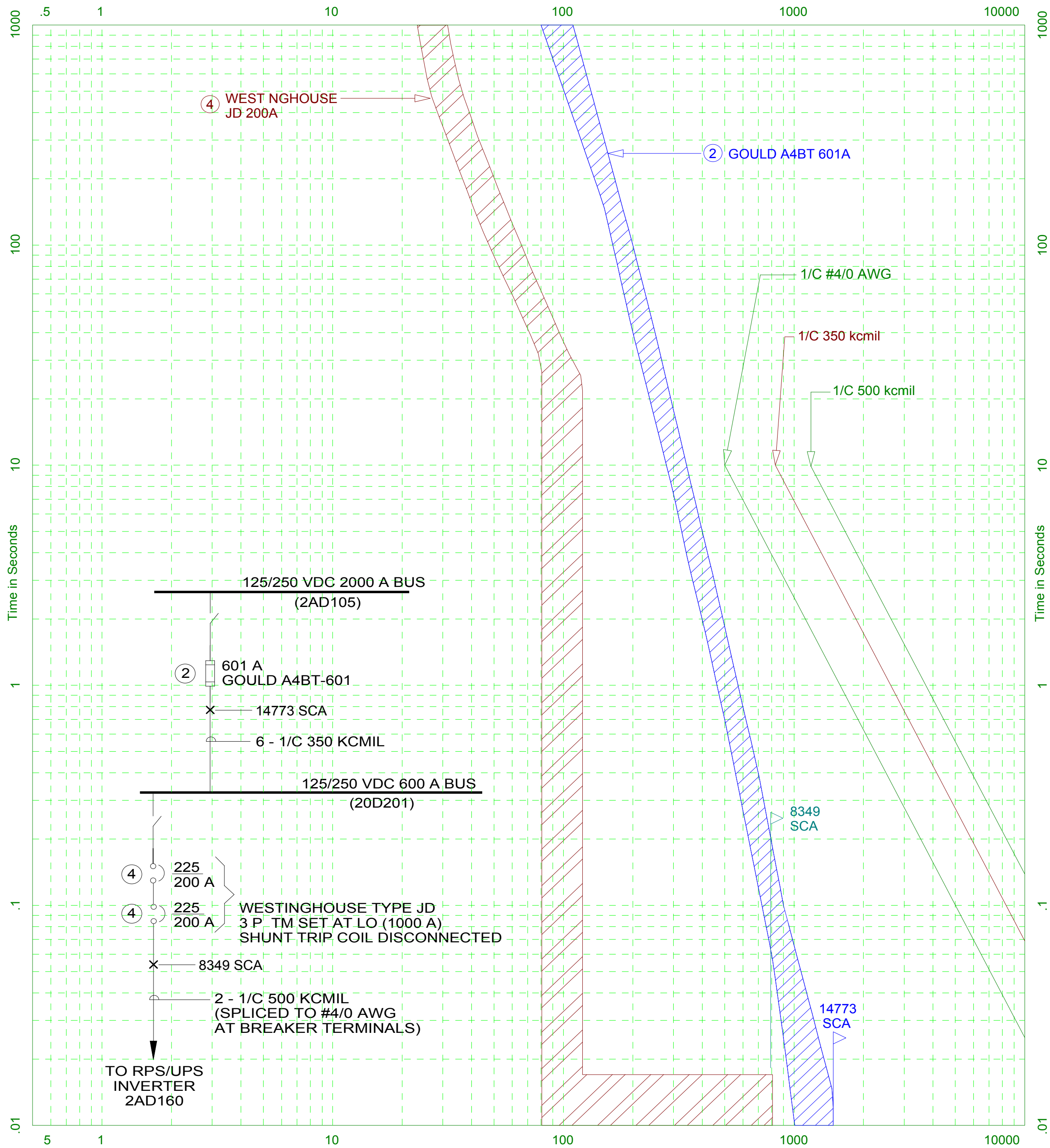


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION I
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2A1D101 & 2A2D101 PROTECTIVE DEVICE COORDINATION

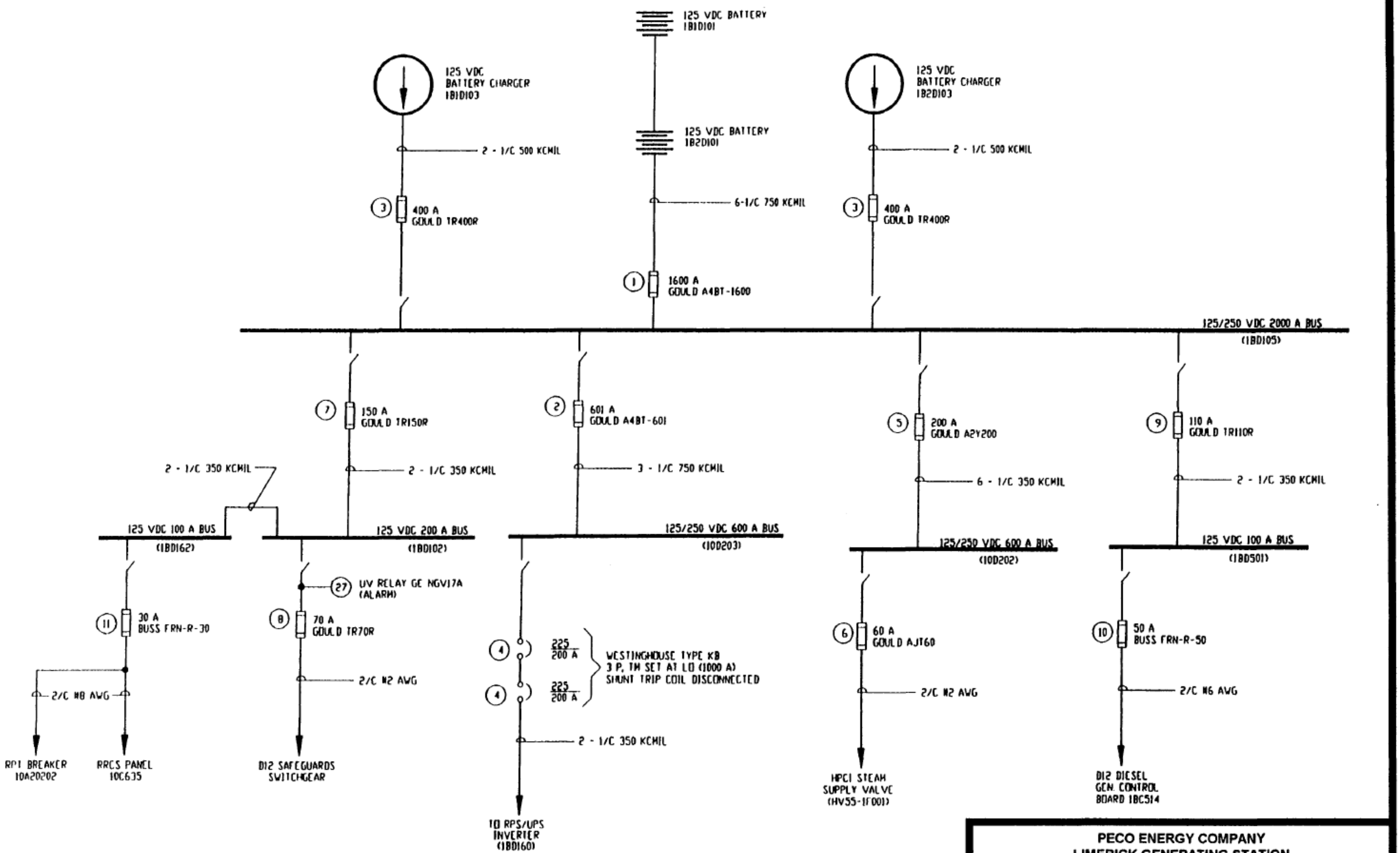
FIGURE 9A-17 Sht. 9 of 10 Rev. 09 11/99



LIMERICK GENERATING STATION
UNIT 2, DIVISION 1
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT
125/250 Vdc SYSTEM - BATTERIES
2A1D101 & 2A2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-17 Sht 10 of 10 **REV. 14, 09/08**

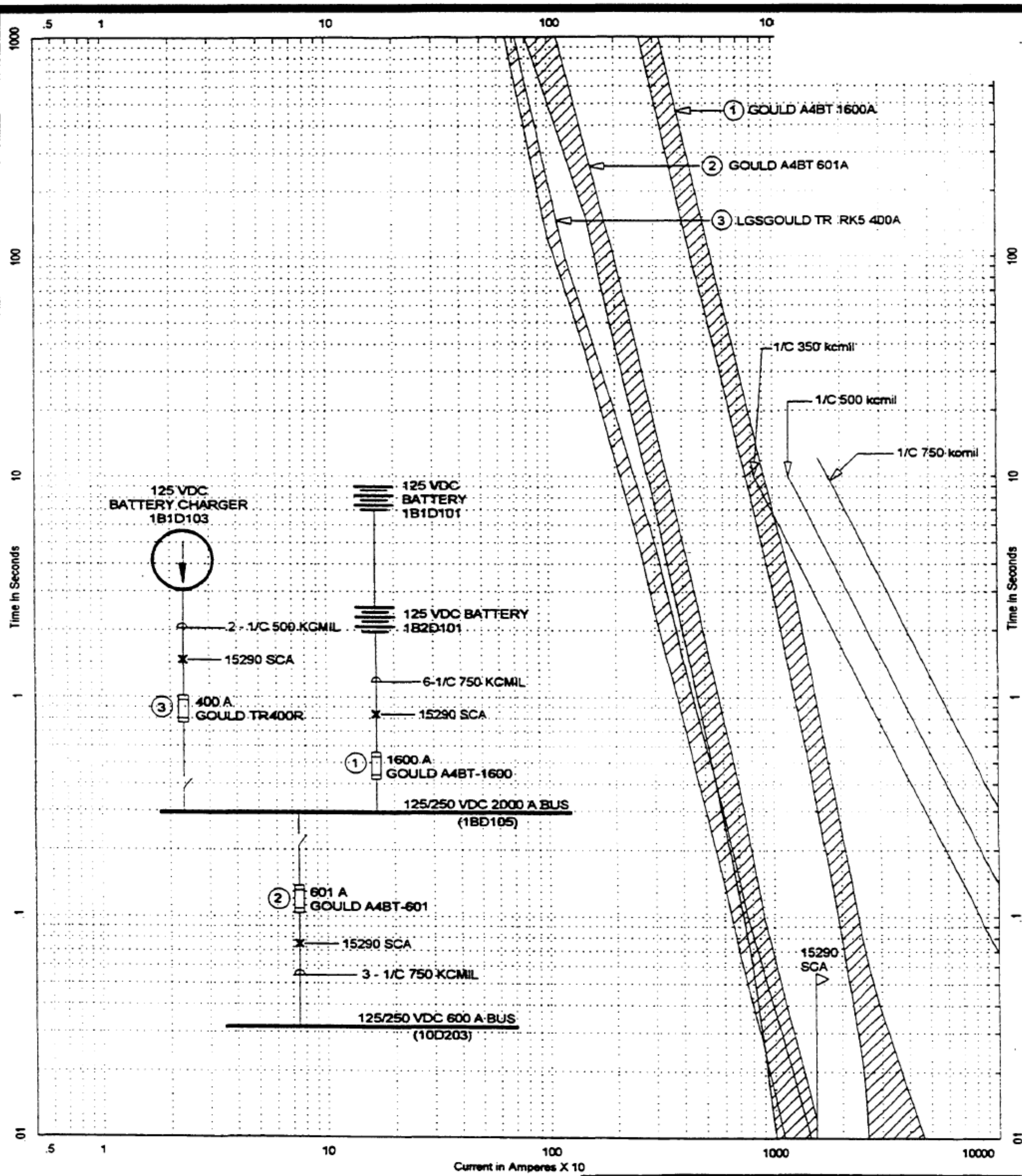


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 1B1D101 & 1B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 1 of 12 Rev. 09 11/99

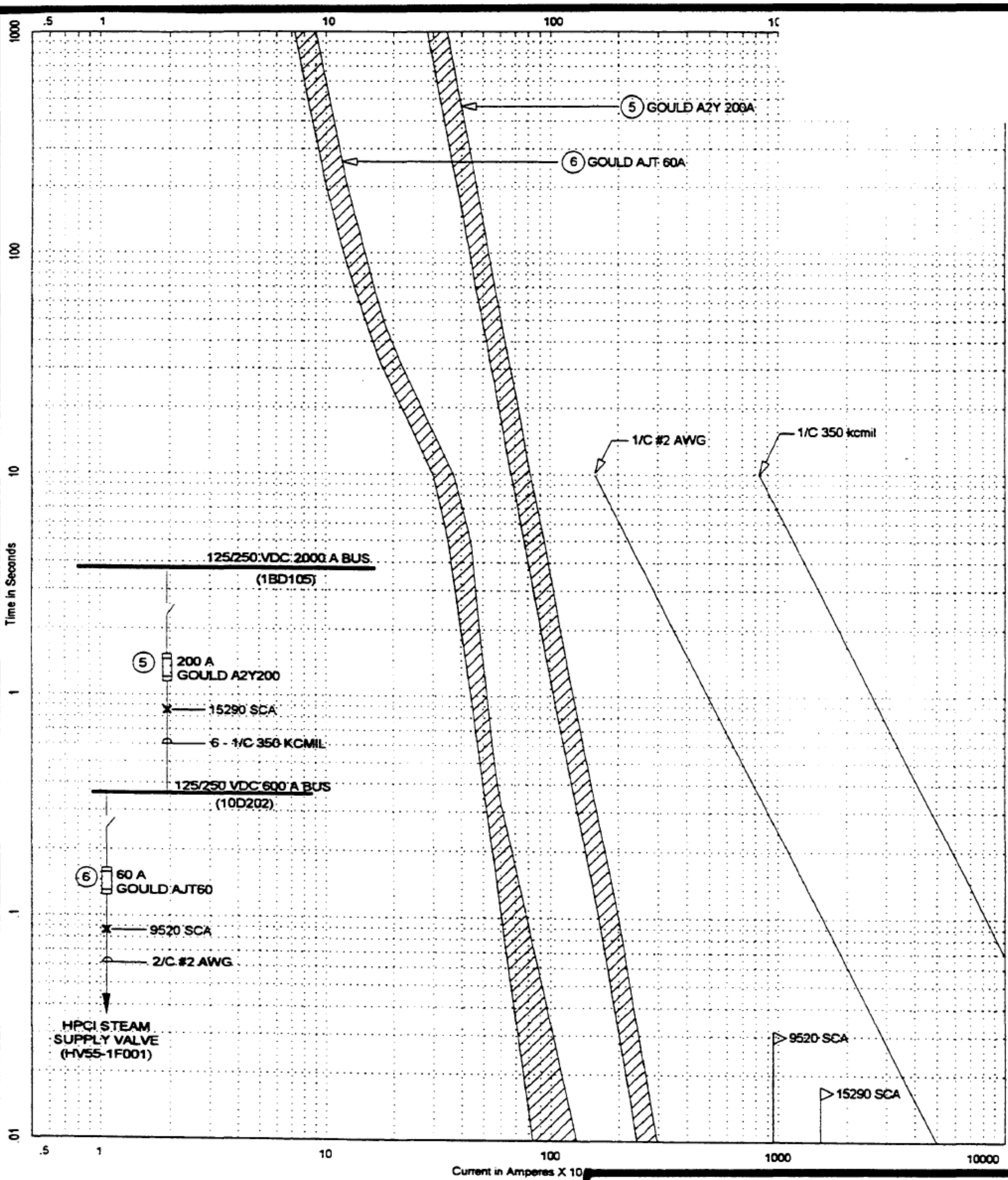


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 1B1D101 & 1B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 2 of 12 Rev. 09 11/99

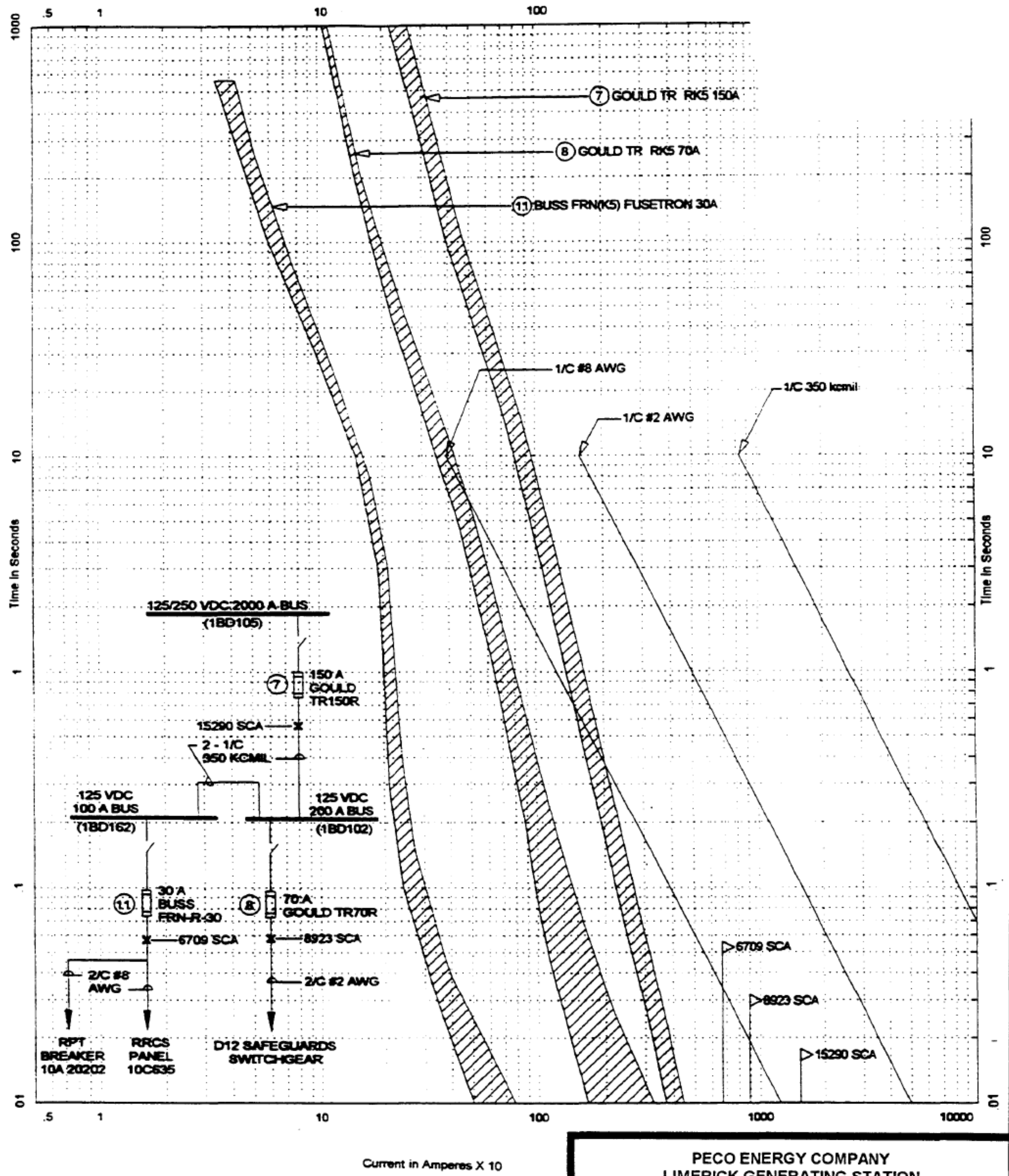


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 1B1D101 & 1B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 3 of 12 Rev. 09 11/99

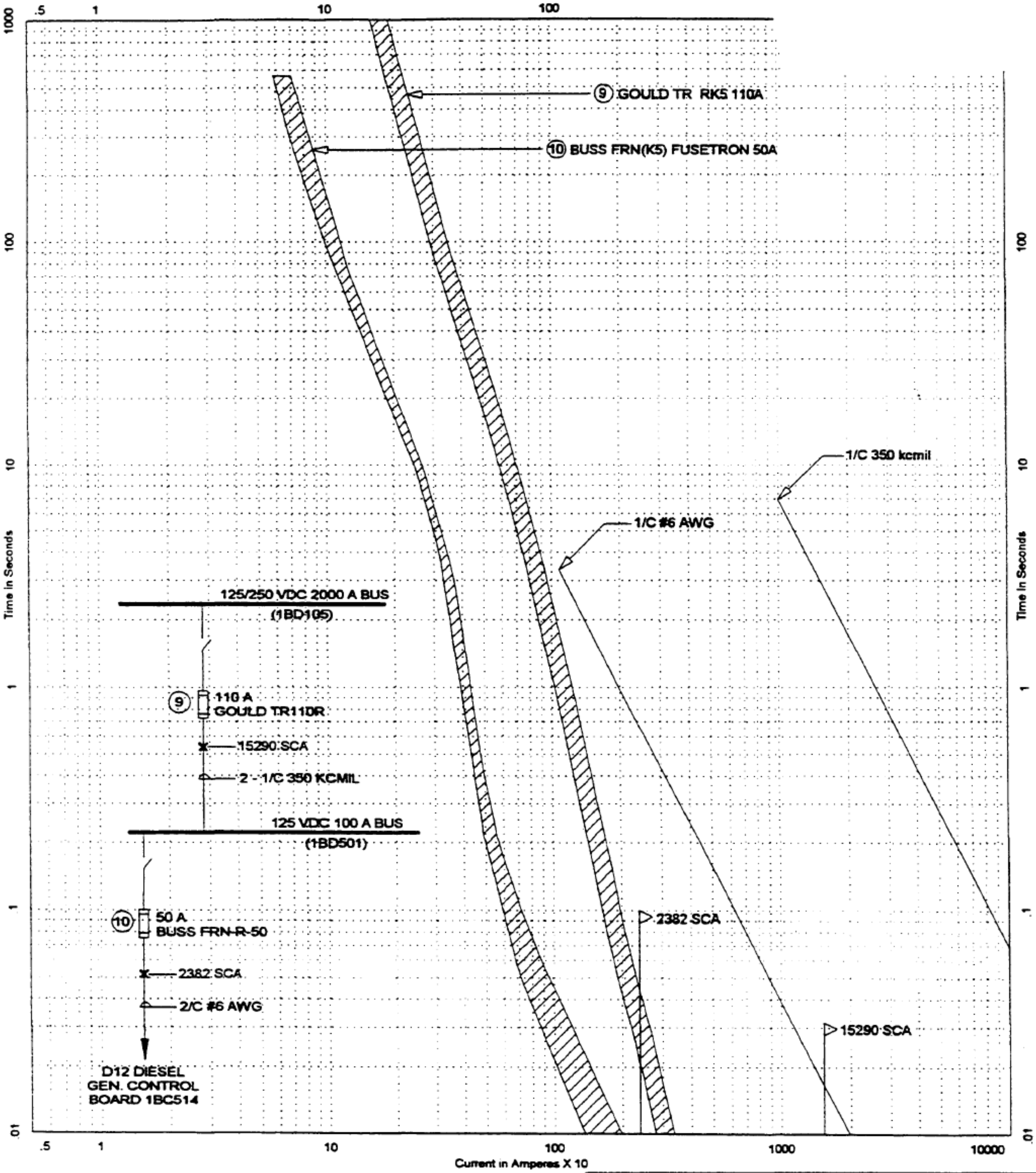


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1B1D101 & 1B2D101
PROTECTIVE DEVICE COORDINATION

FIGURE **9A-18** Sht. 4 of 12 **Rev. 09 11/99**

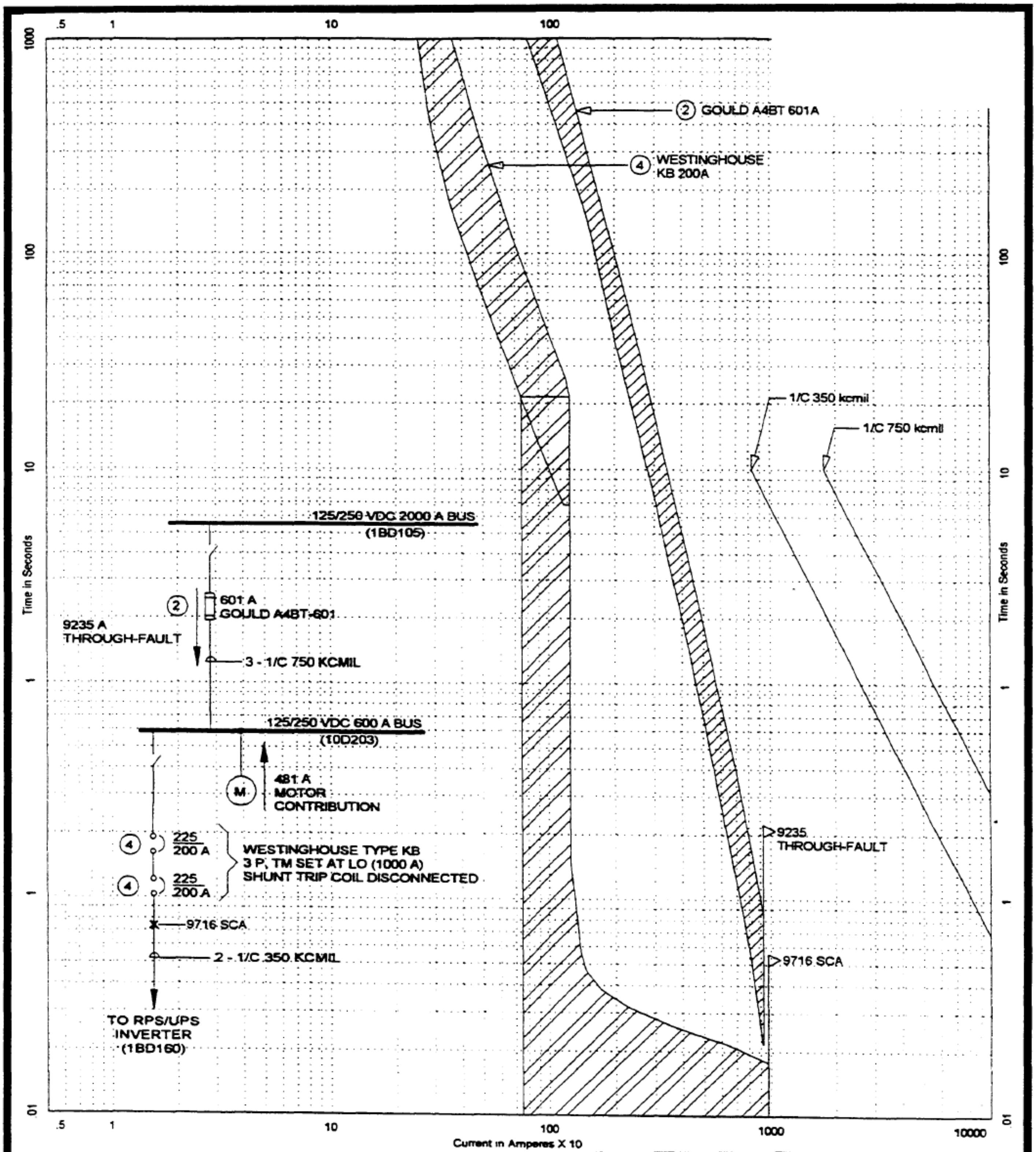


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1B1D101 & 1B2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 5 of 12 Rev. 09 11/99

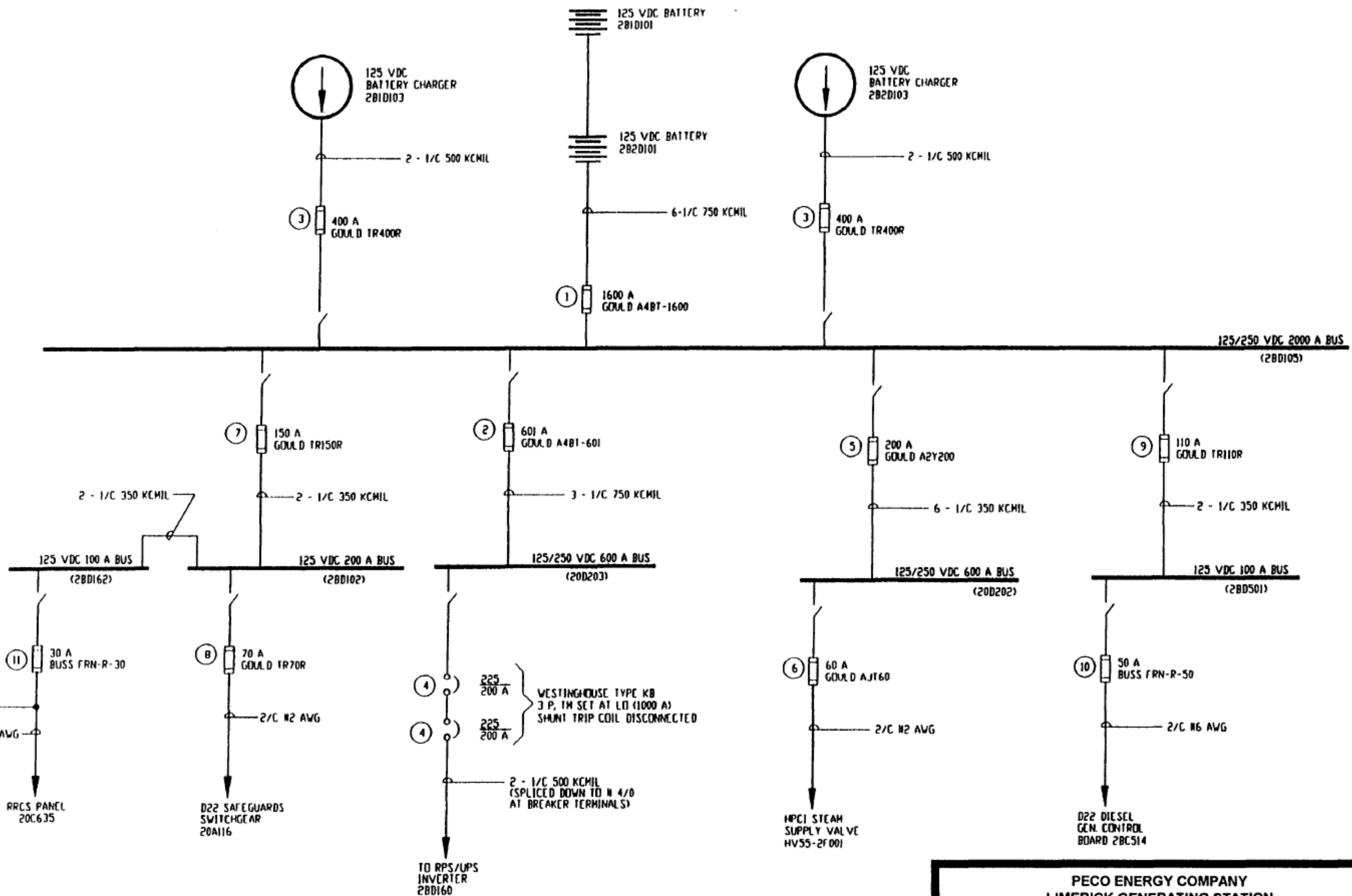


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 1, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
1B1D101 & 1B2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 6 of 12 Rev. 09 11/99

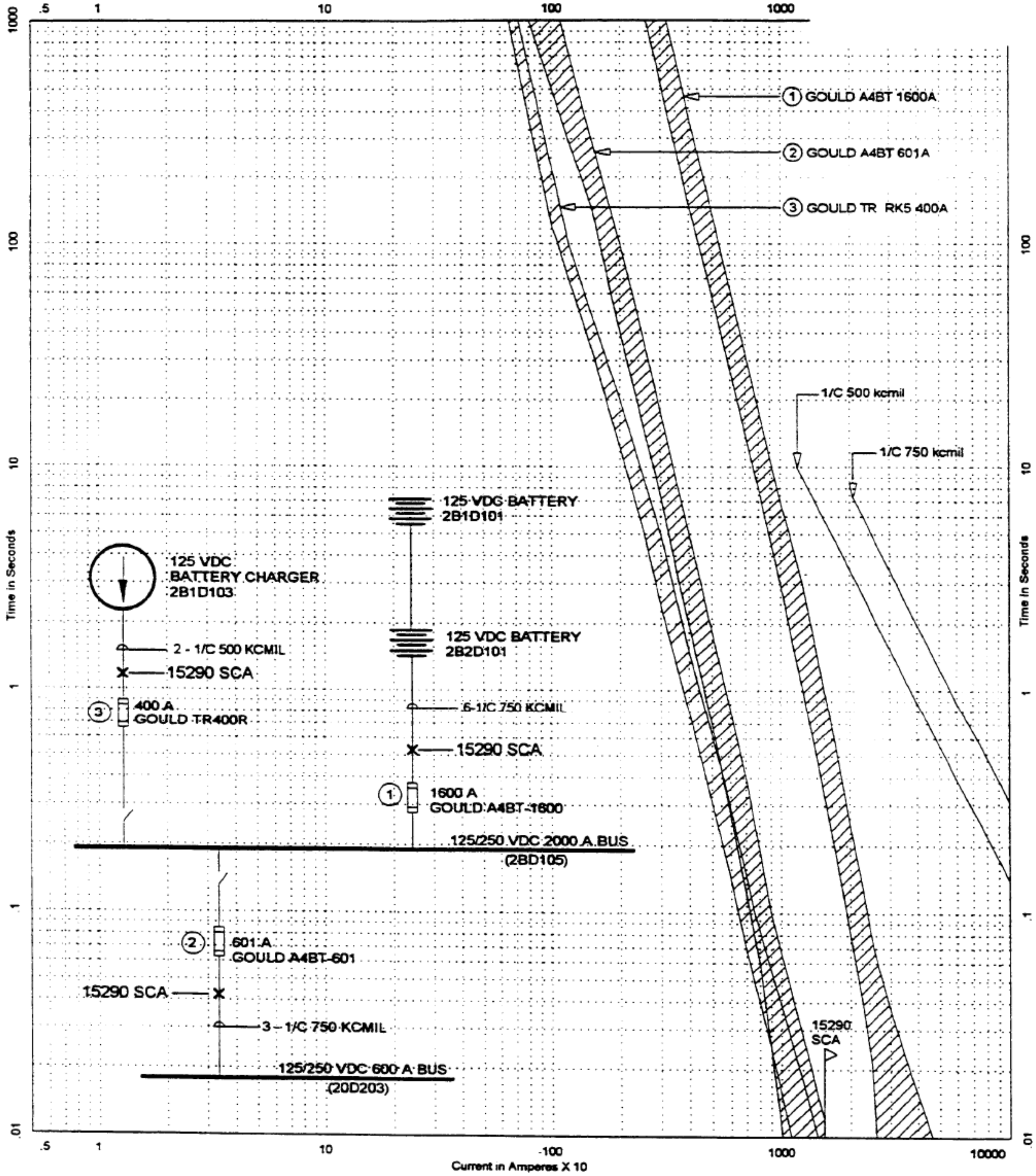


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2B1D101 & 2B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 7 of 12 Rev. 09 11/99

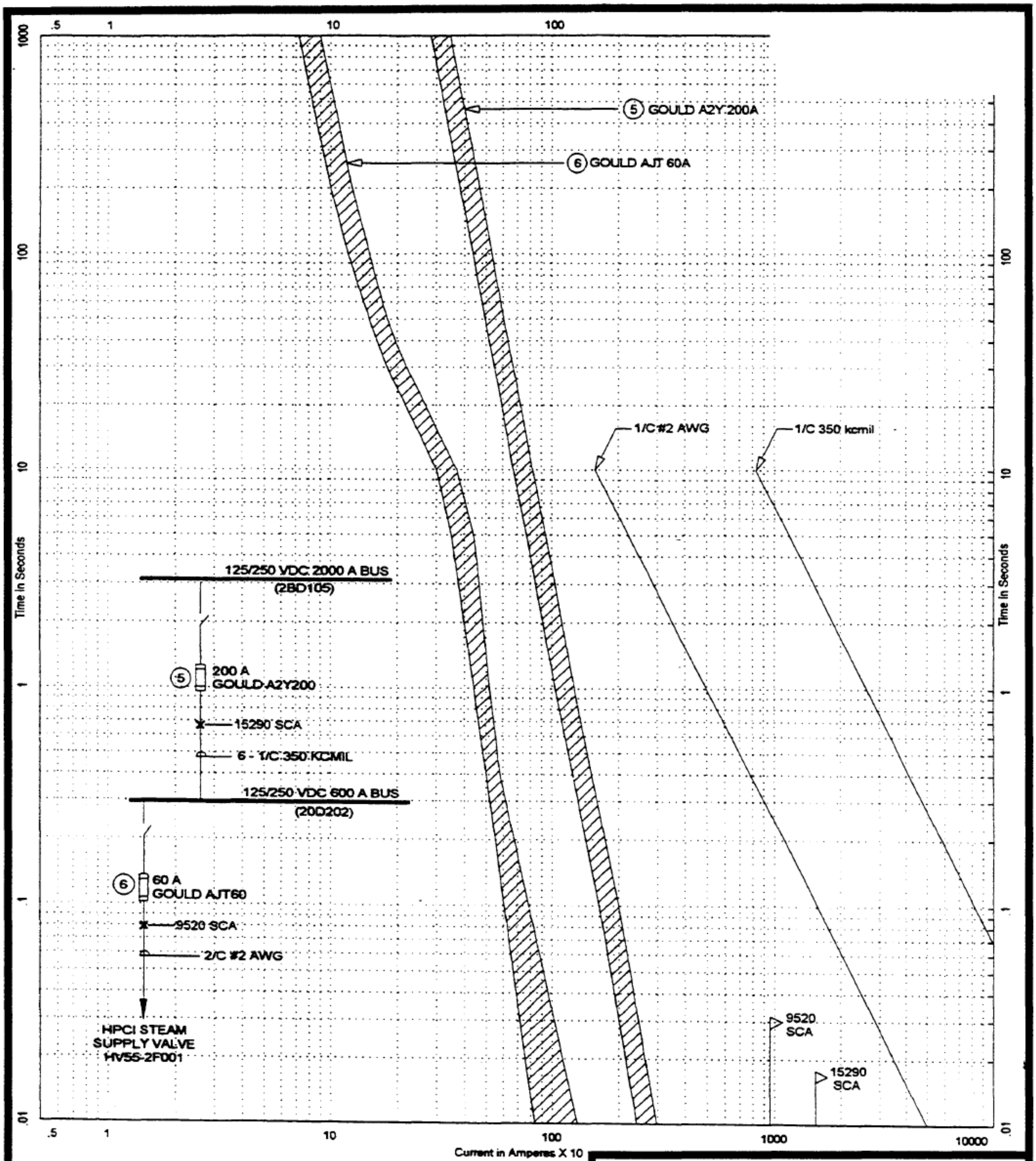


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2B1D101 & 2B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 8 of 12 Rev. 09 11/99

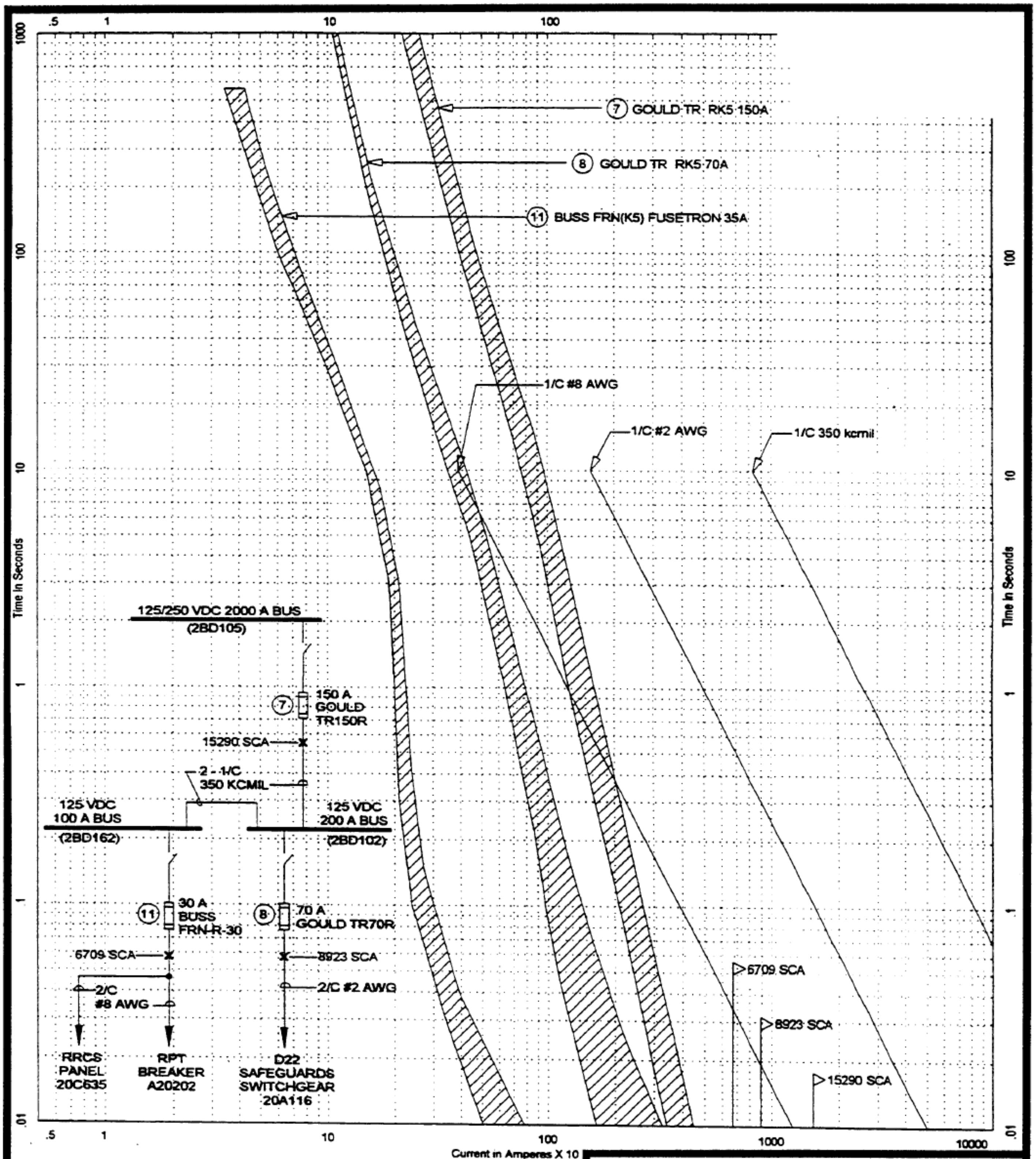


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES
2B1D101 & 2B2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 9 of 12 Rev. 09 11/99

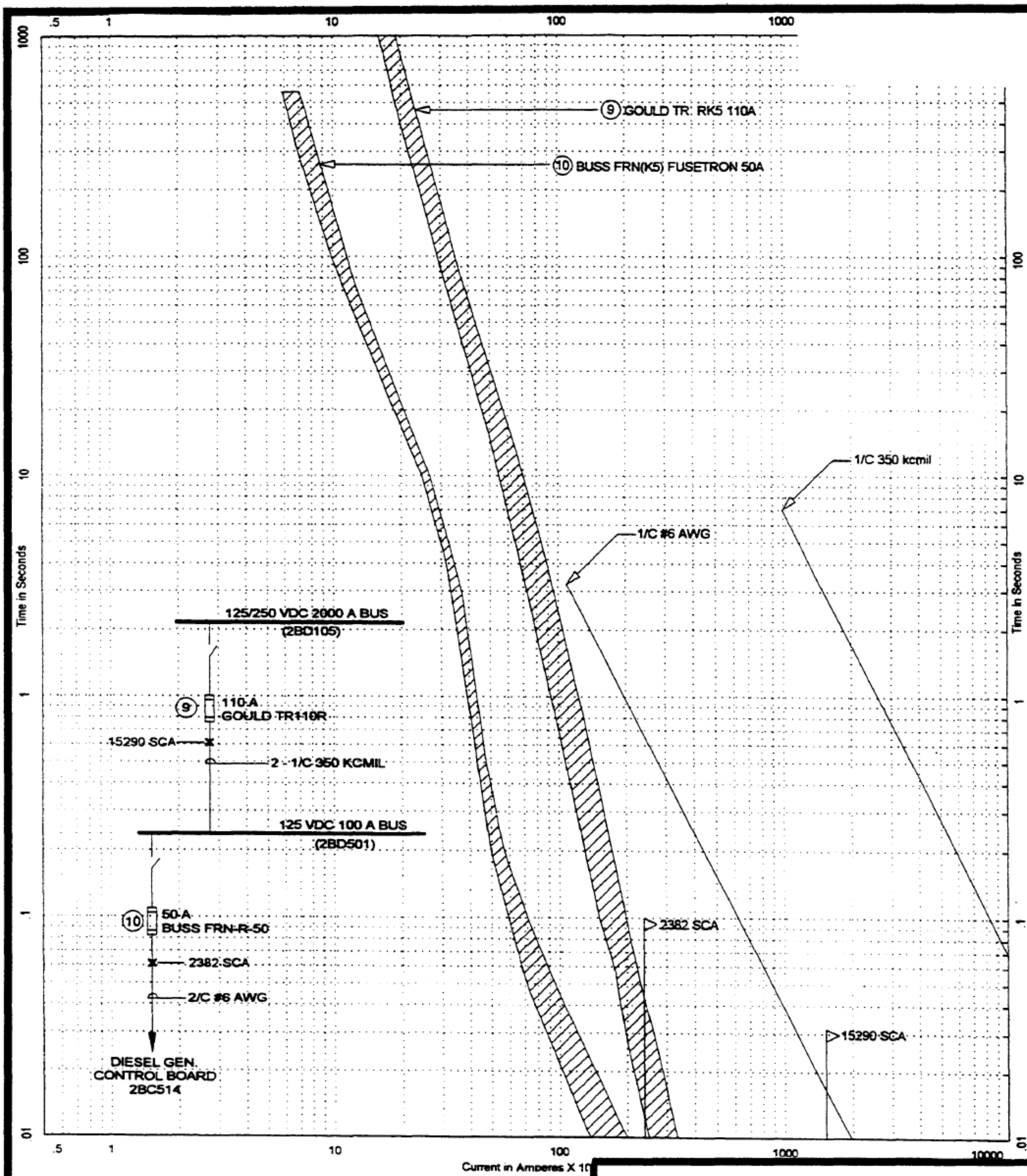


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2B1D101 & 2B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 10 of 12 Rev. 09 11/99

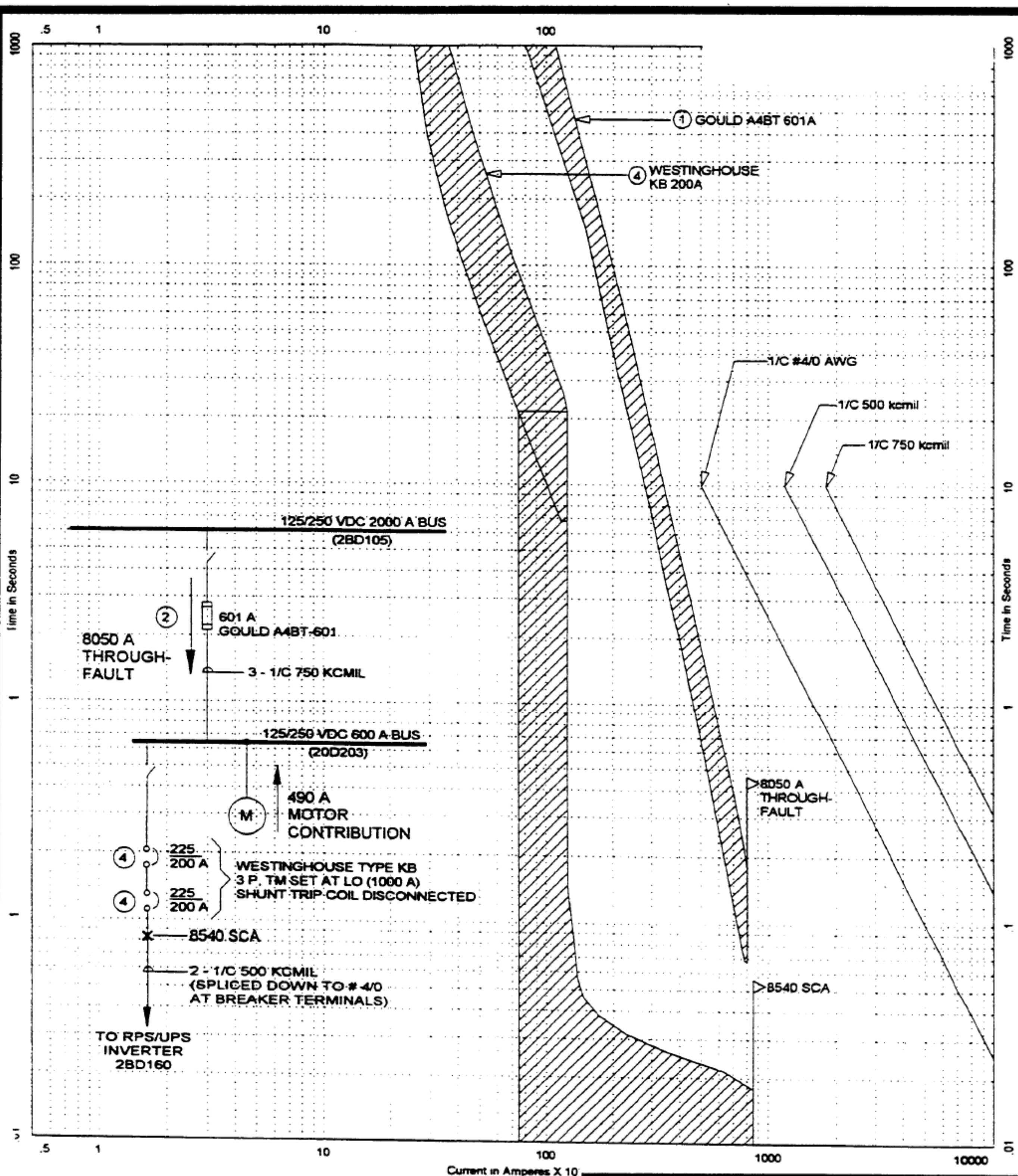


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2B1D101 & 2B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 11of 12 Rev. 09 11/99

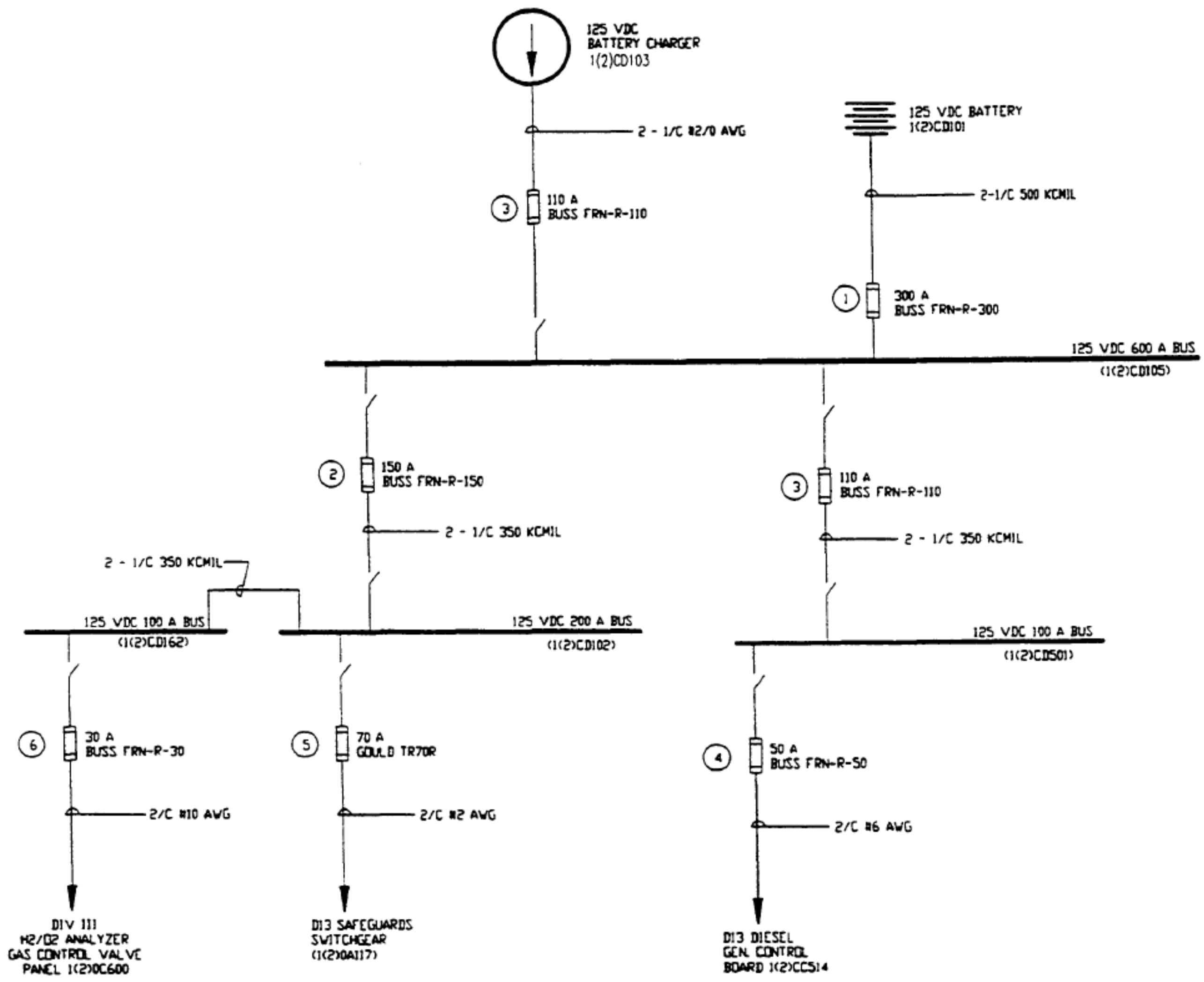


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNIT 2, DIVISION II
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125/250 Vdc SYSTEM - BATTERIES 2B1D101 & 2B2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-18 Sht. 12 of 12 Rev. 09 11/99

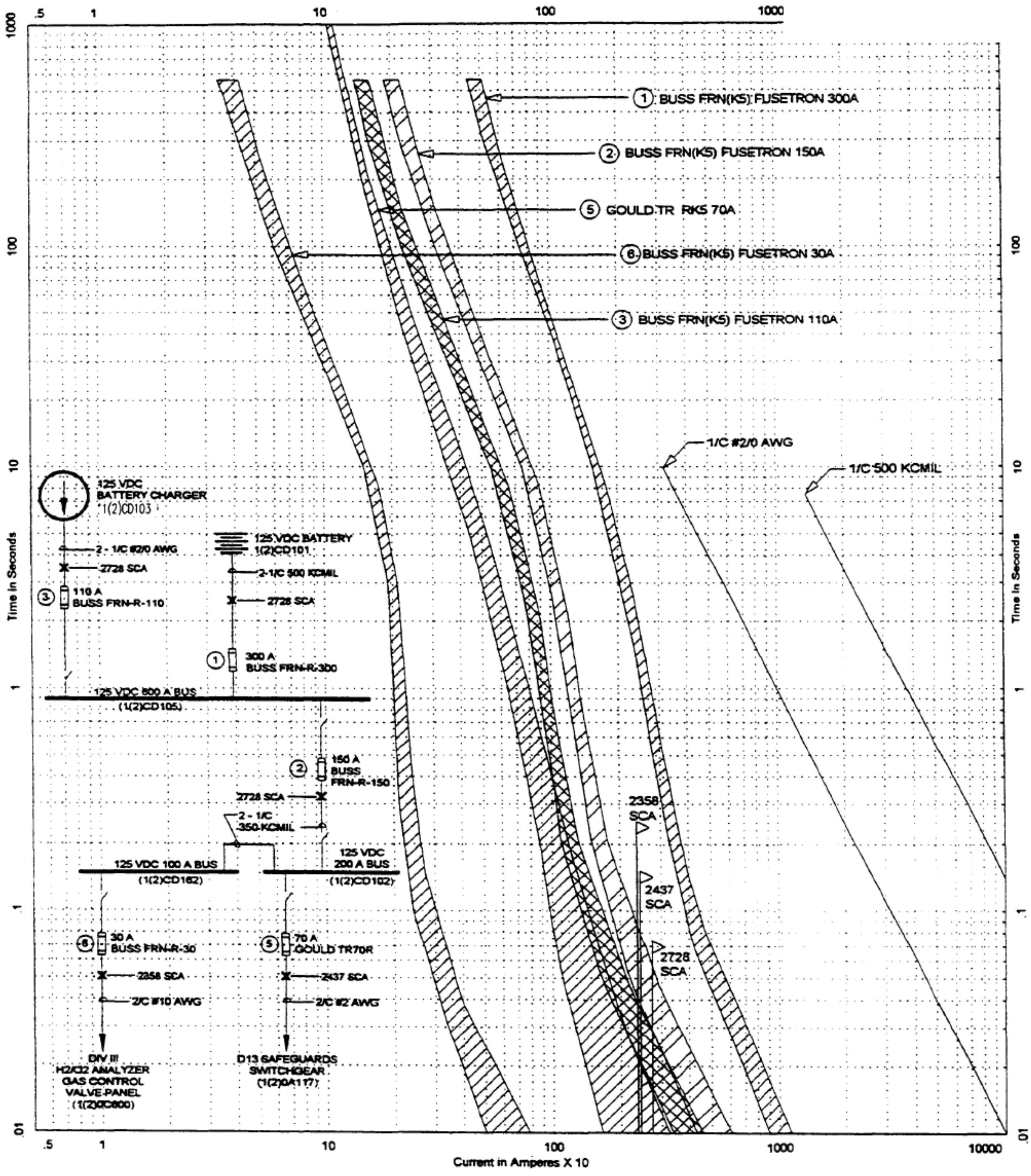


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION III
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES
1C1D101 & 2C2D101
PROTECTIVE DEVICE COORDINATION

FIGURE **9A-19** Sht. 1 of 3 **Rev. 09 11/99**

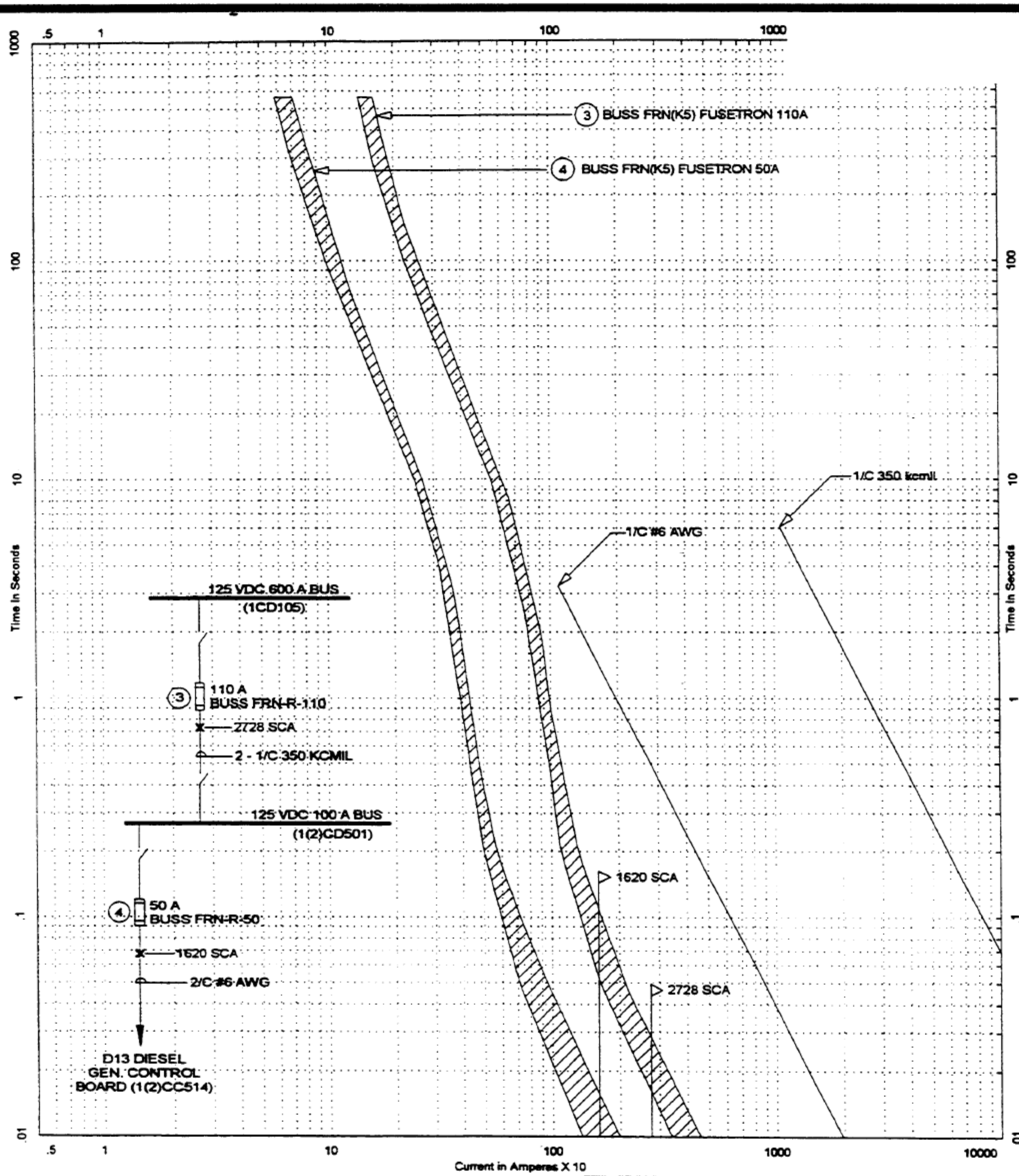


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION III
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES
1C1D101 & 2C2D101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-19 Sht. 2 of 3 Rev. 09 11/99

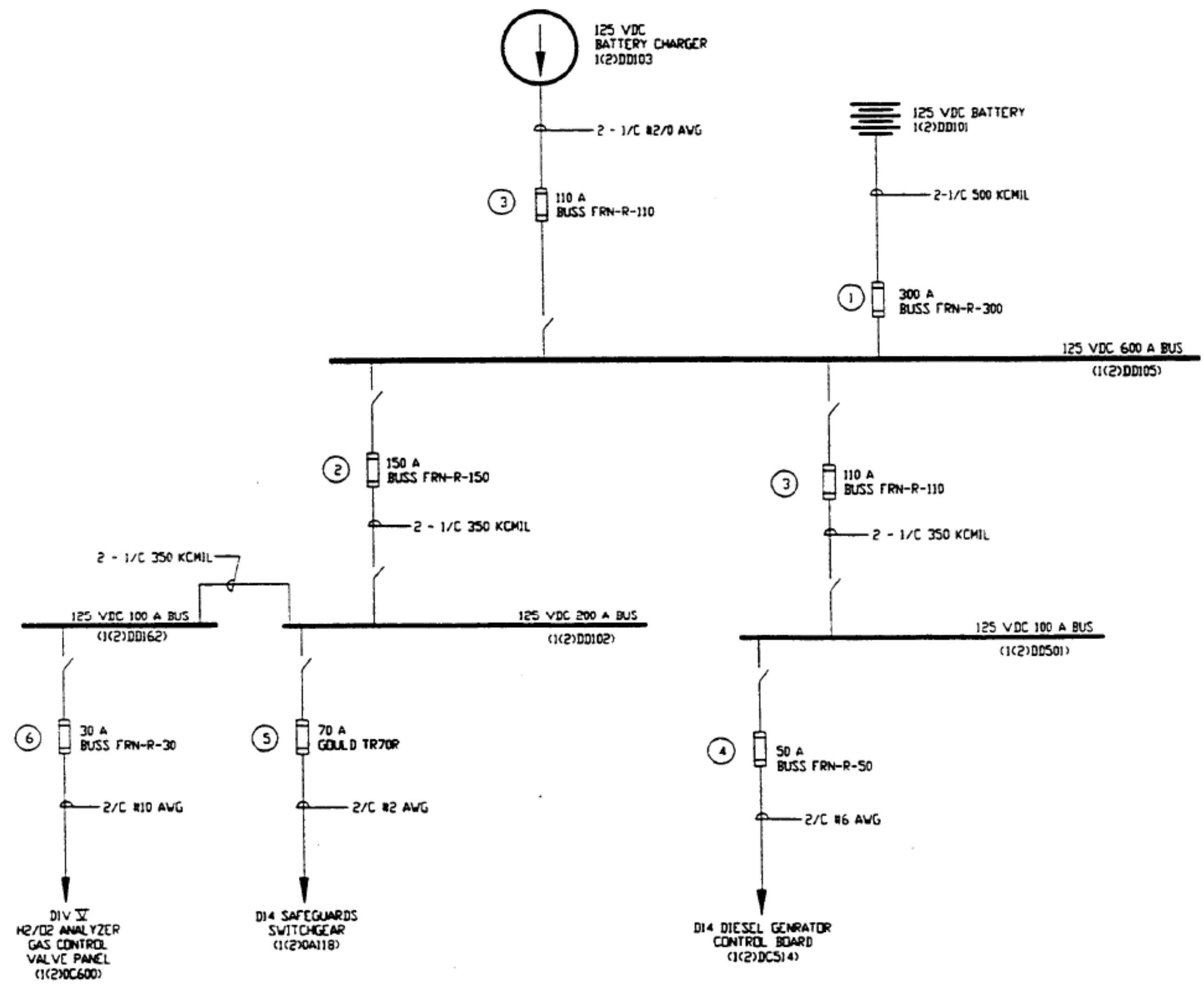


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION III
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES 1C1D101 & 2C2D101 PROTECTIVE DEVICE COORDINATION

FIGURE 9A-19 Sht. 3 of 3 Rev. 09 11/99

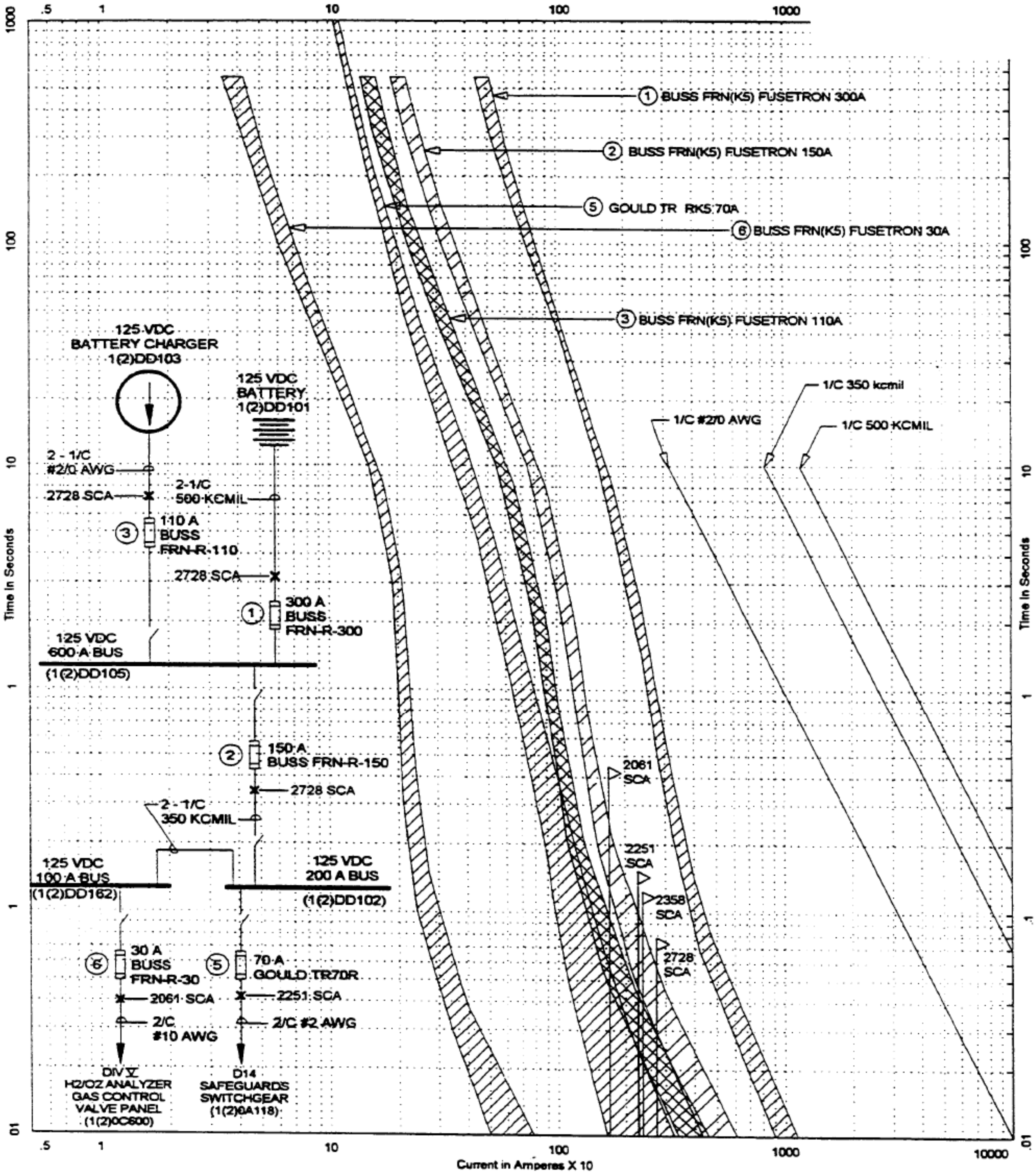


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION IV
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES
1DD101 & 2DD101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-20 Sht. 1 of 3 **Rev. 09 11/99**

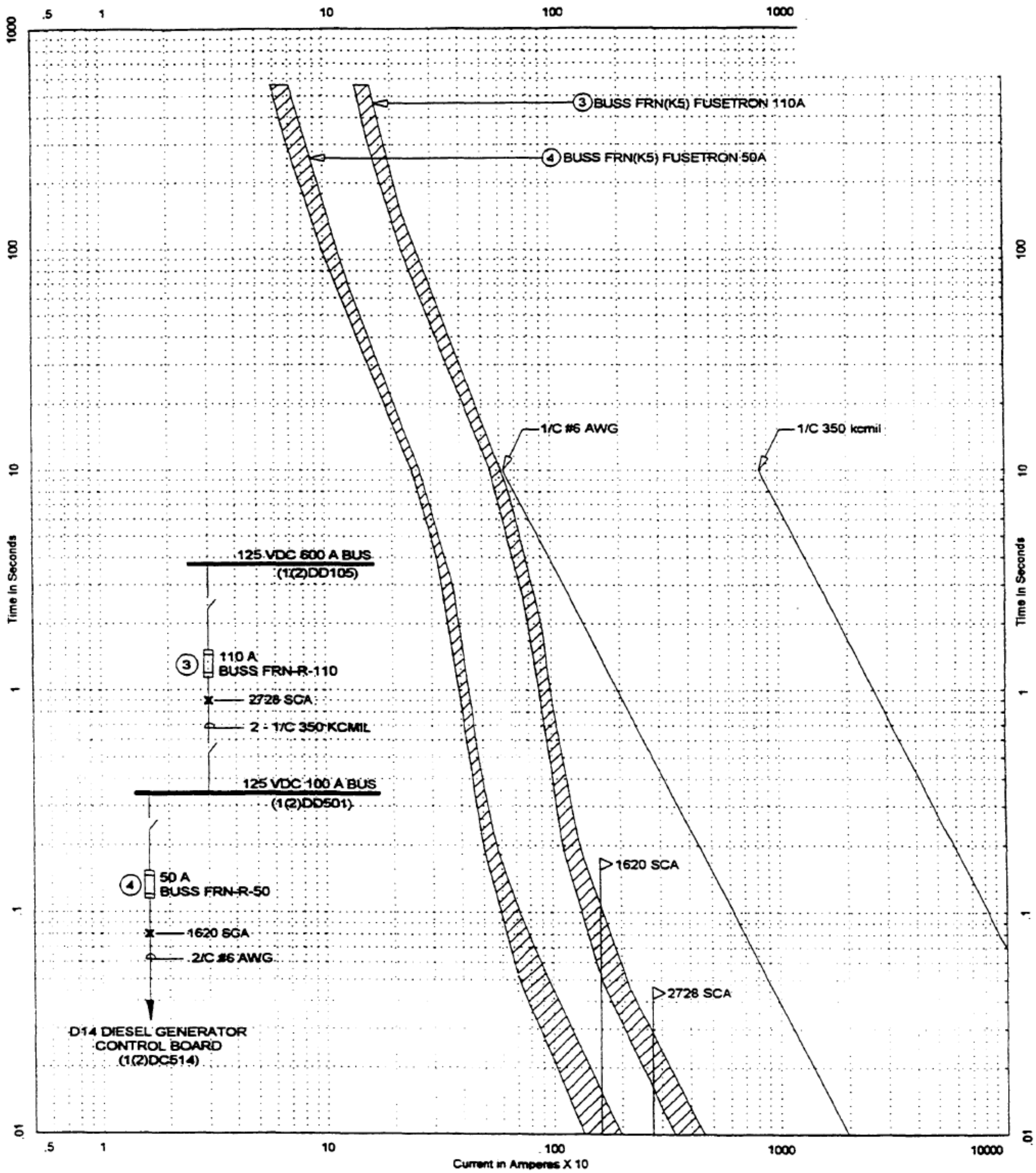


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION IV
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES
1DD101 & 2DD101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-20 Sht. 2 of 3 Rev. 09 11/99

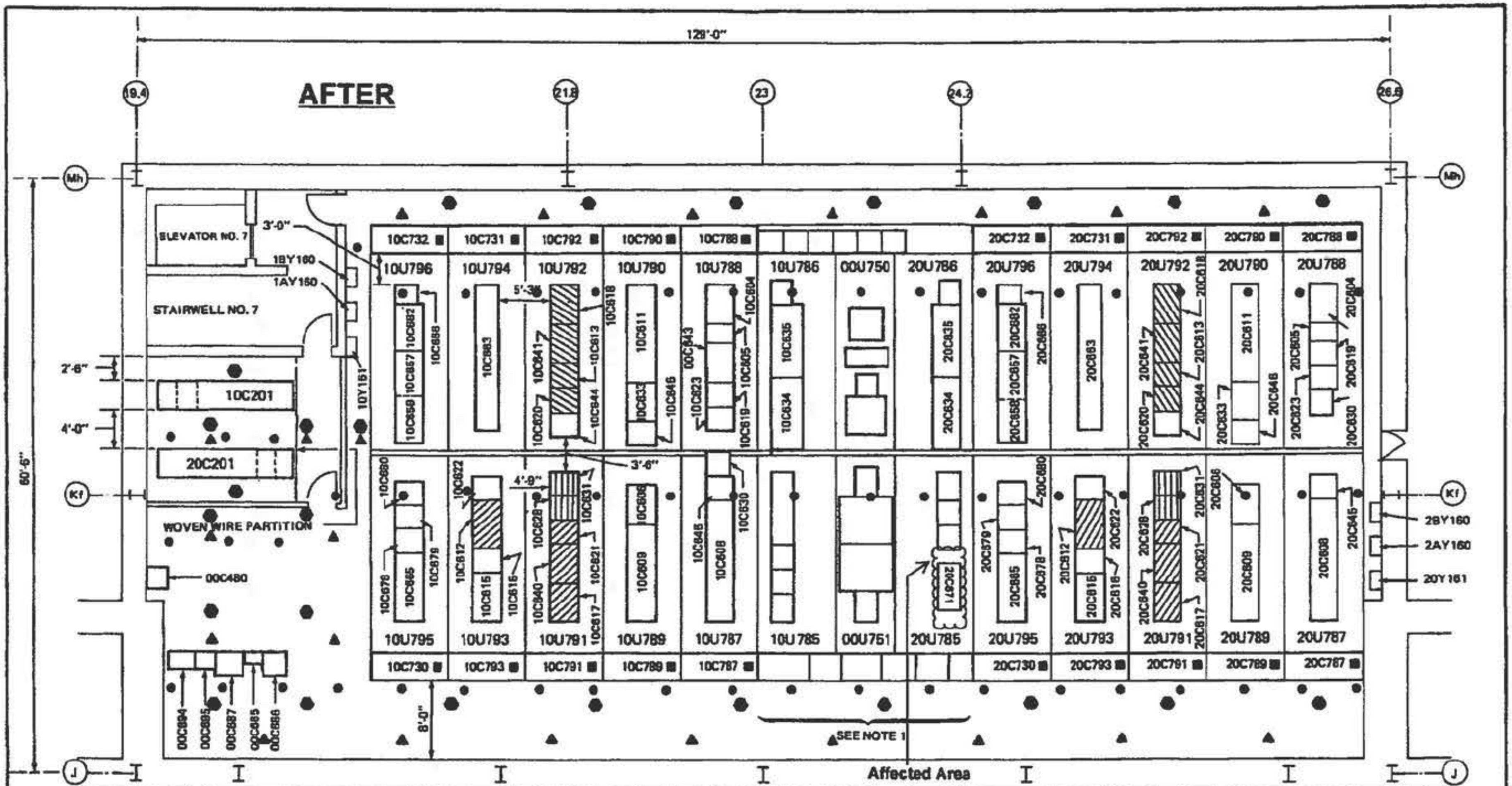


PECO ENERGY COMPANY
LIMERICK GENERATING STATION
UNITS 1 & 2, DIVISION IV
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

125 Vdc SYSTEM - BATTERIES
1DD101 & 2DD101
PROTECTIVE DEVICE COORDINATION

FIGURE 9A-20 Sht. 3 of 3 Rev. 09 11/99



LEGEND

- CABINETS CONTAINING DEVICES ASSOCIATED WITH SHUTDOWN METHODS A AND/OR C
- CABINETS CONTAINING DEVICES ASSOCIATED WITH SHUTDOWN METHODS B AND/OR D
- RELAY PANELS CONTAINING DEVICES ASSOCIATED WITH ADS (SHUTDOWN METHODS A,B,C&D)
- ● HEAT DETECTORS LOCATED WITHIN THE RAISED FLOORING (NOT INCLUDING HEAT DETECTORS IN THE FLOOR SECTIONS OF THE PGCC; SEE NOTE 2)
- ▲ SMOKE DETECTORS LOCATED WITHIN THE RAISED FLOORING (NOT INCLUDING SMOKE DETECTORS IN THE FLOOR SECTIONS OF THE PGCC; SEE NOTE 2)
- ■ SMOKE DETECTORS LOCATED IN TERMINATION CABINETS
- ● SMOKE DETECTORS LOCATED BELOW THE CEILING OF THE AUXILIARY EQUIPMENT ROOM AND THE REMOTE SHUTDOWN ROOM

NOTES

1. THE CONSOLES AND CABINETS LOCATED ON FLOOR SECTIONS 00U750, 00U751, 10U785, 10U786, 20U785, AND 20U786 AND WITHOUT IDENTIFICATION NUMBERS INDICATED ARE ASSOCIATED WITH THE PLANT COMPUTERS.
2. EACH FLOOR SECTION OF THE PGCC CONTAINS 8 HEAT DETECTORS AND 4 SMOKE DETECTORS. THESE DETECTORS ARE NOT SHOWN ON THIS DRAWING.

LIMERICK GENERATING STATION
UNITS 1 AND 2
UPDATED FINAL SAFETY ANALYSIS REPORT

FIRE PROTECTION EVALUATION REPORT

AUXILIARY EQUIPMENT ROOM ARRANGEMENT

FIGURE 9A-21