TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

9.0 AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

9.1.1 NEW FUEL STORAGE

9.1.1.1 Design Bases

9.1.1.1.1 Safety Design Bases - Structural

Structural related safety design bases are as follows:

a. The new fuel storage racks containing a full complement of fuel assemblies are designed to: (1) withstand all credible static and dynamic loadings, (2) prevent damage to the structure of the racks, and therefore the contained fuel and (3) minimize distortion of the racks arrangement.

b. The racks are designed to protect the fuel assemblies from excessive physical damage which may cause the release of radioactive materials in excess of <10 CFR 20> and <10 CFR 50.67> requirements under normal or abnormal conditions caused by impacting from either fuel assemblies, bundles or other equipment.

c. The racks are designed and constructed in accordance with the Quality Assurance requirements of <10 CFR 50, Appendix B>.

d. The new fuel storage racks are categorized as Safety Class 2 and Seismic Category I.

e. The design of the building containing the new fuel storage vault (new fuel storage facility) conforms to the guidelines of <Regulatory Guide 1.13>. Thus it ensures that any deleterious effects on fuel storage (fuel rack) integrity due to natural phenomena such as earthquakes, tornadoes, hurricanes, missiles, and floods will be precluded.

f. The design of the external and internal structure associated with the handling and storage of new fuel fulfills the requirements of General Design Criteria 2, 3, 4, 5, 61, 62, and 63 and <Regulatory Guide 1.29>.

9.1.1.1.2 Safety Design Bases - Nuclear

Nuclear related safety design bases are as follows:

a. The new fuel storage racks are designed and maintained with sufficient spacing between the new fuel assemblies to assure that the array, when racks are fully loaded, will be subcritical by at least 5 percent ΔK, including allowance for calculational biases and uncertainties. In the calculations performed to assure that $k_{eff} \leq 0.95$, the standard lattice methods (Reference 1) used at General Electric are employed. Under conditions where diffusion theory is valid, it is used in calculations. Monte Carlo techniques are employed to "bench mark" the diffusion theory results to assure accuracy.

b. The storage array is assumed to be infinite in all directions. Since no credit is taken for leakage, the values reported as effective neutron multiplication factors are in reality infinite neutron multiplication factors.

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

9.1.1.1.3 Power Generation Design Bases

Two vaults for new fuel storage racks are supplied, each for 24 percent of the full core fuel load. New fuel storage racks are designed and arranged so that the fuel assemblies can be handled efficiently during refueling operations.

9.1.1.2 Facilities Description

An exemption was granted from the NRC (Reference 4) which permitted the receipt, inspection handling, and storing of unirradiated fuel in the fuel handling building without having a criticality monitoring system with two separate criticality detectors as required by <10 CFR 70.24>. However, PNPP has chosen to comply with the requirements of <10 CFR 50.68(b)> rather than <10 CFR 70.24>.

In order to use the New Fuel Vaults, the requirements of <10 CFR 50.68(b)(2)> and <10 CFR 50.68(b)(3)> must be met.

Storage and handling of new fuel is accomplished in the east section of the intermediate building <Figure 1.2-5>. The working floor in the intermediate building is at Elevation 620'-6". All new fuel enters the plant through the railhead area at the east end of the working floor. New fuel containers are handled at that point by an auxiliary hoist mounted from the 125 ton hoist of the fuel handling area crane or forklift or side loader. Each new fuel storage rack <Figure 9.1-1> holds up to 10 channeled or unchanneled assemblies in a row.

Fuel spacing (seven inches nominal center-to-center within a rack, 12 inches minimum center-to-center between adjacent racks) within the rack and from rack-to-rack will limit the effective multiplication factor of the array (k_{eff}) to not more than 0.95. The fuel assemblies are loaded into the rack through the top. Each hole for a fuel assembly has adequate clearance for inserting or withdrawing the assembly channeled or unchanneled. Sufficient guidance is provided to preclude damage to the fuel assemblies. The upper tie plate of the fuel element rests against the rack to provide lateral support. The design of the racks prevents accidental insertion of the fuel assembly in a position not intended for the fuel. This is achieved by abutting the sides of each casting to the adjacently installed casting. In this way, the only spaces in the assembly are those into which it is intended to insert fuel. The weight of the fuel assembly is supported by the lower tie plate which is seated in a chamfered hole in the base casting.

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

9.1.1.3 Safety Evaluation

9.1.1.3.1 Criticality Control

The calculations of k_{eff} are based on the geometrical arrangements of the fuel array and subcriticality does not depend on the presence of neutron absorbing materials. The arrangement of fuel assemblies in the fuel storage racks results in k_{eff} below 0.95 in a dry condition or completely flooded with water which has a density of 1 g/cc. To meet the requirements of General Design Criterion 62, geometrically-safe configurations of fuel stored in the new fuel array are employed to assure that k_{eff} will not exceed 0.95 if fuel is stored in the dry condition or if the abnormal condition of flooding (water with a density of 1 g/cc) occurs. In the dry condition, k_{eff} is maintained ≤ 0.95 due to under-moderation. In the flooded condition, the geometry of the fuel storage array assures the k_{eff} will remain ≤ 0.95 due to over-moderation.

The floor of each vault is sloped to a drain at the low point to drain any water that may be introduced. The design of the fuel, racks and vault ensures that water will not be retained in or around a channeled or unchanneled fuel bundle should the vault be flooded and drained.

The new fuel storage racks located in the new fuel storage vault are designed to store the fuel assemblies in an array which is sufficient to maintain a k_{eff} of 0.95 or less in the normal dry condition or abnormal completely water flooded condition. The racks are not designed to maintain a k_{eff} of 0.98 or less under optimum moderation (foam, small droplets, spray, or fogging). New Fuel may not be stored in the New Fuel Storage Vaults until such time a criticality analysis is completed which meets the requirements of <10 CFR 50.68(b)(2)> and <10 CFR 50.68(b)(3)>.

Perry's procedure prohibits the storage of new fuel in the New Fuel Storage Vaults.

9.1.1.3.2 New Fuel Rack Design

New fuel rack design features are as follows <Figure 9.1-1>:

a. Each of the two new fuel storage vaults contain 18 sets of racks, each may contain up to 10 fuel assemblies. A maximum of 360 fuel assemblies may be stored.

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

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

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

e. The minimum center-to-center spacing for the fuel assembly between rows is 12 inches. The minimum center-to-center spacing within the rows is seven inches. Fuel assembly placement between rows is not possible.

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

g. The rack is designed to withstand the impact force of 4,000 ft-lbs while maintaining the safety design basis. This impact force could be generated by the vertical free fall of a fuel assembly from the height of six feet.

h. The storage rack is designed to withstand the pull-up force of 4,000 lbs and a horizontal force of 1,000 lbs. There are no readily available forces in excess of 1,000 lbs. The racks are designed with lead-outs to prevent sticking. However, if a fuel assembly sticks, the maximum lifting force of the fuel handling platform grapple is limited to 1,100 ± 50 lbs by a load cell.

i. The storage rack is designed to withstand horizontal combined loads up to 222,000 lbs, well in excess of expected loads.

j. The maximum stress in the fully loaded rack in a faulted condition is 25.6 ksi. This is significantly lower than the allowable stress.

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

l. The fuel storage rack is designed using non-combustible materials. Plant procedures and inspections assure that combustible materials are restricted from this area. Fire prevention by elimination of combustible materials and fluids is regarded as the prudent approach, rather than fire accommodation and the need for fire suppressant materials which could inhibit or negate criticality control assurances. For these reasons, fire accommodation is not considered a problem.

m. The fuel storage racks are provided protection from adverse environmental effects by proper design of the new fuel storage facility.

9.1.1.3.3 (Deleted)

9.1.1.3.4 Protection Features of Fuel Storage Facilities

Each new fuel storage vault is surrounded by a four inch reinforced concrete curb; this curb is covered by a four piece cover when not receiving or discharging new fuel. Each piece consists of a rectangular frame made of standard steel channels and a channel strengthener down the long dimension. A 1/8-inch thick steel plate is welded to fill in the frame about two inches below the top of the channel. Two-inch thick gypsum plankboard is placed in the cavity between the top of the channel and steel plate. A checkered grid plate is bolted to the channel frame to sandwich the gypsum. The grid plate is also bolted to the curb embedment around the pit. One cover can be removed at a time to permit movement of fuel within one-quarter of the fuel rack.

9.1.2 SPENT FUEL STORAGE

Two kinds of spent fuel storage racks are used: those achieving subcriticality by spacing in a loose packed geometric array, and those using a neutron absorber to achieve subcriticality in a close packed or dense geometric array. The loose packed fuel storage racks (furnished by General Electric) are used in containment. The densified fuel storage racks (furnished by Programmed and Remote Systems, Inc.) are used in the spent fuel storage pits in the fuel handling and storage area of the intermediate building.

<u>NOTE</u>: An on-site Independent Spent Fuel Storage Installation (ISFSI) facility has been constructed that will be used for the storage of spent nuclear fuel. The Spent Fuel Dry Storage (SFDS) operations at PNPP will be conducted under a general license in accordance with <10 CFR 72>.

9.1.2.1 Design Bases

9.1.2.1.1 Structural - GE Racks

Structural related safety design bases for General Electric racks are as follows:

a. The array of spent fuel storage racks inside containment contains storage space sufficient for 25 percent of one full core of fuel assemblies; it is designed to withstand all credible static and dynamic loadings, thereby preventing damage to the structure of the racks and the contained fuel, and minimizing distortion of the racks arrangement <Table 3.9-2>.

b. The racks are designed to protect the fuel assemblies from excessive physical damage which may cause the release of radioactive materials in excess of <10 CFR 20> and <10 CFR 50.67> requirements under normal or abnormal conditions caused by impacting from other fuel assemblies.

c. The racks are constructed in accordance with the Quality Assurance requirements of <10 CFR 50, Appendix B>.

d. The spent fuel storage racks are categorized as Safety Class 2 and Seismic Category I.

e. The spent fuel storage facility is designed in accordance with General Design Criteria 2, 3 and 4, and <Regulatory Guide 1.13>, <Regulatory Guide 1.29>, <Regulatory Guide 1.102>, and <Regulatory Guide 1.117>. The design precludes any deleterious effects on spent fuel rack integrity due to natural phenomena such as earthquakes, tornadoes, hurricanes, missiles, and floods. Compliance with <Regulatory Guide 1.13> is discussed in <Section 9.1.2.3.3> and <Section 1.8>.

9.1.2.1.2 Structural - PAR Racks

Structural related safety design bases for Programmed and Remote Systems, Inc. (PAR) racks are as follows:

a. The densified spent fuel storage racks are designed to withstand all credible static and dynamic loadings to prevent damage to the rack structure, thereby preserving the structural integrity of the contained fuel and minimizing distortion of its array in storage.

b. The densified racks are designed to protect the spent fuel assemblies from excessive physical damage which might cause the release of radioactive materials in excess of <10 CFR 20> requirements under normal and abnormal conditions.

c. The densified racks are constructed in accordance with the Quality Assurance requirements of <10 CFR 50, Appendix B>.

d. The densified racks are categorized as Safety Class 2 and Seismic Category I.

e. The densified racks provide storage spaces for a total of 4,020 spent fuel assemblies and 30 spaces for multi-purpose storage of containers for failed fuel, channels or control rods. The rack array in the fuel preparation and storage pool provides storage spaces for 1,620 spent fuel assemblies and 30 spaces for multi-purpose storage. The rack array in the spent fuel pool provides storage spaces for 2,400 spent fuel assemblies.

f. The densified rack design precludes the possibility of placing fuel elements anywhere within the array other than in the storage spaces provided.

g. The spent fuel storage facility is designed in accordance with General Design Criterion 2, 3 and 4, and <Regulatory Guide 1.13>, <Regulatory Guide 1.29>, <Regulatory Guide 1.102>, and <Regulatory Guide 1.117>. This design precludes any deleterious effects on spent fuel rack integrity due to natural phenomena such as earthquakes, tornadoes, hurricanes, missiles, and floods.

9.1.2.1.3 Nuclear - GE Racks

Nuclear related safety design bases for General Electric racks are as follows:

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

b. Standard General Electric lattice methods (Reference 1) and Monte Carlo techniques are employed in the calculations performed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal fuel storage conditions.

c. The storage array is assumed to be infinite in all directions. Since no credit is taken for leakage, the values reported as effective neutron multiplication factors are in reality infinite neutron multiplication factors.

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

9.1.2.1.4 Nuclear - PAR Racks

The fuel array in the fully loaded, densified spent fuel racks is designed to be subcritical by at least 5 percent ΔK. Neutron absorber, sealed inside the rack's structure, and geometry are employed to ensure that k_{eff} will not exceed 0.95 under all normal and abnormal storage conditions. Neutron absorber is relied on to ensure that the k_{eff} of the spent fuel in storage is ≤0.95.

a. 1979 Study

The original criticality safety analysis was principally performed by means of a series of diffusion theory calculations. The results of the analysis are compared with the results of an independent calculation using the multi-group, multi-dimensional Monte Carlo Neutron Transport Code KENO-IV with 123 group AMPX cross section library. The analysis assumed 8 by 8 fuel arrays with fuel segments (lattices) enriched up to 3.25 weight percent U-235 with no gadolinia loaded.

b. 1995 Study

The original criticality analysis was updated to incorporate higher fuel enrichments and various fuel arrays with credit taken for gadolinia poison. Standard GE lattice methods (Reference 1) and Monte Carlo techniques are employed in the calculations.

The high enrichment compliance limit is based upon the 8 by 8 fuel array (3.25% U-235) used in the original criticality analysis for the densified fuel racks and is valid for the 9 by 9 array and 10 by 10 array with fuel lattice enrichments of up to 4.5% U-235 with no restrictions on gadolinia content. The ΔK bias correction is calculated for the higher lattice enrichment and geometry, and can be used in conjunction with the ΔK calculated in the original analysis.

c. 2000 Study

The criticality analysis for the High Density Storage Racks located in the Fuel Handling Building was re-performed to allow storage of

GE14 10 by 10 fuel with fuel lattices enriched up to 4.9 weight percent U-235, (Reference 6), (GE14 Spent Fuel; Storage Rack Analysis for Perry Power Station). This analysis assumed the fuel bundles contained the burnable poison Gadolinia. The Gadolinia loading was designed such that the peak lattice reactivity of 10 by 10 array was equivalent to the original 8 by 8 array enriched to 3.25 weight percent U-235 with no Gadolinia. The combination of 10 by 10 arrays with maximum lattice enrichment of 4.9% U-235 and Gadolinia loading created a peak lattice incore K-infinity of 1.3746 (equivalent to the original 8 by 8 array). The analysis then calculated an inrack K-effective. The inrack K-effective plus required uncertainties was demonstrated to be less than Technical Specification limit of 0.95. As a result of this analysis, any combination of lattice types, U-235 enrichments and Gadolinia loadings such the peak lattice incore K-infinity is less than 1.3746 is acceptable for storage at Perry.

It should be noted, it is not possible to build a lattice/bundle for use at Perry with a incore K-infinity greater than 1.3746 because Perry’s fuel manufacturer has two licensing limits which must be satisfied. First; the bundle must be certified for shipping in accordance with various government regulations. The fuel manufacturer adds Gadolinia to reduce lattice K-infinities to within the assumptions of the shipping container criticality analysis. As such the required Gadolinia loading is greater than what was assumed in this study (Reference 6). Second; the fuel manufacturer must comply with the GESTAR II, General Electric Standard Application for Reload Fuel, requirements. Namely, in order to store fuel in GE designed racks and satisfy the GE rack criticality analysis, the peak lattice incore K-infinity must be less than 1.30 (which less than what was used in the analysis).

The 2000 Study assumed a fuel lattice geometry consisting of a GE14 fuel design with a uniform enrichment of 4.90 w% U235, consistent with the plant's geometry (BWR-6; S-Lattice). The lattice was exposed to its peak cold reactivity point using standard GE lattice physics codes (Reference 6). The spent fuel storage rack simulations incorporated lattices with as-burned burnable poison and explicit fission product inventories associated with lattices peak cold, exposure-dependent in core statepoints, for all designs considered. Normal and abnormal spent fuel storage rack configurations were evaluated with two dimensional geometry models. The analysis conditions and assumptions are in compliance with the requirements contained in the USNRC <Regulatory Guide 1.13>, Spent Fuel Storage Facility Design Basis, Rev. 2, and ANSI/ANS-57.2-1983, Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants.

The 2000 Study recreated the results of the 1979 and 1995 Studies and demonstrated a negligible change in results arising from changes in the neutron cross section libraries, lattice physics codes, and Monte-Carlo neutron transport techniques. The study used TGBLA04 lattice physics code to determine the incore K-infinity values and the criticality solution method of MCNPO1A to determine the inrack K-effective values. The methodology of determining the incore K-infinity to confirm compliance with the inrack K-effective limit is describes in GESTAR II Section 3.5 (Reference 7). Implicit to this discussion is the use of GNF latest versions of lattice physics methods and Monte-Carlo methods. GE14 was verified to satisfy this methodology in NEDC-32868P, Revision 1, "GE14 Compliance with Amendment 22 of NEDE-24011-P-A (GESTAR II)."

The High Density Storage Racks located in the Fuel Handling Building were demonstrated to provide for a subcritical multiple factor, K_{eff}, of <0.95 for all normal and abnormal material/geometry scenarios including all biases and uncertainties <Section 9.1.2.3.2>.

Criticality analyses assume that fuel assemblies can be stored in racks with or without channels. These analyses conservatively include the impact of storing a channel in the storage cavities.

Validation of the criticality analysis is in accordance with ANSI N16.9.

d. 2006 Study

The 2006 Study, (Reference 8) analyzed the fuel pool configuration where a fuel bundle is loaded (dropped) into the pool such that it is outside the nominal PAR fuel pool storage rack but adjacent to a storage rack cell without an intervening Boral poison panel. This study utilized the same high enrichment fuel bundle design as the 2000 Study and concluded that the basis and result of the 2000 Study (Reference 6) was conservative for this configuration.

e. 2014 Study

The criticality analysis for the High Density Storage Racks located in the Fuel Handling Building was re-performed to allow storage of GNF2 10 by 10 fuel with fuel lattices enriched up to 4.9 weight percent U-235, (Reference 32), Perry Nuclear Power Plant GNF2 Fuel Transition Criticality Safety Analysis. This analysis assumed GNF2 fuel with a peak lattice incore K-infinity of 1.3746 (equivalent to the original 8 by 8 array). The analysis then calculated an inrack K-effective. The inrack K-effective plus required uncertainties was demonstrated to be less than Technical Specification limit of 0.95. This analysis demonstrated that, for GNF2 fuel, any combination of lattice types, U-235 enrichments and Gadolinia loadings such that the peak lattice incore K-infinity is less than 1.3746 is acceptable for storage at Perry (Reference 33).

The 2014 Study also analyzed the fuel pool configuration where a GNF2 fuel bundle is loaded (dropped) into the pool such that it is outside the nominal PAR fuel pool storage rack but adjacent to a storage rack cell without an intervening Boral poison panel. This study utilized the same high enrichment GNF2 fuel bundle design as the criticality analysis for the normal configuration High Density Storage Racks and concluded that the basis and result of the normal configuration High Density Storage Rack criticality analysis was conservative for this configuration.

f. 2017 Study

General Electric-Hitachi (GEH) notified Perry of a modeling error in the GE14 and GNF2 Spent Fuel Pool Criticality Analysis reports (References 8 and 32, respectively). In both reports, GEH modeled the gap between the spent fuel pool storage aluminum cans and the boral absorber contained within as water filled. The aluminum cans are sealed and the gap is air filled. Since the geometry is over-moderated, removing water from the gap causes the geometry to be slightly more reactive. The revised GE14 and GNF2 studies by GEH with the correction to the modeling error demonstrated that the spent fuel storage racks containing either GE14 or GNF2 fuel meet the acceptance criteria of less than or equal to 0.95 under all normal and abnormal storage conditions. The revised 2017 studies are reported in References 34 (GE14) and 35 (GNF2).

9.1.2.1.5 Power Generation - GE Racks

Power generation design bases for GE racks are as follows:

a. Spent fuel storage space shall be provided in the containment upper fuel pool that will contain storage space for 25 percent of one full core fuel load.

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

9.1.2.2 Facilities Description

9.1.2.2.1 Facilities Description – GE Racks

From north to south <Figure 1.2-9>, the structural features provided in containment at Elevation 689′-6″ to enable refueling activities are: the moisture separator storage pool, the reactor well, the steam dryer pit, the spent fuel storage deep pit, and (adjacent to it to the east) the fuel transfer canal and inclined transfer tube between the fuel transfer canal in the containment and the fuel transfer pool in the intermediate building.

The moisture separator storage pool <Figure 1.2-11> is separated from the reactor well by a partial height wall to Elevation 680′-0″. The steam dryer pool is separated from the reactor well by a partial height wall to Elevation 688′-5″, which has a slot in it with bottom Elevation 666′-4″ to accommodate a water gate. The fuel transfer canal is separated from the steam dryer pool and the spent fuel storage deep pit to its west by a partial height wall to Elevation 688′-5″. A slot near the south end of the west wall of the fuel transfer canal accommodates a water gate with bottom Elevation 666′-4″ to permit fuel transfers between it and spent fuel storage deep pit. Elevation 664′-7″ is the bottom elevation of the moisture separator storage pool, the reactor well and the steam dryer pit. Elevation 646′-0″ is the bottom elevation of the spent fuel storage deep pit and the fuel transfer canal.

Maximum and minimum water elevations of all the above pools during refueling operations are 688′-8″ and 688′-5″, respectively. The tops of spent fuel elements in storage are at Elevation 661′-4″ which provides a minimum of 27 feet, 1 inch over these elements for radiation shielding.

A circuit failure or tamper switch signal to the control panel would be transmitted as a trouble signal to the fire monitoring system.

The control panels and alarms associated with the HVAC deluge systems are arranged the same with the exception of the heat detection system, which is not alarmed through the fire system control panel.

The HVAC charcoal filters have a heat detector strip installed immediately downstream of the charcoal beds. This provides first and second stage high temperature alarms as well as analog temperature signals. These alarm in the Control Room. The second stage alarm annunciates at the Control Room HVAC control panel. It is set several hundred degrees less than the spontaneous ignition temperature of the charcoal to allow for corrective actions to be taken to control the temperature. If the control measures do not prevent ignition or the high temperature is due to a fire in the charcoal, the deluge systems can be actuated locally at the riser.

These heat detector alarms circuits are not supervised but there are multiple lines transmitting information to the Control Room. Periodic testing is done to insure operability of the system. Separate fire detection in the form of duct mounted and/or ceiling mounted smoke detectors as described in <Section 9.5.1.2.7.i> is also available.

c. Preaction water spray systems

These systems are hydraulically designed and equipped with a deluge valve, spray nozzles with fusible elements or thermosensitive glass bulbs, heat detectors, and a supervised air supply. System actuation (deluge valve trip) is achieved automatically by a signal from a heat detector or manually by operation of a manual release station. The deluge valve must

9.1.2.2.2 Facilities Description - PAR Racks

Storage and handling of spent fuel is accomplished in the fuel handling area of the intermediate building <Figure 1.2-5>. The working floor elevation in the intermediate building is 620'-6". The structural features provided in the fuel handling and storage area of the fuel handling building are: the fuel cask decontamination pad; the cask pit, in which spent fuel is loaded under water into the fuel shipping cask; the two dry new fuel storage pits in which fresh fuel is stored in the GE racks; the spent fuel storage pool containing the PAR spent fuel storage racks; the fuel transfer pool for moving fresh and spent fuel into and out of the containments under water; and the fuel preparation pool which is used to store spent fuel in PAR racks and to channel and dechannel fuel in preparation for loading into the reactor.

The fuel transfer pool is separated from both the fuel preparation and storage pool and the spent fuel pool by full height walls. Slots in the walls down to Elevation 594'-6" allow the fuel handling platform's fuel mast to pass through after the water-tight gate in each wall has been removed. The spent fuel pool is separated from the shipping cask storage pit by a full height wall with a slot down to Elevation 594'-6" that is provided with a water-tight gate. Normal and minimum water elevations in all wet pools are 619'-6" and 619'-3", respectively; with the exception of the step floor in the cask storage pit, which is at Elevation 599'-0", the bottoms of the wet pools are at Elevation 575'-11".

The top of spent fuel elements in the spent fuel storage racks are at Elevation 591'-4" which provides a minimum of 28 feet of water over them for radiation shielding. Spent control rods are stored, two to a hanger, on control rod hangers attached at Elevation 612'-0" to the north and south walls of the fuel preparation and storage pool and to the north, south and west walls of the spent fuel pool. During spent control rod transit, the minimum required submergence for shielding purposes will be maintained at no less than 6 feet - 3 inches. Once the spent control rod is resting on the hanger, the tops of the highest spent control rods in underwater storage are covered by a minimum of 6 feet - 7 inches of water. The gross water volumes in each of the wet pits in the intermediate building are as follows:

a.	Fuel preparation and storage pool	31,640 ft^3
b.	Fuel transfer pool	11,000 ft^3
c.	Spent fuel pool	39,100 ft^3
d.	Shipping cask storage pit	10,800 ft^3
	Total	92,540 ft^3

Arrays of densified spent fuel storage racks are provided in the fuel preparation and storage pool, and in the spent fuel pool located in the fuel handling area in the east section of the intermediate building. Densified spent fuel storage racks provide medium term storage for spent fuel within the fuel handling and storage area of the intermediate building. As mentioned previously, these racks are being designed and furnished by Programmed and Remote Systems Corporation (PAR). The densified storage racks use neutron absorber and structural material in a densely packed, square array of storage spaces to achieve subcriticality.

The storage racks provide an individual storage compartment for each fuel assembly which are stored in the vertical position. The racks are of the free standing design which does not require the fuel pool walls to carry any rack loads. Rack loads will be completely carried by the floor anchorage system.

9.1.2.3 Safety Evaluation

9.1.2.3.1 Criticality Control - GE Racks

The design of the spent fuel storage racks provides for a subcritical multiplication factor (k_{eff}) for both normal and abnormal storage conditions. For normal and abnormal conditions, k_{eff} is equal to or less than 0.95. Normal conditions exist when the fuel storage racks are located in the pool and are covered with a normal depth of water (about 27 feet above the stored fuel) for radiation shielding and with the maximum number of fuel assemblies or bundles in their design storage position. The spent fuel is covered with water at all times by a minimum depth required to provide sufficient shielding. An abnormal condition may result from accidental dropping of equipment or damage caused by the horizontal movement of fuel handling equipment without first disengaging the fuel from the hoisting equipment. To meet the requirements of General Design Criterion 62, geometrically safe configurations of fuel stored in the spent fuel array are employed to assure that k_{eff} does not exceed 0.95 under all normal and abnormal storage conditions. The geometry of the spent fuel storage array is such that k_{eff} is ≤0.95 due to over-moderation. To ensure that the design criteria are met, the following normal and abnormal spent fuel storage conditions are analyzed:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array <Figure 9.1-3>.

c. Fuel stored in control rod racks (Figure 9.1-4).

d. Pool water temperature increases to 212°F.

e. Two bundles placed side by side while separated from the storage rack area by 12 inches of water <Figure 9.1-5>.

f. Three-bundle tee array separated from the storage rack area by 12 inches of water <Figure 9.1-5>.

g. Three-bundle linear array separated from the storage rack area by 12 inches of water <Figure 9.1-5>.

h. Normal storage array of ruptured fuel.

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

j. Moving fuel bundle between work rack and storage area.

k. Moving fuel bundle in aisle between storage racks.

l. Grapple drop displacing two fuel bundles.

m. (Deleted)

n. Dropped fuel assembly lying across the top of the rack.

9.1.2.3.2 Criticality Control - PAR Racks

The storage racks are designed to maintain a k_{eff} of less than 0.95 for both normal and abnormal storage conditions of enriched fuel in demineralized water.

The criticality analysis accounts for:

a. Lattice fuel enrichments up to and including 4.9% U-235.

b. Storage rack materials.

c. Variation in fuel center-to-center spacing due to storage rack fabrication tolerances and clearances between the fuel assembly and storage cavities.

d. Water density variations due to temperature and boiling within the temperature range established by the thermal hydraulic analysis.

e. Storage rack basic geometry.

f. Model and calculational uncertainties.

g. Vibratory seismic responses which might reduce center-to-center spacing.

h. Sensitivity to rack materials and fuel enrichment.

i. Fuel data including 8 by 8, 9 by 9, 10 by 10 fuel arrays.

j. A dropped assembly lying across the tops of the rack array.

k. A dropped assembly standing beside an array in the space between the module and the fuel pool wall.

l. The fuel was exposed to its peak cold reactivity point using standard GE lattice physics methods.

m. Gadolinia is loaded such that the peak lattice incore K-infinity is less than or equal 1.3746.

n. Channeled and unchanneled fuel.

o. Water replacing minor structural members.

p. Normal positioning in the spent fuel storage array.

q. Eccentric positioning in the spent fuel storage array.

r. Fuel stored in control rod racks.

s. Pool water temperature increases to 212°F.

t. Two bundles placed side by side while separated from the storage rack area by 12 inches of water.

u. Three-bundle tee array separated from the storage rack area by 12 inches of water.

v. Three-bundle linear array separated from the storage rack area by 12 inches of water.

A radiological analysis, as a result of a fuel drop above the spent fuel pool racks is bounded by the analysis for a fuel drop inside containment. <Section 15.7.4> and <Section 15.7.6> identify the causes of the accident, assumptions and starting conditions. The fission product release from the fuel and the airborne activity released to the environs is calculated, and the corresponding radiological effects offsite are evaluated using the methods, assumptions and conditions in <Regulatory Guide 1.183>.

9.1.2.3.3 Spent Fuel Rack Design - GE Racks

Spent fuel rack design features are as follows <Figure 9.1-2>:

a. The containment spent fuel pool contains 19 sets of racks which may contain up to 190 fuel assemblies.

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

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

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

e. The minimum center-to-center spacing for the fuel assembly between rows is 12 inches. The minimum center-to-center spacing within the rows is seven inches. Fuel assembly placement between rows is not possible.

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

g. The rack is designed to withstand the impact force of 4,000 ft-lbs while maintaining the safety design basis. This impact force could be generated by the vertical free fall of a fuel assembly from the height of six feet.

h. The storage rack is designed to withstand the pull-up force of 4,000 lbs and a horizontal force of 1,000 lbs. There are no readily available forces in excess of 1,000 lbs. The racks are designed with lead-outs to prevent sticking. However, in case of a stuck fuel assembly, the lifting bail will yield at a pull-up force less than 1,000 lbs.

i. The storage rack is designed to withstand horizontal combined loads up to 220,000 lbs, well in excess of expected loads.

j. The maximum stress in the full loaded rack in a faulted condition is 25.6 ksi <Table 3.9-3>. This is significantly lower than the allowable stress.

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

l. The spent fuel storage racks of each containment also have the capability of storing nine defective fuel storage containers. These special castings prevent fuel from exceeding k_{eff} of 0.95 if they are in these positions.

The fuel storage facilities are designed to Seismic Category I requirements to prevent earthquake damage to the stored fuel. The capability of the fuel storage facilities to prevent damage to the fuel racks due to flooding, tornadoes, hurricanes, and missiles is discussed in <Chapter 3>.

From the foregoing analyses, it is concluded that the spent fuel storage arrangement and design meet the safety design bases and satisfy the intent of <Regulatory Guide 1.13>, which precludes any deleterious effects on spent fuel storage integrity due to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. The fuel storage pool has adequate water shielding for the stored spent fuel. Adequate shielding for transporting the fuel is also provided. Liquid level sensors are installed to detect a low pool water level. Adequate makeup water is available to assure that the fuel will not be uncovered should a leak occur.

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

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

9.1.2.3.4 Spent Fuel Racks Design - PAR Racks

The first of two types of racks used <Figure 9.1-6> provides a 10 by 10 square array of storage spaces with a nominal 6.625 inch center-to-center spacing between them. The nominal center-to-center spacing between adjacent rows in adjacent racks is 9.375 inches. The second type rack provides a 7 by 10 array of spent fuel storage spaces, <Figure 9.1-7>, and a row of 5 multi-purpose storage cavities. Adjacent fuel storage spaces in the 7 by 10 part of the array are on a nominal 6.625 inch center-to-center spacing. The five multi-purpose storage cavities are on a nominal center-to-center spacing of 13.25 inches. <Figure 9.1-8> shows a cross section through a fuel element stored in the corner of a rack.

The high density spent fuel racks are of anodized aluminum construction. They consist of six basic components <Figure 9.1-6>:

a. Top grid casting.

b. Bottom grid casting.

c. Neutron absorber canisters (poison cans).

d. Side plates.

e. Corner angle clips.

f. Adjustable foot assembly.

The top and bottom grids are machined to accurately locate and support the fuel elements. The castings have pockets cast in every other cavity opening into which the neutron absorber canisters nest. With this arrangement, no structural loads are imposed on the neutron absorber canisters. The neutron absorber canister (poison cans) consists of two concentric tubes with the neutron absorber plates located in the annular gap. The outer tube is folded into the inner tube at the ends and totally seal welded to isolate the neutron poison from the pool water. The grid structures are bolted and riveted together by four corner angles and four side shear panels. Large leveling screws are located at the module corners to adjust for variations in pool floor level.

The neutron absorber plates “Boral” TM consist of boron carbide in an aluminum composite matrix which is clad with aluminum sheets.

A 0.125 inch lead-in at the top of the rack provides guidance of the fuel assembly during insertion.

All fuel storage spaces will have sufficient internal clearance to limit insert and withdraw drag forces to less than 20 pounds.

The minimum clear space under the rack for water flow is 7.25 inches.

Six integral racks, consisting of 7 by 10 spaces for the storage of fuel, and five multi-purpose storage cavities are provided <Figure 9.1-7>. The multi-purpose storage cavities provide storage for defective fuel containers, guide tubes and control rods. They consist of aluminum tubing located between top and bottom module castings similar to the poison cans. The inside diameter (R) of these multi-purpose cavities is 11.5 inches and the outside diameter (S) is 12 inches.

The nominal module overall dimensions and weight are as follows:

Module Size	"A" (in.)	"B" (in.)	"C" (in.)	Dry Weight (lbs)
10 x 10	181.375-182.875	68.875	68.875	11,500
7 x 10&5MP	181.375-182.875	68.875	62.250	10,200

The rack is designed to withstand a lifting force of 4,000 pounds applied to the top at any fuel bundle location. Also, the rack is designed to withstand a horizontal force of 1,000 pounds applied to the top of the rack at any fuel bundle location and at a varying angle from 0° to 45° from the horizontal.

The rack is designed to withstand the impact of a fuel bundle dropped from 18 inches above the racks on the middle of the top casting, on the corner of the top casting or through an empty cavity on the bottom casting without exceeding allowable stress limits. Additionally, the rack is designed to withstand the impact of a fuel bundle dropped from seven feet above the rack on the middle of the largest top casting without causing rack deformation which would allow k_{eff} to exceed .95.

The capability of the spent fuel storage facilities to prevent damage to the fuel racks due to flooding, tornadoes, hurricanes, and missiles is discussed in <Chapter 3>.

Detail design of the densified storage racks is provided in (Reference 2).

The Subsequent Criticality Analysis performed for the densified fuel racks which includes the high enrichment compliance limit is provided in (Reference 5).

9.1.2.3.5 Spent Fuel Storage Facilities Protective Features - GE Racks

The polar crane and the 8 inch Schedule 40 pipe of the containment spray system are the only potential missiles of significant consequences that could effect the integrity of spent or new fuel in storage, or in transit within the containment. The containment spray system piping is Safety Class 2, Seismic Category I and is of adequate structural integrity to withstand all design basis loads applied. The polar crane is designed to Seismic Category I requirements and a safety factor of 5. Both the bridge and trolley are equipped with earthquake restraints and brakes that prevent overturning during a seismic event and maintain them in a parked position whenever new or spent fuel is in transit. Thus, the polar cranes have adequate structural integrity to withstand all design basis loads applied.

9.1.3 SPENT FUEL POOL COOLING AND CLEANUP SYSTEM

9.1.3.1 Design Bases

9.1.3.1.1 Safety Design Bases

The fuel pool cooling and cleanup system is designed to remove the decay heat from the fuel assemblies, maintain pool water level and remove radioactive materials from the pool, thus minimizing the release of radioactive elements stored in the containment upper pool and the pools in the fuel building.

The fuel pool cooling and cleanup system will:

a. Minimize corrosion product buildup and will control water clarity, so that the fuel assemblies can be efficiently handled underwater.

b. Minimize fission product concentration in the water which could be released from the pool to the refueling building environment.

c. Monitor fuel pool water level and maintain a water level above the fuel sufficient to provide shielding for normal building occupancy.

d. Maintain the pool water temperature below approximately 130°F under normal operating conditions. This temperature is set to establish a minimum acceptable environment for personnel working in the vicinity of the fuel pool. Conservatively assuming the operation of two units rather than the single licensed unit, the maximum normal heat load from spent fuel stored in the fuel handling building pools is 26 x 10^6 Btu/hr. This is the sum of the decay heat from 4,020 bundles discharged from two units over a nine year period in accordance with the schedule noted in <Table 9.1-1>. Discharge batch sizes represent approximately 42 percent of a core. All fuel has achieved a burnup of 28,440 MWd/MTU except for the final discharge which has a burnup of 18,000 MWd/MTU. Both pumps and both heat exchangers are required to maintain the pool water temperature at approximately 130°F for this maximum normal condition. If a faulted condition exists wherein one pump is lost, the pool temperature remains below 150°F. For the unusual condition of loss of both a pump and a heat exchanger at the time the reactor is being refueled, the pool temperature would rise to a maximum of 154°F approximately 364 hours after shutdown, assuming the fuel has been unloaded in that time. After approximately 27 days from shutdown, the pool temperature will fall below 150°F under the condition of only one pump and one heat exchanger in operation. It should be noted that the expected refueling down time will be on the order of 30 days. During this time, the RHR system of the shutdown reactor could be used to maintain the pool temperature below 150°F. The RHR system will be used to supplement the fuel pool cooling and cleanup system under the maximum load condition as defined in <Section 9.1.3.3>. Suitable redundancy, interconnections and isolation capabilities are provided in the cross connection to the RHR system <Figure 9.1-9>.

A seismic Class I source of cooling water is provided per <Section 9.1.3.3.4>, and the heat load is limited per <Section 9.1.3.2.2>.

e. Maximum water purity for visual purposes.

Conformance with applicable GDCs is discussed in <Section 3.1>.

9.1.3.2 System Description

9.1.3.2.1 System Description - Normal Operation

The fuel pool cooling and cleanup (FPCC) system <Figure 9.1-9> maintains the containment pools, the spent fuel and cask storage pool and the fuel transfer pool below a desired temperature (i.e., at an acceptable radiation level and at a degree of clarity necessary to transfer and service the fuel bundles). The FPCC also maintains the containment pool temperature, radiation level and clarity necessary to transfer and service the reactor internals and fuel bundles.

The FPCC system cools the spent fuel storage pools by transferring the spent fuel decay heat to the nuclear closed cooling system during normal plant operation as described in <Section 9.2.8>. The maximum nuclear closed cooling system water temperature is 95°F. The FPCC system consists of two parallel pumps and two parallel heat exchangers. Assuming the initial two-unit design conditions with both pumps delivering a total of 3,000 gpm and both heat exchangers, absorbing a total of 26 x 10^6 Btu/hr, are required to maintain the pool water temperature below approximately 130°F with the maximum normal two unit heat load in the pool. When the decay heat decreases to less than half the maximum normal two unit output, the FPCC system would revert to single pump and single heat exchanger operation. With two pumps operating, the entire inventory of water in the fuel handling building pools is circulated every seven hours. The major portion of the equipment is located in the intermediate building near the fuel pools.

The maximum normal single unit heat load from the spent fuel stored in the fuel handling building pools is 14×10^6 Btu/hr. This is the sum of the decay heat from 4020 fuel bundles discharged from a single unit over a 21 year period in accordance with the schedule noted in <Table 9.1-1a>. Discharge batch sizes represent approximately 42 percent of the core. All fuel has achieved a burnup of 45,000 MWd/MTU.

Water from the upper and lower pools is transferred through surface skimmers to the surge tanks in the fuel handling building. Overflow from the tanks is channeled to the radwaste system. The circulating pumps take suction from the bottom of the tanks and pump the water through the components of the system.

The FPCC System is designed to remove suspended or dissolved impurities from the following sources:

a. Dust or other airborne particles.

b. Surface dirt dislodged from equipment immersed in the pool.

c. Crud and fission products emanating from the reactor during refueling.

d. Debris from inspection or disposal operations.

e. Residual cleaning chemicals or flushwater.

Clarity and purity of the pool water are maintained by a combination of filtration and demineralization. The cleanup system will keep the water quality within the following limits: conductivity, 3 μmho/cm at 25°C; chlorides (as Cl^-), 0.5 ppm; suspended solids, 1.0 ppm; total heavy elements (Fe, Cu, Ni), 0.1 ppm. The pH range at 25°C will be 5.3 to 7.5 for compatibility with aluminum fuel storage racks and other equipment.

Conductivity and other analysis will be performed on a periodic basis to ensure that the filter demineralizer is maintaining design water quality. Isotopic analysis of the filter demineralizer effluent will be performed weekly. The water quality will assure visual clarity of the pool water during normal fuel movements.

The cleanup system consists of two sets of filter demineralizers, each has its own piping and is capable of independent operation. Each set of filter demineralizers is located in a separate shielded room in the fuel handling building with controls and instrumentation located outside the rooms to enable the system to be operated without unnecessary exposure to radiation.

The design flow rate of each set of filter demineralizers is 1,000 gpm. Using both units simultaneously will provide a maximum capacity of 2,000 gpm. A bypass line around the filter demineralizers allows the balance of the cooled system flow to enter the fuel storage pools. Normally, only one of the filter demineralizers is operated; the second is used as a spare or is operated when additional capacity is needed.

Because the filter demineralizers are of the pressure precoat type, the system depends on flow to keep the filter medium on the filter elements. Each filter demineralizer uses a holding pump to automatically maintain flow across the filter in case loss of flow from the main system occurs. The filter demineralizer vessels are constructed of stainless steel. The filter element is a replaceable porous, ceramic structure composed of aluminum oxide grains and the filter medium is cellulose fibers or a mixture of cellulose fibers and powdered resin.

The precoat tank in which the resins are mixed is a carbon steel tank lined with a phenolic coating. The tank is equipped with an agitator used to mix a slurry. The slurry is circulated through the system by the precoat pump until the resins coat over the filter elements. The proportion of the resins to be mixed will be determined by water samples taken from the system. The pressure drop across the filters is measured by pressure indicators. When the resins are exhausted or the pressure drop across the filter becomes too great, the filter medium is backwashed from the elements with water from condensate storage into a storage tank and then transferred to the radwaste system. A filter in the discharge line of each filter demineralizer limits the migration of filter medium downstream from the filter demineralizer vessels. Pressure instrumentation is provided to determine when the filter should be replaced.

The circulation patterns within the containment and fuel handling building pools are established by placing the system discharge diffuser pipes near the bottom of the pools and on the opposite side from the surface skimmers. This provides optimum mixing of heated and cooled water and also efficiently removes particles dislodged during refueling operation. The system discharge pipes that return water to the pools are provided with a vent hole slightly below water level to provide a siphon break in case a pipe rupture occurs.

System instrumentation is provided for both automatic and remote-manual operation. Measured parameters include pressure, temperature, flow, and conductivity.

The containment pools and the spent fuel pool are equipped with redundant temperature instrumentation, each instrument having two setpoints. Under abnormal conditions, the pool water temperature will be permitted to rise above the normal to approximately 150°F. For this reason, the instruments are set to signal a high and a high-high temperature. Circulating water temperatures are measured before and after the heat exchangers and recorded on a temperature recorder.

Redundant level sensors are used to alarm high and low water levels in the upper and spent fuel pools and the system surge tank. A separate level indicator is provided for the cask pool. Redundant level instrumentation is provided for the surge tanks which alarm on high or low water level, and which alarm and trip the circulating pumps on a low-low level.

Flow meters are provided to measure the flow through each demineralizer train, flow bypassing the demineralizers, and flow to the upper pools, lower pools or spent fuel pool.

A conductivity instrument is provided to analyze the conductivity of the discharge water from each set of demineralizers.

A gate is closed between the fuel pool and the cask pool to maintain the water level in the fuel pool when the cask pool is drained. The water from the cask pool will be pumped to the waste collection tank in the radwaste building or drained to the equipment drains sump in the intermediate building.

The circulating pumps are controlled from the control room. A low-low level signal from the surge tank instrumentation automatically shuts off the pumps. A pump low discharge pressure alarm is indicated in the control room. The circulating pump motors receive power from the diesel generators if normal power is not available. Circulating pump motor loads are considered non-essential loads and will be operated under accident conditions as required.

The filter demineralizers are controlled from a local panel. Differential pressure and conductivity instruments provided for each filter demineralizer set indicate when backwash is required. Suitable alarms, differential pressure indicators and flow indicators monitor the condition of the filter demineralizers.

9.1.3.3 Safety Evaluation

The calculated maximum abnormal heat load is 46.8 x 10^6 Btu/hr. This value conservatively assumes dual-unit operation and is the sum of the decay heat from 3,388 bundles discharged over an eight year period, plus a sequential full core off-load which fills the fuel handling pools in the area of the intermediate building (4,020 bundles) and stores 116 bundles in the containment pool <Table 9.1-2>. With both FPCC system pumps and heat exchangers operating, the pool temperature will rise to 154°F. This value is derived from a conservative analysis which overestimates the heat loading by approximately 13%. Under realistic conditions, the pool temperature will not exceed 150°F. To prevent this condition, supplemental cooling capacity is available through a permanent cross tie to the RHR system which is no longer required to cool the shut down reactor. The Perry Technical Specifications will not allow reactor startup whenever the RHR system for that unit is being used for spent fuel pool cooling except for shutdown margin demonstrations and training startup (less than or equal to 1% of rated thermal power and less than 200°F reactor coolant temperature). The supplemental RHR cooling capacity, in conjunction with the fuel pool cooling capacity, will reduce the fuel pool water temperature to 106°F. Any time the RHR system is used to supplement the spent fuel cooling system to maintain pool water temperature below

150°F, the reactor will be placed and maintained in a cold shutdown condition or refueling mode as long as the RHR system is needed to supplement the FPCC system. Except for a full core off-load, the fuel pool cooling system is capable of maintaining the fuel pool at approximately 130°F without any assistance for all other heat loads that could conceivably occur under normal operating conditions. The 150°F temperature limit is set to assure that the fuel handling area of the intermediate building environment does not exceed equipment environmental limits. Fuel pool cooling pump motors are designed to operate in a 150°F environment. The temperature limit for the fuel pool demineralizer resin is also 150°F.

The heat load in the spent fuel pool is less than that which can be removed by one division of safety equipment, including the use of that division for reactor decay heat removal <Section 9.2.1> during a design basis event. The design basis event is a loss of coolant accident, a postulated earthquake condition, and a loss of normal AC power, coincident with a single failure that results in the loss of one division of safety equipment. Unit 1 ESW can provide a Seismic Class I source of cooling water to the FPCC heat exchangers <Section 9.2.1> and <Section 9.2.2>.

The fuel storage pool is designed to ensure that no single failure of structures or equipment will cause inability to maintain irradiated fuel submerged in water, to re-establish normal fuel pool water level or to remove decay heat from the pool. The spent fuel pool walls with liner plates are designed to seismic Category I requirements as discussed in <Section 3.8.4>. To limit the possibility of pool leakage around pool penetrations, the pool is lined with stainless steel to provide a high degree of integrity. No outlets or drains are provided in the fuel pool that might permit the pool to be drained below a safe shielding level. Inlet lines extending below this level are equipped with siphon breakers to prevent inadvertent pool drainage. Interconnected drainage paths are provided behind the liner welds. These paths are designed to prevent pressure buildup behind the liner plate, to prevent the uncontrolled loss of contaminated pool water to other relatively cleaner locations within the fuel handling area of the intermediate building and to provide expedient liner leak detection and measurement. The paths are formed by welding channels behind the liner weld joints and are designed to permit gravity drainage to the radwaste system.

Failure to close the gate between the fuel pool and the cask pool while draining the cask pool will not uncover the fuel in the fuel pool. Alarms will alert the operator if the water level in the fuel pool is low. In addition, a concrete weir is provided between the pools to prevent uncovering of the fuel. Whenever a gate is moved between its sealing position and storage position, precautions are taken to prevent the gate from falling into the spent fuel pool. Lifting and moving is performed by the fuel handling platform. The auxiliary hook (also known as monorail hoist assembly) on the platform attaches to the gate lifting lugs by a hook and sling arrangement. Also, a full capacity safety line is secured to the gate during all periods of movement and seating. This redundant arrangement precludes the possibility of the gate ever coming into contact with any portion of the spent fuel assemblies. The gates are classified as Safety Class 2 equipment and are designed to Seismic Category I requirements.

Makeup water from the condensate storage tank is provided to the pool to replace evaporative and leakage losses. If the failure of the normal makeup water system occurs, a permanent connected makeup supply is available from the Seismic Category I emergency service water system. Two manually operated valves in the intermediate building must be opened to allow makeup water to enter the system. The manually operated valves are locked closed to prevent accidental discharge of water from the emergency service water system into the fuel pool system. Details of the emergency service water system are shown in <Figure 9.2-1> and discussed in <Section 9.2.1>.

The fuel pool cooling and cleanup system is designed as Safety Class 3 and Seismic Category I except for the nonsafety class filter demineralizer system, cask pit drain subsystem and fuel transfer tube subsystem.

When a LOCA signal is received, the filter demineralizer system is automatically isolated with redundant safety class valves. FPCC system flow is maintained through a Safety Class 3, Seismic Category I line which bypasses the filter demineralizer system. The primary source of cooling water for the spent fuel pool heat exchangers comes from the nuclear closed cooling (NCC) system. Since the NCC system is not Seismic Category I, it could be rendered inoperable by a DBA, and is thus automatically isolated from the FPCC heat exchangers under LOCA conditions. To provide a backup source of cooling water that is Seismic Category I, the Unit 2 emergency closed cooling water system has been permanently connected to the heat exchanger cooling water supply lines <Section 9.2.2>.

Conformance with Branch Technical Position APCSB 3-1 is discussed in <Section 3.6>.

The fuel handling area of the intermediate building is designed to preclude damage to the fuel within the pool from cyclonic winds or missiles generated by these winds.

From the foregoing discussion, it is concluded that the fuel pool cooling and cleanup system meets its safety design bases and satisfies the intent of <Regulatory Guide 1.13>.

9.1.3.4 Inspection and Testing Requirements

No tests are required because at least one pump and one heat exchanger are normally operating while fuel is stored in a pool. A heatup rate evaluation shall be performed if it is necessary to secure the system while fuel is stored in the pool. The spare unit is operated periodically to handle abnormal heat loads or to replace a unit for servicing. Routine visual inspection of the system components, instrumentation and trouble alarms are adequate to verify system operability.

9.1.3.5 Radiological Considerations

The water level in the fuel storage pool is maintained at a height which is sufficient to provide shielding for normal building occupancy. Radioactive particles removed from the fuel pool are stored in filter demineralizer units which are located in shielded cells. For these reasons, the exposure of plant personnel to radiation from the fuel pool cooling and cleanup system is minimal. Further details of radiological considerations for this system are described in <Chapter 12>.

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 post-irradiation cooling. Safe handling of fuel includes design considerations for maintaining occupational radiation exposures as low as reasonable achievable during transportation and handling.

Design criteria for major fuel handling system equipment is provided in <Table 9.1-3>, <Table 9.1-4>, <Table 9.1-5>, and <Table 9.1-6> which list the safety class, quality group and seismic category. Where applicable, the appropriate ASME, ANSI, industrial, and electrical codes are identified.

The transfer of new fuel assemblies between the new fuel unloading stand and the new fuel inspection stand and/or the new fuel storage vault is accomplished using an auxiliary hoist mounted from the 125 ton hoist of the fuel handling area crane equipped with a general purpose grapple or the fuel bundle lift hook.

The new fuel will be transferred from the new fuel vault or from the inspection stand to a 4-bundle rack on the cask pool floor using either the fuel building crane equipped with a special purpose grapple or the 1,000 pound monorail hoist on the fuel handling platform. From this point on, the fuel will be handled by the telescoping grapple on the fuel handling platform and transported to either the Spent Fuel Pool/ Fuel Prep Pool Storage Racks or the Fuel Prep Machines or the Incline Fuel Transfer System. The fuel therefore is never more than six feet above the spent fuel storage racks - thus minimizing the fresh fuel drop accident. The fuel will be transported between the reactor and fuel handling area of the intermediate buildings by the fuel transfer system. In the containment, the fuel will be handled by the telescoping grapple on the refueling platform.

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

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

The fuel grapple is used for lifting and transporting fuel bundles. It is designed as a telescoping grapple that can extend to the proper work level and in the normal up position state can still maintain adequate water shielding over fuel. The auxiliary fuel grapple and the monorail hoist of the fuel handling platform are designed to Seismic Category I requirements.

Redundant electrical interlocks preclude the possibility of raising radioactive material out of the water. Full up travel and full down travel are set using encoders and PLC generated limits. The full up travel stop is encoder/PLC based. An independent limit switch is utilized as a backup.

Providing a separate cask loading pool, capable of being isolated from the fuel storage pool, will eliminate the potential accident of dropping the cask and rupturing the fuel storage pool. Furthermore, limitation of the travel of the crane handling the cask will preclude transporting the cask over any fuel storage pool. Refer to <Chapter 15.0> for accident considerations.

9.1.4.2 System Description

<Table 9.1-7> lists typical tools and servicing equipment supplied with the nuclear system. The sections that follow describe the use of some of the major tools and servicing equipment, and address safety aspects of the design where applicable. Sections may be performed in parallel and not as listed.

9.1.4.2.1 Spent Fuel Shipping Cask and Spent Fuel Dry Storage Casks

The initial designs of cask storage and handling facilities are based on a design cask weighing approximately 125 tons with approximate dimensions 21 feet long and 10 feet in diameter. This size cask is expected to accommodate 24 to 32 fuel bundles. A flatbed (railroad or truck) transports the cask to and from the fuel handling area of the intermediate building. The flatbed is equipped with a cask cooling system and storage area for the cask yoke. Overland offsite transportation of the cask conforms to transportation rules and regulations of <49 CFR 173>.

The cask is handled by a yoke which is attached to the cask lifting trunnions. The yoke is provided with sufficient component redundancy and design safety features to ensure that, for all postulated credible component failures, a cask drop is precluded.

Each end of the cask is equipped with an energy-absorbing crash cone. The crash cones are constructed of a stainless steel honeycomb encased in aluminum. The performance of the crash cone complies with the requirements of <49 CFR 173>.

9.1.4.2.1.1 Spent Fuel Dry Cask Storage Casks

The HI-TRAC 125D transfer cask provides shielding and structural protection of the multi-purpose canister (MPC) during loading, unloading, and movement of the MPC from the spent fuel pool to the storage overpack. The transfer cask is a multi-walled (carbon steel/ lead/carbon steel) cylindrical vessel with a neutron shield water jacket attached to the exterior. This cask can accommodate a maximum of 68 fuel assemblies. The HI-TRAC is approximately 16.8 feet long and 7.81 feet in diameter, as shown on Drawing 3768, Sheet 3 (Reference 31). The 125 ton weight designation for this transfer cask is the maximum weight of a loaded transfer cask during any loading, unloading or transfer operation. Two Pressure Relief Valves are part of the HI-TRAC transfer cask water jacket, where they perform a water/steam pressure relief function if necessary. The HI-TRAC 125D design includes a bottom pool lid which is removable to facilitate transfer of the loaded MPC into the HI-STORM 100S Version B while in a stacked cask configuration.

The HI-STORM 100S Version B is a heavy-walled steel and concrete, cylindrical vessel that provides shielding and structural protection of the MPC during storage. The HI-STORM 100S Version B is approximately 18.2 feet long and 11 feet in diameter, as shown on Drawing 4116, Sheet 3 (Reference 31). The HI-STORM 100S Version B design includes a lid which incorporates the air outlet ducts into the lid. Its side wall consists of plain (unreinforced) concrete that is enclosed between inner and outer carbon steel shells. The cask has four air inlets at the bottom and four air outlets at the top to allow air to circulate naturally through the cavity to cool the MPC inside. The inner shell has supports attached to its interior surface to guide the MPC during insertion and removal, and allow cooling air to circulate through the overpack. A loaded MPC is stored within the HI-STORM 100S Version B in a vertical orientation.

9.1.4.2.2 Overhead Bridge Cranes

9.1.4.2.2.1 Containment Polar Crane

The containment polar crane is designed to Seismic Category I requirements. The crane consists of two crane girders and a trolley. The circular runway (rails) which supports the crane girders is supported from the containment walls at Elevation 721’-0” <Figure 1.2-11> and provides for 360° rotation of the crane girders.

The trolley travels laterally on the crane girders. The main and auxiliary hoisting equipment (125 ton and 10 ton capacity, respectively) are located on the trolley.

The containment polar crane with the vessel head strongback will be used to handle the 90 ton RPV head. The polar crane with the dryer/separator strongback will be used to handle the RPV internals. Both strongbacks are designed so that no single component failure will cause the load to drop or swing uncontrollably out of an essentially horizontal attitude.

The vessel head strongback is cruciform-shaped. It attaches to the crane sister hook by means of an integral hook box and two hook pins. Each pin is capable of carrying the rated load. Each leg of the cruciform is capable of carrying the rated load.

On both ends of each leg are adjustable lifting rods, suspended vertically to attach the lifting legs to the RPV head. These are for adjustment for even four point load distribution and allow for some flexibility in diametrical location of the lifting lugs on the head.

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

The shroud head load of 53 tons and the steam dryer load of 36.4 tons will both be lifted with the dryer/separator strongback.

This strongback is a cruciform shape with box-shaped sockets at the four ends. Each socket box is adjustable to accommodate the two different lug spacings on the dryer and on the shroud head. Pneumatically operated lifting pins will penetrate the sockets to engage the lifting lugs and pneumatically operated hook box pins will engage the polar crane sister hook.

Prior to initial use, each of the above strongbacks are load tested at 125 percent rated load or higher. At this test, measurements are taken to verify that deflections are within acceptable limits. Non-destructive testing of load bearing structural welds, in accordance with ANSI N14.6 1978, is performed after the load test to ensure structural integrity.

For lifting other loads over or near spent fuel, the Reactor Building polar crane auxiliary hoist is qualified for lifting light loads (loads less than 1048 lbs) over spent fuel, for lifting the IFTS gates near the spent fuel, as well as for other specified tools and components noted in (Reference 10) for loads up to 4,000 lbs. in accordance with administrative and maintenance procedures. When the polar crane load blocks are moved over or near spent fuel in the racks or open reactor, the main hoist shall be electrically disabled.

The polar crane is also used for the erection of major pieces of equipment during the construction phase. The containment polar crane is not used for fuel handling purposes.

9.1.4.2.2.2 Fuel Handling Area Crane

The primary purpose of the fuel handling area crane is to facilitate onsite handling of the fuel cask. This is a bridge-type crane, supported by reinforced concrete columns that spans the width of the fuel handling area. Its range of service includes the new fuel storage site, cask storage pool and cask washdown area. The fuel handling area crane rails do not extend over any portion of the spent fuel pool; thus, the cask cannot be transported over the spent fuel storage racks. The main hook has a 125 ton capacity and the auxiliary hook has a 20 ton capacity.

The original Fuel Handling Building crane furnished by P&H Harnischfeger did not meet current guidelines for designation as "single-failure-proof". The crane has a main hook rated for 125 tons that was originally qualified to "single-failure-proof" based upon NRC <Regulatory Guide 1.104> [Overhead Crane Handling Systems for Nuclear Power Plants, February 1976 (Withdrawn August 16, 1979)]. The crane was modified to comply with current guidelines for designation of the hoist for main hook as single-failure-proof, including applicable guidelines of NRC <NUREG-0554> (Single-Failure-Proof Cranes for Nuclear Power Plants, May 1979) and NRC <NUREG-0612> (Control of Heavy Loads at Nuclear Power Plants, July 1980) (Appendix C) of <NUREG-0612> applies to upgrade of existing cranes to single-failure-proof) to support spent fuel dry storage cask handling activities. Compliance with <NUREG-0554> required evaluation of existing components and upgrading of controls. (Appendix C) of <NUREG-0612> addresses the method to be used for modification of existing cranes. A <NUREG-0554> Conformance Matrix was developed to identify upgrades to the crane necessary for it to comply with applicable guidelines of <NUREG-0554> (Reference 10). A specification was prepared that identified the modifications to the Fuel Handling Building crane necessary for its designation as single-failure-proof (Reference 11). With the crane and main hook qualified to applicable guidelines of <NUREG-0554> and <NUREG-0612> for a single-failure-proof handling system, it is no longer necessary to postulate occurrence of a spent fuel cask drop accident as assessed in <Section 15.7.5.2>, Cask Drop from Crane since a load drop from the main hook is not a credible event.

9.1.4.2.3 Fuel Servicing Equipment

The fuel servicing equipment discussed in the sections that follow has been designed in accordance with the criteria listed in <Table 9.1-3>.

9.1.4.2.3.1 Fuel Prep Machines

A fuel preparation machine, <Figure 9.1-10> is mounted on the wall of the fuel storage pool and can be used for stripping reusable channels from the spent fuel and for rechanneling of the new fuel. The machine is also used with the fuel inspection fixture to provide an underwater inspection capability.

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 a permanently installed up-travel-stop to prevent raising fuel above the safe water shield level. The movable carriage is operated by a foot pedal controlled air hoist. One fuel prep machines (1F11E001A) function has been changed to facilitate setting blade guides into the steam dryer pool for storage prior to installation into the reactor vessel. The modification will not permit a fuel bundle to be inserted in the machine.

9.1.4.2.3.2 New Fuel Inspection Stand

The new fuel inspection stand, <Figure 9.1-11>, serves as a support for the new fuel bundles undergoing receiving inspection and provides a working platform for technicians engaged in performing the inspection.

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

Although, there is not a specific criticality analysis for storing fresh fuel in the new fuel inspection stand, generic fuel vendor analysis demonstrates that an array of three un-irradiated GE12/GE14 fuel bundles separated by 12 inches from other fuel is acceptable. The analysis supporting fresh fuel assumes a 10 by 10 fuel rod matrix, channeled or un-channeled, enriched to 5% U235 with sufficient Gadolinium loading to meet the minimum shipping requirements of the vendor supplied shipping crates (Reference 9). This generic fuel vendor analysis supports the condition where two fuel bundles are stored in the new fuel inspection stand and a third bundle is brought near the new fuel inspection stand using either the bundle lift hook and fuel handling building crane or the Aux Hoist and the General Purpose Grapple on the Fuel Handling Platform.

A generic fuel vendor analysis for GNF2 fuel bundle configurations outside of storage racks was also performed to demonstrate that up to three GNF2 bundles at peak reactivity condition may be moved in any configuration outside of storage locations in the spent fuel pool, reactor vessel area, fuel transfer tube, and other fuel preparation equipment such as the New Fuel Inspection Stand and be shown to maintain a maximum reactivity less than 0.95 (Reference 32).

9.1.4.2.3.3 Channel Bolt Wrench

The channel bolt wrench, <Figure 9.1-12>, 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 in the fuel preparation machine.

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

9.1.4.2.3.4 Channel Handling Tool

The channel handling tool, <Figure 9.1-13>, 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, a lock/release knob, extension shaft, angle guides, and clamp arms which engage the fuel channel. The clamps are actuated (extended or retracted) by manually rotating lock/release knob.

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

9.1.4.2.3.5 Fuel Pool Sipper

(Historical Information – Fuel Sipping is typically performed using vendor supplied equipment).

The fuel pool sipper, <Figure 9.1-14>, provides a means of isolating a fuel assembly in demineralized water in order to concentrate fission products in relation to a controlled background.

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

9.1.4.2.3.6 Channel Gauging Fixture

The channel gauging fixture, <Figure 9.1-15>, is a go/no-go gauge used to evaluate the condition of a fuel channel, prior to rechanneling or when one is difficult to install.

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

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

9.1.4.2.3.7 General Purpose Grapple

The general purpose grapple, <Figure 9.1-16>, is a handling tool used generally with the fuel.

9.1.4.2.3.8 Deleted

9.1.4.2.3.9 Fuel Handling Platform

Refer to <Section 9.1.4.2.7.3> for a discussion of the fuel handling platform.

9.1.4.2.3.10 Channel Handling Booms

A channel handling boom, <Figure 9.1-18>, with a spring-loaded balance reel is used to assist the operator in supporting a portion of the weight of the channel after it is removed from the fuel assembly. The boom is set between the fuel preparation machines. With the channel handling tool attached to the reel, the channel may be conveniently moved between fuel preparation machines.

9.1.4.2.3.11 Fuel Transfer System

The inclined fuel transfer system <Figure 9.1-19> is used to transfer fuel, control rods, defective fuel storage containers, and other small items between the containment and the fuel building pools by means of a carriage traveling in a transfer tube (a 23 inch I.D. stainless steel pipe). At the containment upper pool, the transfer tube connects to pool penetration and to a sheave box. Connected to the sheave box is a 24 inch flap valve, a vent pipe, cable enclosures, and a fill valve. In the fuel building pool, the transfer tube connects to a 24 inch gate valve. A bellows connects the building penetration to the valve and transfer tube to prevent water entrapment between the tube and penetration. A four inch Weldolet located on the transfer tube approximately two feet above the fuel building pool water level and a motor-operated valve are provided for connections to a drain pipe for water level control in the transfer tube. A containment isolation assembly containing a blind flange and a bellows which connects from the containment penetration to the assembly are provided to make containment isolation. A hand operated 24 inch gate valve is provided to isolate the reactor building pool water from the transfer tube so that the blind flange can be installed. A hydraulically actuated upender is provided in each pool for rotating part of the carriage, the tilt tube, to the vertical position for loading and unloading and to the inclined position for transfer. The carriage consists of the tilt tube and a follower connected with a pivot pin which allows upending of the tilt tube while maintaining the follower in the inclined position. The carriage has rollers and wheels which ride on tracks within the transfer tube and upenders to ensure low friction, correct carriage orientation, and smooth transition across valves and between other components. The tilt tube is designed to accept two different inserts: a fuel bundle insert with a two-bundle capacity, and a control rod insert for control rods, defective fuel storage container, and other small items.

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

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

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

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

Control panels are provided in close proximity to each transfer pool area and are connected for voice and interlock communication. Each panel has control buttons for actuating the upender, a button for initiating the transfer sequence to the other building and a stop button. The transfer operation functions on an automatic basis with provision made for manual override. Automatic sequencing is accomplished by use of an electronic controller located in the fuel building which utilizes sensors for confirming the successful completion of each step before initiating the next step. The completion of a transfer sequence is signaled at the control panels. The control panels also contain a programmable logic controller (PLC) driven touchscreen monitor to permit monitoring of the Inclined Fuel Transfer System (IFTS) equipment. It is from these touchscreen monitors that the automatic sequence is initiated. A touchscreen monitor on each of the fuel platforms will also permit monitoring and automatic transfer initiation. All four (4) of these locations are equipped with emergency stop pushbuttons.

Interlocks assure the correct sequencing of the transfer system components and fuel handling equipment during automatic or manual override operation. Interlocks prevent the refueling platform from moving into the reactor building transfer area unless the mast and associated load are at a clear elevation above the upender (7). In addition, interlocks prevent upender movement if the platform is in the transfer area and the mast is not at a clear elevation (refer to <Figure 9.1-19> for component and equipment locations). An interlock prevents the fuel handling platform from moving into the fuel building IFTS transfer tube area unless the upender (31) is in the vertical position. Another interlock prevents movement of the upender (31) if the fuel handling platform is in the lower IFTS transfer area. The refueling interlocks instrumentation and control and other control safety aspects of the refueling system are described and evaluated in <Section 7.7>.

The operational sequence for the fuel transfer system <Figure 9.1-19> is described as follows. As a starting point, assume the carriage (24) is in the containment transfer pool with the tilt tube (24A) supported by the upender (7) in the vertical position. In this position, the sheave box cover (11) and manual gate valve (17) are open with the fill valve (13), gate valve (25) and drain valve (27) closed. The operational sequence is as follows:

a. The automatic operation is started by selecting the Auto Run Start Monitor Touchbutton on the containment control panel or the Refuel Bridge monitor. The hydraulic cylinder (9) is actuated to pull the tilt tube into the inclined position for transfer.

b. The winch (1) starts unwinding the cables to lower the carriage (24).

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

d. The carriage is stopped approximately 2 feet above the gate valve (25).

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

f. The gate valve (25) is opened and the drain valve (27) closed.

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

h. The hydraulic cylinder (9) is actuated to push the upender (31) and tilt tube (24A) to the vertical position then the auto sequence stops.

i. Unload and load cargo.

j. The automatic operation to return the carriage to the containment is started by selecting the Auto Run Start Monitor Touchbutton on the fuel handling control panel or the fuel handling bridge monitor.

k. The hydraulic cylinder is actuated to lower the tilt tube and upender to the inclined position.

l. The winch is started and pulls the carriage (24) to a position approximately two feet above the gate valve (25) where it is automatically stopped.

m. The gate valve (25) is closed.

n. The fill valve (3) is opened.

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

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

q. The hydraulic cylinder (9) is actuated to push the upender and tilt tube (7 and 24A) to the vertical position then the auto sequence stops.

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

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

a. Close the manual gate valve (17).

b. Remove bolts from the containment isolation assembly (18) as required to allow insertion of the blind flange. (Not all bolts will have to be removed.) Loosen remaining bolts to allow adequate movement of the transfer tube flange. In operating Modes 1, 2, or 3, the unbolted configuration of the blind flange is limited to 20 hours in a 12 month period.

c. Compress the transfer tube bellows with the hydraulic cylinders (16).

d. Insert the blind flange and install bolts.

e. Relax the transfer tube bellows with the cylinders (16).

f. Relieve pressure on the cylinders and tighten the bolts.

Containment is made by the containment isolation assembly and blind flange, containment bellows (19) and the steel containment penetration. Special gaskets and double ply bellows are provided for leak checking to ensure containment isolation. A bellows assembly with a test connection is installed to permit confirmatory leak testing of the double ply bellows <Table 6.2-40>. (When the blind flange is removed in operating Modes 1, 2, or 3, containment is made by the remaining portion of the containment isolation assembly, containment bellows (19), steel containment penetration, transfer tube, drain line, drain valve, and local leak rate test valve.) A time restriction of 60 days per cycle exists for this configuration, i.e., the blind flange removed in operating Modes 1, 2, or 3.

Refer to <Table 9.1-4> for component identification essential classifications, safety classifications, quality groups, and seismic categories.

9.1.4.2.3.12 4-Bundle Rack

The 4-Bundle Rack is a movable storage rack located in the Cask Pit in the Fuel Handling Building. The 4-Bundle Rack consist of four storage locations – each capable of holding one fuel bundle (channeled or un-channeled). Each storage location consists of an enclosed box approximately 5.6 inches on each side and approximately 14 feet tall. Each storage location is open on the top and bottom. The four storage locations are arranged in square configuration such that the fuel bundles are on 12 inch centers. The 4-Bundle Rack is made of 304 Stainless Steel.

The purpose of the 4-Bundle rack is to allow transfer of fresh fuel from either the New Fuel Inspection Stand or New Fuel Storage Vaults to storage locations in the Spent Fuel Pool, Fuel Prep Pool, the Fuel Prep Machines, or the Inclined Fuel Transfer System. First, fresh fuel is transferred from either the New Fuel Inspection Stand or New Fuel Storage Vaults using the Aux Hoist and the General Purpose Grapple on the Fuel Handling Platform to a storage location in the 4-Bundle Rack. Second the fuel is transferred from the 4-Bundle Rack using the telescoping grapple on the Fuel Handling Platform to storage locations in the Spent Fuel Pool/Fuel Prep Pool or transferred to a Fuel Prep Machine or the Inclined Fuel Transfer System.

The 4-Bundle Rack is qualified to Safety Class 2/Seismic Category I requirements. The structural analysis assumed only two storage locations were in use. Perry's procedures limit the use of the 4-Bundle to only contain two fuel bundles at a time.

Although, there is not a specific criticality analysis for storing either fresh or irradiated fuel in the 4-Bundle Rack, generic fuel vendor analysis demonstrates that an array of three un-irradiated GE12/GE14 fuel bundles separated by 12 inches from other fuel is acceptable (Reference 9). The analysis supporting fresh fuel assumes a 10 by 10 fuel rod matrix, channeled or un-channeled, enriched to 5% U235 with sufficient Gadolinium loading to meet the minimum shipping requirements of the vendor supplied shipping crates. This generic fuel vendor analysis supports the condition where two fuel bundles are stored in the 4-Bundle Rack and a third bundle is brought near the 4-Bundle Rack using either the telescoping grapple on the Fuel Handling Platform or the Aux Hoist and the General Purpose Grapple on the Fuel Handling Platform.

A generic fuel vendor analysis for GNF2 fuel bundle configurations outside of storage racks was also performed to demonstrate that up to three GNF2 bundles at peak reactivity condition may be moved in any configuration outside of storage locations in the spent fuel pool, reactor vessel area, fuel transfer tube, and other fuel preparation equipment such as the 4-Bundle Rack and be shown to maintain a maximum reactivity less than 0.95 (Reference 32).

9.1.4.2.3.13 New Fuel Unloading Stand

The New Fuel Unloading Stand is a tall platform bolted to the Fuel Handling Floor behind the New Fuel Inspection Stand. The platform consists of four I-beams on an approximately 3 foot by 3 foot square and approximately 16 feet tall. There is a small platform located near the top. Additionally, a channel handling boom is located on top of the

Unloading stand. The channel handling boom consists of an I-beam approximately 15 feet tall, a swing arm, and a small electric hoist attached to the end of the swing arm.

The purpose of the New Fuel Unloading Stand is to hold the metal inner shipping container in the upright position while the new fuel bundles are removed from the inner shipping container. The purpose of the channel handling boom is to allow channeling of new fuel bundles in the New Fuel Inspection Stand. First, using the hoist on the swing arm, a channel is raised to the full up position. Second, the swing arm is pulled over the new fuel bundle in the New Fuel Inspection Stand such that the channel is centered over the fuel bundle. Third, the channel is lowered down over the fuel bundle.

If receiving channeled fuel assemblies, installation of the channel handling boom is optional.

The New Fuel Unloading Stand is qualified to Safety Class 2/Seismic Category I requirements. The structural analysis assumes a fully loaded metal inner container with two bundles and a channel hanging from the channel handling boom.

Although, there is not a specific criticality analysis for fresh fuel in the New Fuel Unloading Stand, generic fuel vendor analysis demonstrates that an array of three unirradiated GE12/GE14 fuel bundles separated by 12 inches from other fuel is acceptable (Reference 9). The analysis supporting fresh fuel assumes a 10 by 10 fuel rod matrix, channeled or un-channeled, enriched to 5% U235 with sufficient Gadolinium loading to meet the minimum shipping requirements of the vendor supplied shipping crates. This generic fuel vendor analysis supports the condition where two fuel bundles are stored in the New Fuel Unloading Stand and a third bundle is brought near the New Fuel Unloading Stand using the bundle lift hook and Fuel Handling Building Crane.

A generic fuel vendor analysis for GNF2 fuel bundle configurations outside of storage racks was also performed to demonstrate that up to three GNF2 bundles at peak reactivity condition may be moved in any configuration outside of storage locations in the spent fuel pool, reactor vessel area, fuel transfer tube, and other fuel preparation equipment such as the New Fuel Unloading Stand and be shown to maintain a maximum reactivity less than 0.95 (Reference 32).

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 independent of the platform. Local area underwater lights are small diameter lights for additional illumination. Drop lights are used for illumination where needed.

A radiation hardened designed underwater closed circuit television (CCTV) 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.

A general purpose, plastic viewing aid is provided to float on the water surface to provide better visibility. The sides of the viewing aid are brightly colored to allow the operator to observe it in the event of filling with water and sinking. Portable, submersible type, underwater vacuum cleaners are 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 will fit into a standard shipping container for offsite burial. Fuel pool tool accessories are also provided to meet servicing requirements. A fuel assembly sampler may be used to detect defective fuel assemblies during open vessel periods while the fuel is in the core.

9.1.4.2.5 Reactor Vessel Servicing Equipment

The essentiality and safety classifications, the quality group and the seismic category for this equipment is listed in <Table 9.1-5>. The sections that follow describe the equipment designs in reference to <Table 9.1-5>.

9.1.4.2.5.1 Deleted

9.1.4.2.5.2 Steam Line Plugs

The steam line plugs are used during reactor refueling or servicing; they are inserted in the steam outlet nozzles from inside of the reactor vessel to prevent a flow of water from the reactor well into the main steam line during servicing of safety/relief valves, main isolation valves, or other components of the main steam lines, while the reactor water level is at the refueling level. The steam line plug design provides two safety related seals. Each one is independently capable of holding full head pressure and is seismically qualified. The equipment is constructed of non-corrosive materials. The plug body is designed in accordance with applicable industry codes.

9.1.4.2.5.3 Shroud Head Bolt Wrenches

This is a hand held tool for operation of the shroud head bolts. It is designed for a 40 year life and is made of aluminum for ease of handling and resistance to corrosion. 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 and strongback/carousel during periods of reactor service. The pedestals have studs which engage three evenly spaced stud holes in the head flange. The flange surface rests on replaceable wear pads made of aluminum. When resting on the pedestals, the head flange is approximately three 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.

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

9.1.4.2.5.5 Head Stud Rack

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

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

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

9.1.4.2.5.6 Dryer and Separator Strongback

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

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

The structure is designed in accordance with “The Manual of Steel Construction” by AISC. The completed assembly is proof tested at 150 percent of rated load and all structural welds are non-destructively tested in accordance with ANSI N14.6 1978 after load test.

9.1.4.2.5.7 Head Strongback/Carousel

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

The strongback is a box beam structure which has a hook box with two hook pins in the center for engagement with the containment polar crane sister hook. Each arm has a lift rod for engagement to the four lift lugs on the RPV head. The monorail is mounted on extensions of the strongback arms and four additional arms equally spaced between the strongback arms. The monorail circle matches the stud circle of the reactor vessel and it serves to suspend stud tensioners and nut handling devices. The storage tray is suspended from the ends of the same eight arms and surrounds the RPV flange. A manifold is mounted underneath the hook box for distributing hydraulic and pneumatic pressures to equipment traveling on the monorail. The head strongback/carousel serves the following functions:

a. Lifting of Vessel Head

   The strongback, when suspended from the containment polar crane main hook, will transport RPV head plus the carousel with all its attachments between the reactor vessel and storage on the pedestals.

b. Tensioning of Vessel Head Closure

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

c. Storage with RPV

The carousel, when stored with the RPV head on the head holding pedestals, carries the same load for Item b., above. When in storage position, it accommodates nut cleaning and inspection.

d. Storage without RPV Head

During reactor operation, the carousel is stored on the refueling floor, straddling the three pedestals. Support cradles with a flat base are provided for supporting the four carousel legs on the floor.

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

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

The strongback is tested in accordance with ASME, American National Standard for overhead hoists ANSI B30.16 - 1973, Paragraph 16-1.2.2.2, and designed such that one hook pin and one main beam of the structure are capable of carrying the total load, and no single component failure will cause the load to drop or swing uncontrollably out of an essentially level attitude.

9.1.4.2.6 In-Vessel Servicing Equipment

The instrument handling tool is attached to a refueling platform auxiliary hoist and is used for removing and installing neutron source holders and dry tubes. Each in-core instrumentation guide tube is sealed by an O-ring on the flange and, if the seal needs to be replaced, an in-core 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 rods, flux monitor dry tubes, sources, and other internals of the reactor. Interlocks on both the grapple hoists and auxiliary hoist are provided for safety purposes; the refueling interlocks are described and evaluated in <Section 7.7.1.6>.

9.1.4.2.7 Refueling Equipment

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

Administrative procedures prohibit movement of loads capable of developing a kinetic energy more than the kinetic energy being developed by one fuel assembly and its associated handling tool over fuel in the spent fuel racks, except when:

1. moving gates in the Fuel Handling Building pools between their sealing position and storage position in accordance with approved procedures consistent with <Section 9.1.3.3>;

2. the Reactor Building polar crane auxiliary hoist is used for handling IFTS gates, light loads (load less than 1048 lbs) as well as for other specified tools and components noted in (Reference 10) for loads up to 4,000 lbs. The Reactor Building polar crane auxiliary hoist is qualified for lifting light loads (loads less than 1048 lbs) over spent fuel, for lifting the IFTS gates near the spent fuel, as well as for other specified tools and components noted in (Reference 10) for loads up to 4,000 lbs. in accordance with administrative and maintenance procedures. When the polar crane load blocks are moved over or near spent fuel in the racks or open reactor, the main hoist shall be electrically disabled.

9.1.4.2.7.1 Refueling Platform

The refueling platform is a gantry crane which is used to transport fuel and reactor components to and from pool storage and the reactor vessel. The platform spans the fuel storage and vessel pools on bedded tracks in the refueling floor. A telescoping mast and grapple suspended from a trolley system is used to lift and orient fuel bundles for core, storage rack, fuel preparation machine, or upender placement. The refueling grapple may include an underwater CCTV camera to assist the refueling platform operator/personnel with a close-up view of the fuel assembly and the reactor core. A safety railing adjacent to the pools is provided to keep personnel from entering the pool area. Control of the platform is from various operator stations on the platform.

The platform control system permits variable-speed, simultaneous operation of all three platform motions. Maximum speeds are:

a. Bridge - 50 fpm

b. Trolley - 30 fpm

c. Grapple Hoist - 40 fpm

A single operator can control all the motions of the platform required to handle the fuel assemblies during refueling. Interlocks on the main grapple hoist prevent hoisting of a fuel assembly over the core with a control rod withdrawn; interlocks also prevent withdrawal of a control rod with a fuel assembly over the core attached to the main fuel grapple. Interlocks block travel over the reactor in the startup mode.

The interlocks which block travel over the reactor when the reactor is in the startup mode may be bypassed provided appropriate administrative controls on the reactor mode switch are implemented to maintain it in an other than startup position.

The refueling platform contains a position indicating system and programmable logic controller (PLC) that indicates position of the fuel grapple over the core and prevents collisions with pool obstacles. The readout on the computer display, in the operator’s cab, matches the reactor core arrangement cell identification numbers. The position indicator is sufficiently accurate to minimize jogging required to correctly place the grapple over the core.

The grapple in its normal up position provide 6 feet 10 inches minimum water shielding over the grappled fuel bundle during transit. The fuel grapple hoist has a redundant load path so that no single component failure will result in a fuel bundle drop. Interlocks on the platform prevent unsafe operation over the vessel during control rod movements, prevent collision with the auxiliary platform, avoid unsafe operation in the transfer tube upender zone, limit travel of the fuel grapple, and interlock grapple hook engagement with hoist load and hoist up power. Two half-ton design load capacity auxiliary hoists (the Frame Hoist mounted on the main trolley and the Monorail Hoist mounted on the monorail trolley) are located on the refueling platform. These hoists are provided for incore servicing such as detector module replacement, fuel support replacement, jet pump servicing, and control rod blade replacement. To ensure handling of fuel is precluded when using these auxiliary hoists, the overload cutoffs are administratively limited to a maximum hook load of 550 pounds. Field settings must be lower than this limit based on load cell sensing system tolerance.

9.1.4.2.7.2 Auxiliary and Vessel Platforms

An auxiliary platform is provided to allow versatility of operations. This platform will operate over the reactor building pool and will provide an additional work area for reactor servicing. A half-ton design load capacity hoist is provided for reactor servicing tasks. The hoist is administratively limited to 500 pounds. The design of the auxiliary platform allows concurrent reactor servicing with fuel movements by the refuel platform.

9.1.4.2.7.3 Fuel Handling Platform

The fuel handling platform is a gantry crane which is used to transport fuel within the fuel building storage pool. The platform spans the fuel storage and transfer tube upender pools on tracks bedded in the fuel building floor. A telescoping mast and grapple is used to lift and orient fuel bundles for storage rack or upender placement. Control of the platform is from various operator stations on the platform. A vertical position indicating system is provided for the grapple. Encoders and PLC based limits located on the end trucks prevent the platform from running into pool obstacles. A 1,000 pound capacity auxiliary hoist is mounted on the monorail trolley and is used for moving new fuel from either the new fuel vaults or the new fuel inspection stand to the 4 bundle rack in the cask pool and control rod transport. Both main fuel hoist and monorail hoist have redundant load paths so that no single component failure will result in a fuel bundle drop. During transfer of fuel, the grapple in its normal up position provides approximately 7 feet minimum water shielding (seven feet over the grappled bundle).

9.1.4.2.7.4 Portable Radiation Shield

The portable radiation shield is a temporary shielding device that is installed prior to transfer of spent fuel bundles from the reactor to the spent fuel pool. The fuel bundles are passed through the shield which reduces radiation levels in the upper drywell area. The shield is handled by the containment polar crane. In the installed position, one end of the shield is supported by the reactor vessel flange and the other end is supported from the floor at Elevation 664’-7”. Following its use, the shield is stored in the separator storage pool.

9.1.4.2.8   Storage Equipment

Specially designed equipment storage racks are provided. Additional storage equipment is listed in <Table 9.1-7>. For fuel storage racks description and fuel arrangement, see <Section 9.1.1> and <Section 9.1.2>.

Defective fuel assemblies may be placed in special fuel storage containers which are stored in the defective fuel storage rack. These may be used to isolate leaking or defective fuel while in the fuel pool and during shipping. Channels can also be removed from the fuel bundle while in a defective fuel storage container. Defective fuel assemblies may be placed in fuel storage racks provided a channel is installed.

The fuel pool sipper may be used for out-of-core wet sipping at any time. They are 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 so it will not fit into the fuel grapple.

9.1.4.2.9   Under Reactor Vessel Servicing Equipment

The primary function of the under reactor vessel servicing equipment is to remove and install control rod drives, service thermal sleeve and control rod guide tube and install and remove the neutron detectors. <Table 9.1-6> lists the equipment and tools required for servicing.

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

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

The seal cap is designed to prevent leakage of primary coolant from incore detector housings during detector replacement. It is designed to industrial codes, manufactured from non-corrosive material.

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

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

The key bender is designed to install and remove the anti-rotation key that is used on the thermal sleeve.

9.1.4.2.10 Description of Fuel Transfer

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

This Section describes a typical refueling and servicing sequence. (Note: The order of the steps may change slightly from one outage to the next.) Fuel handling procedures are shown in <Figure 9.1-21>, <Figure 9.1-22>, <Figure 9.1-23>, <Figure 9.1-24>, and <Figure 9.1-25>. Typical fuel handling areas of the intermediate building and containment building are shown in <Figure 9.1-26> and <Figure 9.1-27>, and component drawings of the principal fuel handling equipment are shown in <Figure 9.1-10>, <Figure 9.1-11>, <Figure 9.1-12>, <Figure 9.1-13>, <Figure 9.1-14>, <Figure 9.1-15>, <Figure 9.1-16>, <Figure 9.1-17>, <Figure 9.1-18>, and <Figure 9.1-19>.

9.1.4.2.10.1 Arrival of Fuel on Site

New fuel comes to the site as either un-channeled fuel bundles or as channeled fuel assemblies.

The new fuel arrives on site in shipping crates. Each crate contains up to two fuel bundles or two fuel assemblies, enclosed in a metal shipping container which supports the entire length of the bundles/assemblies. The crate is approximately 29 x 29 x 200 inches and weighs approximately 3,600 pounds.

The new fuel is delivered to a receiving station located within the fuel handling building loaded upon a flatbed transport vehicle. As each crate is unloaded from the flatbed, it is examined for damage during shipment. As an alternative, the flatbed transport vehicle can be located outside the Fuel Handling Building a forklift/side loader can be used to move the shipping crates into the building.

Once unloaded, each crate is opened and the shipping container is removed and placed in a storage area. The shipping container is then opened, jockeyed to the upright position, and placed in the New Fuel Unloading Stand. The fuel bundles/assemblies are then removed from the shipping container and placed into the new fuel inspection stand. Both the shipping crate and the shipping container are reusable. The fuel handling area crane is used to perform all lifting during these activities.

<Section 9.1.4.2.10.2> describes the activities associated with the preparation of the new fuel.

9.1.4.2.10.2 New Fuel Preparation

9.1.4.2.10.2.1 Inspection of New Fuel

Inspection of the new un-channeled fuel is done concurrently with the unloading of the fuel bundles. Once located in the New Fuel Inspection Stand, the fuel bundles are dimensionally and visually inspected. If the bundles pass this inspection, then bundles are channeled (after channeling fuel is called an assembly) using the channel handling boom attached to the New Fuel Unloading Stand. Finally, the fuel assemblies are transferred to the 4-Bundle Rack (located in the Cask Pit). From the 4-Bundle Rack, the fuel assemblies can be stored in either the Spent Fuel Pool/Fuel Prep Pool Racks or transferred to a Fuel Prep Machine or the Inclined Fuel Transfer System.

Inspection of the new channeled fuel is performed concurrently with the unloading of the channeled fuel assemblies. Once located in the New Fuel Inspection Stand, the channeled fuel assemblies are visually inspected. If the fuel assemblies pass this inspection, then the channeled fuel assemblies are transferred to the 4-Bundle Rack (located in the Cask Pit). From the 4-Bundle Rack, the channeled fuel assemblies can be stored in either the Spent Fuel Pool/Fuel Prep Pool Racks or transferred to the Inclined Fuel Transfer System.

9.1.4.2.10.2.2 Channeling New Fuel

New un-channeled fuel will be channeled using unirradiated channels.

Unirradiated channels will be installed when the fuel bundle is still in the new fuel inspection stand, as described in paragraph 9.1.4.2.10.2.1 above.

9.1.4.2.10.3 Reactor Shutdown

The reactor is shut down according to a prescribed plant operating procedure. During cooldown, the reactor pressure vessel is vented and filled to above flange level to promote cooling. With the reactor shut down, the containment isolation valve between the fuel handling building and the reactor building can be opened (if not previously opened per the 60 hour per cycle allowance). At this time, channeled new fuel assemblies may be transferred to the containment pool where the refueling platform places them into containment pool storage racks. These racks have a capacity for 25 percent of a core load of fuel. When the reactor is sufficiently cooled, the gate separating the storage rack section of the upper containment pool from the reactor well is closed <Figure 9.1-27>. The reactor well water is drained by gravity through a pipe connection at the bottom of the reactor well to the hotwell. The reactor well is drained in preparation for drywell head, vessel head and vessel internals removal.

9.1.4.2.10.4 Drywell Head Removal

Immediately after cooldown and deflooding, the work to unbolt the drywell head can begin. The unbolted drywell head is lifted by the containment polar crane to its appointed storage space on the refueling floor <Figure 9.1-27>. Refer to <Figure 9.1-21> for an illustration of the removal sequence. The drywell seal surface protector is installed before any activity, that may cause sealing surface damage, proceeds in the reactor well area. See <Section 9.1.4.2.2.1> for a description of the containment polar crane.

9.1.4.2.10.5 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 water tight. Vessel head piping and the head insulation is removed and stored on the refueling floor.

Water level in the vessel is now lowered to flange level in preparation for head removal.

9.1.4.2.10.6 Reactor Vessel Head Removal

The combination head strongback and carousel stud tensioner is transported by the containment polar crane and positioned on the reactor vessel head. Each stud is tensioned and its nut loosened and removed. The vessel head guide caps are installed.

Next, the strongback with the head and carousel attached is transported by the containment polar crane to the head holding pedestals on the refueling floor. Refer to <Figure 9.1-22> for an illustration of the vessel head removal sequence. The head holding pedestals keep the vessel head elevated to facilitate inspection and O-ring replacement. The six studs in line with the fuel transfer canal are removed to provide a path for fuel movement.

9.1.4.2.10.7 Dryer Removal

The dryer/separator strongback is lowered by the containment polar crane and attached to the dryer lifting lugs. The dryer is lifted from the reactor vessel and transported to its storage location in the dryer storage pool adjacent to the reactor well. Refer to <Figure 9.1-23> for an illustration of the dryer removal sequence. As an alternative, the dryer may be stored in the separator storage pool.

9.1.4.2.10.8 Main Steam Line Plug Installation

Prior to removal of the steam separator, the main steam line plugs are installed in the four main steam nozzles from inside the vessel.

9.1.4.2.10.9 Separator Removal

In preparation for the separator removal, the separator is unbolted and unlatched from the shroud. When the unbolting is accomplished, the dryer/separator strongback is lowered into the vessel and attached to the separator lifting lugs. The separator is then lifted out of the vessel and transported to the separator storage area in the containment pool. Refer to <Figure 9.1-24> for an illustration of the Separator Removal Sequence. As an alternative, the separator may be stored in the dryer storage pool.

9.1.4.2.10.10 Fuel Assembly Sampling

During reactor operation, the core offgas radiation level is monitored. If a rise in offgas activity has been noted, fuel assemblies may be sampled to locate any leaking fuel assemblies.

9.1.4.2.10.11 Refueling and Reactor Servicing

The reactor well is filled to the level of the containment pools. The gate isolating the containment pool from the reactor well is removed, thereby interconnecting the containment pool, the reactor well and the fuel transfer area. The refueling of the reactor can now begin.

During a 24 month equilibrium outage, approximately 42 percent of the fuel is removed from the reactor vessel, the remaining fuel is shuffled in the core and 42 percent new fuel is installed.

The refueling platform transports the spent fuel from the core to the Inclined Fuel Transfer System (IFTS) upender. (Refer to <Section 9.1.4.2.7.1> for a description of the refueling platform and <Section 9.1.4.2.3.11> for a description of IFTS.) The IFTS transfers the spent fuel to the IFTS upender in the fuel handling pool. The fuel handling platform then transports the spent fuel to its storage location within the spent fuel pool.

The fuel handling platform transports the new fuel to the upender in the fuel handling pool. The IFTS transfers the new fuel to the upender in the containment pool. The refueling platform places the new fuel either into the storage rack or into the core. The refueling platform is also used to shuffle fuel within the core or within the containment pool.

The operation of the fuel handling platform, the refueling platform, and the IFTS will be administratively coordinated with each other to ensure a safe, continuous refueling process.

9.1.4.2.10.12 Vessel Closure

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

a. Install pool gate.

b. Core verification. The core position of each fuel assembly must be verified to ensure the desired core configuration has been attained. Underwater CCTV camera with a video tape recorder may be used.

c. Control rod drive tests. The control rod drive timing, friction and scram tests are performed as required.

d. Replace separator.

e. Drain separator storage pool and reactor well.

f. Remove the four steam line plugs.

g. Remove drywell seal surface covering.

h. Replace steam dryer.

i. Replace vessel studs.

j. Install reactor vessel head.

k. Install vessel head piping and insulation.

l. Hydro-test vessel, if required.

m. Install drywell head. Leak check.

n. Flood reactor well.

o. 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 in-core flux monitors are calibrated.

9.1.4.2.10.13 Departure of Fuel from Site

The empty cask arrives at the fuel handling building on a specially designed shipping flatbed. The personnel shipping barrier is removed and stored in the fuel handling building near the flatbed entrance. If inspection shows that the radioactivity level of the cask exceeds <10 CFR 20> limits, the cask is washed with demineralized water. When the fuel handling area crane is in operation, administrative controls ensure that the fuel handling platform is not operating in the cask handling area. Warning of fuel handling area crane operation is given by signal lights and an audible alarm. Cask handling operations are not performed during refueling.

The front cask crash cone is removed and stored near the flatbed. The cask yoke is then removed from its flatbed storage area and attached to the cask trunnions. The fuel handling area crane then upends the cask and transfers it to the cask storage pool. It is not necessary to move the flatbed during these operations. Although it is possible for the cask to pass over the new fuel storage vault, a cask drop accident on the new fuel storage racks is not a nuclear safety concern. The normal path of cask travel does not include the new fuel storage vault and administrative controls ensure that the normal path of travel is followed.

As the cask is lowered into the pool, the water is drained so that the water level is maintained just below the yoke crossbar. After the cask is set on the storage pool floor, the yoke and head seal are removed and stored. The cask storage pool is then refilled and the pool separation gate is removed.

Once the cask is loaded and the gate is in place, the water level is lowered to the top of the cask. The head seal and yoke are reattached to the cask. As the cask is raised, the water level is maintained just below the top of the cask until the pool is filled and the cask is out of the water.

For normal operation, no cooling is necessary for the cask during transfer to the flatbed. The cask design is such that cooling can be delayed for 8 to 12 hours before the heat generation exceeds allowable limits. This situation can occur when power to the crane drive is lost or the drive itself becomes inoperative. Should a cask crane hoist malfunction cause such a delay that it appears that the heat generation may exceed allowable limits, cooling water may be readily supplied to the cask at any point along its path of travel by connecting a flexible hose between the cask and a demineralizer water supply nozzle, located in the washdown area.

9.1.4.2.10.14 Onsite Spent Fuel Dry Storage (SFDS)

PNPP has implemented an on-site Independent Spent Fuel Storage Installation (ISFSI) facility that will be used for storage of spent nuclear fuel.

The Spent Fuel Dry Storage (SFDS) operations at PNPP will be conducted under a general license in accordance with <10 CFR 72>.

The ISFSI site is located inside the Protected Area (PA) fence, southeast of the Fuel Handling Building (FHB). The ISFSI pad is designed for a capacity of 80 storage units.

The PNPP ISFSI utilizes the HOLTEC International (HOLTEC) HI-STORM 100 Spent Fuel Dry Storage (SFDS) system. The SFDS system includes the HI-STORM 100S Version B storage cask (HI-STORM), the MPC-68 multi-purpose canister (MPC) (Reference 31).

The HI-STORM, a steel and concrete upright cylindrical structure, provides shielding, structural protection, and passive cooling of the inserted MPC during storage.

The MPC-68 is a welded, leak-tight canister that provides the confinement boundary and criticality protection for the stored fuel. A total of 68 Boiling Water Reactor (BWR) spent fuel assemblies are permitted to be loaded in the MPC.

9.1.4.2.10.14.1 Spent Fuel Dry Storage Operations

SFDS operations involve the placement of spent nuclear fuel from the spent fuel pool into the MPC, and placing the MPC into the HI-STORM which takes place within the FHB. The loaded HI-STORM is then transported to an onsite ISFSI facility. A haul path has been installed to enable the transport of spent nuclear fuel between the FHB and the ISFSI pad. The loaded HI-STORM is transported to the ISFSI area and placed in its predetermined position on the ISFSI pad. Building structures and equipment have been evaluated for the imposed loads (Reference 20), (Reference 21), (Reference 22), (Reference 23), (Reference 25), (Reference 26), (Reference 27), (Reference 28), (Reference 29), and (Reference 30).

9.1.4.2.10.14.2 Operations Involving the FHB Crane and SFDS Heavy Load Handling

The FHB overhead bridge crane hoist for the main hook, rated for 125 tons, has been upgraded to meet current <NUREG-0554> and <NUREG-0612> (Appendix C) requirements for designation as "single-failure-proof", as discussed in <Section 3.9.2.2.3> and <Section 9.1.4.2.2.2>. The hoist for the crane's auxiliary hook, which has a 20 ton capacity, was not upgraded to single-failure-proof status (this hook is not used for any critical lifts). The crane, crane control system, documentation, and materials have been modified as necessary so that the hoist for the main hook meets the applicable crane single-failure-proof guidelines. The FHB overhead bridge crane has been evaluated, and is capable of supporting a loaded HI-TRAC during the Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) events. Heavy load handling special lifting devices are per <ANSI N14.6> (Reference 18), (Reference 19), and (Reference 24). Load handling during activities in support of spent fuel dry cask storage are administratively controlled.

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.

The fuel prep machine (except for 1F11E001A) removes and installs channels with all parts remaining underwater. Mechanical stops prevent the carriage from lifting the fuel bundle or assembly to a height where water shielding is less than seven 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 which prevent the loading of fuel bundles into this rack.

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

The refueling platform is designed to prevent it from toppling into the pools during a SSE. Safety interlocks are provided to prevent accidentally running the grapple into stationary objects. The grapple utilized for fuel movement is on the end of a telescoping mast. At the normal up position of the mast, the fuel bundle is six feet ten inches (minimum) below the water surface, so there is no chance of raising a fuel assembly to the point where it is inadequately shielded by water.

The grapple is hoisted by redundant cables inside of the mast; and is lowered by gravity. The computer monitor is displayed to the operator, showing him the exact coordinates of the grapple over the core.

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

The grapple has two independent hooks, each operated by an air cylinder. Engagement is indicated to the operator. Interlocks prevent grapple disengagement while a hoist loaded signal from the lifting cables indicates that the fuel assembly is loaded on the grapple. The refueling grapple head may include an internally mounted underwater CCTV camera to provide close up viewing of the fuel assembly and the reactor core.

In addition to the main hoist on the trolley, there is an auxiliary hoist on the trolley and another hoist on its own monorail. The bridge and trolley can only be operated from one control station at a time. The two auxiliary hoists have load cells with interlocks which prevent the hoists from moving anything as heavy as a fuel bundle.

The two auxiliary hoists have electrical interlocks which prevent the lifting of their loads higher than six feet ten inches below the water surface.

The fuel handling system complies with General Design Criteria 2, 3, 4, 5, 61, 62, and 63, and applicable portions of <10 CFR 50>. <Regulatory Guide 1.13> is complied with, since the refueling platform is designed to prevent toppling into the pool during an SSE. Safety interlocks are provided to prevent accidentally running the fuel grapple into stationary objects.

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

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

9.1.4.4 Inspection and Testing Requirements

Refueling and servicing equipment is subject to the strict controls of quality assurance, incorporating the requirements of <10 CFR 50, Appendix B>. Components such as the fuel storage racks, refueling platforms and fuel transfer tube have an additional set of engineering specified, "quality requirements" that identify features which require specific QA verification of compliance to drawing requirements.

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

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

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

Qualification testing is performed on refueling and servicing equipment prior to multi-unit production. Test specifications are defined by the responsible design engineer and may include: sequence of operations, load capacity and life cycle 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 re-qualified by test or calculation.

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

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

Passive units (such as the fuel storage racks) and minor tools (such as underwater lights, poles, or magnetic retrievers) are visually inspected prior to use.

Fuel handling and vessel servicing equipment preoperational tests are described in <Section 14.2.12>.

9.1.4.5 Instrumentation Requirements

The refuel servicing equipment is manually operated and controlled by the operator’s visual observations. This type of operation does not necessitate the need for a dynamic instrumentation system. The refueling platform has the capability to perform manual and automatic movements in three axes.

There are several components that are essential to prudent operation 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. Interlocks and control room monitor are provided to prevent the fuel grapple from operating in any fuel cell when a control rod is not in the proper orientation for refueling. Refer to <Section 7.7.1.6> for discussion of refueling interlocks.

Additionally, a programmable logic controller (PLC) utilizes encoder position inputs and a series of mechanically activated switches and relays to provide monitor indications on the operator's console for grapple limits, hoist and cable load conditions and confirmation that the grapple's hook is either engaged or released. The PLC also provides the necessary protective interlocks for three dimensional manual and automatic movements of the platform.

A series of load control units are installed to provide automatic stoppage of hoist raise power whenever threshold limits are exceeded on either the fuel grapple or the auxiliary hoist units.

9.1.4.5.2 Inclined Fuel Transfer Tube

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

The microprocessor control and proximity type sensors also provide monitor and status conditions of the fuel transfer operation on each of the two operator's consoles, one located in the fuel building and the other on the RPV refueling floor. There are remote operator stations on the fuel handling and refuel bridges. Interlocks are provided to shutdown the system whenever personnel have access to radiation hazardous areas along the transfer tube's route.

9.1.4.5.3 Fuel Support Grapple

The fuel support grapple has an instrumentation system consisting of mechanical switches and indicator lights. This system provides the operator with a positive indication that the grapple is properly aligned and oriented and that the grappling mechanism is either extended or retracted.

9.1.4.5.4 Other

Refer to <Table 9.1-7> for additional refueling and servicing equipment not requiring instrumentation.

9.1.4.5.5 Radiation Monitoring

The radiation monitoring equipment for the refueling and servicing equipment is discussed in <Section 12.3.4>.

9.1.5 CONTROL OF HEAVY LOADS OVER OR NEAR SPENT FUEL AND OTHER CRITICAL PLANT SYSTEMS/COMPONENTS

During the operational phase, the guidelines of <NUREG-0612>, "Control of Heavy Loads at Nuclear Power Plants," Section 5.1.1 (Phase I of <NUREG-0612>, as defined in <Generic Letter 85-11>), are complied with to reduce the potential of an uncontrolled movement or lowering of a heavy load, by adherence to the following procedures and requirements:

a. Maintenance procedures provide the necessary guidelines to ensure safe handling of heavy loads over or in the vicinity of spent fuel, fuel in the core, and safe shutdown, and decay heat removal systems and equipment.

b. Engineering evaluation and subsequent approval of a defined safe load path and rigging/lifting arrangement.

c. Specified training/qualification of crane operators, periodic testing/inspection of lifting equipment and control of lifting devices in accordance with plant administrative procedures.

d. Per ANSI N14.6-1978, to verify continuing compliance, each special lifting device shall be subjected annually (period not to exceed 14 months) to a load test equal to 150% of the maximum loads to which the device is to be subjected and to visual inspection of critical areas (including major load-bearing welds) for defects, and all components shall be inspected for permanent deformation. As an alternative, the load testing may be omitted, and dimensional testing, visual inspection, and nondestructive testing of major load-carrying welds and critical areas can be performed. If the device has not been used for a period exceeding one year, this testing is not required, but is conducted before returning the device to service. For the refuel special lifting devices, i.e., the Refuel Shield Strongback, Dryer Separator Strongback, RPV Head Strongback/Carousel, Insulation Frame Strongback and Adapter, Stud Strongback and Hardware, testing to verify continuing compliance is performed consistent with ANSI N14.6-1978 with the exception the NDE or load testing is conducted on a 10 year interval.

9.1.5.1 Introduction/Licensing Background

NRC <Generic Letter 80-113> and <Generic Letter 81-07> requested that Cleveland Electric Illuminating (CEI) review their controls for handling of heavy loads to determine the extent to which they met the guidelines in <NUREG-0612>, “Control of Heavy Loads at Nuclear Power Plants.”

In a CEI letter, dated 6/19/1981, to NRC, (Reference 11), CEI documented completion of review of controls for the handling of heavy loads at the Perry Nuclear Power Plant (PNPP). The conclusion of the CEI Perry Nuclear Plant Control of Heavy Loads Study, Revision 0, submitted by the 6/19/1981 letter, was that with the exception of specific procedures under development for the administrative control for handling heavy loads, crane inspection, testing and maintenance as well as operator qualification, there were no changes or modifications required to fully satisfy the requirements of <NUREG-0612>. Revision 1 of the Heavy Loads Study, which was submitted to the NRC on September 28, 1981, concluded that the result of the PNPP Heavy Load Study/Evaluation demonstrated that the estimated consequences of such a drop do not exceed the limits set by the evaluation criteria of <NUREG-0612>. Additional submittals from CEI were provided to the NRC on June 9, 1982; September 15, 1982; and November 8, 1982; and on January 14, 1983, (Reference 12), (Reference 13), (Reference 14), and (Reference 15).

In <Generic Letter 85-11>, the NRC staff concluded that a detailed review of the <NUREG-0612> Phase II guidelines (specifically guidelines in <Section 5.1.2>, <Section 5.1.3>, <Section 5.1.4>, <Section 5.1.5>, and <Section 5.1.6> was not necessary. The staff based its conclusion on the improvements resulting from implementation of Phase I <Section 5.1.1> requirements and the findings through a pilot review of several Phase II responses.

In Perry SSER 5, the NRC staff and its consultant, Idaho National Engineering Laboratory (INEL), documented their review of the CEI submittals identified above. As a result of the review, INEL issued a Technical Evaluation Report (TER) that was included as Appendix K of SSER 5. The staff reviewed the TER and concurred with the TER conclusion that CEI has acceptably satisfied the guidelines of <NUREG-0612>, <Section 5.1.1> (<NUREG-0612> Phase I). The staff also concluded in SSER 5 that CEI need not take any further action regarding <Section 5.1.2>, <Section 5.1.3>, <Section 5.1.4>, <Section 5.1.5>, and <Section 5.1.6> of <NUREG-0612> (<NUREG-0612> Phase II).

In NRC Bulletin (NRCB) 96-02, "Movement of Heavy Loads Over Spent Fuel, Over Fuel in the Reactor Core, or Over Safety Related Equipment," the staff noted concerns on specific instances of heavy load handling and requested that licensees provide information documenting their compliance with these guidelines and licensing bases. The NRC issued NRCB 96-02 for three principal reasons:

1. Alert licensees to the importance of complying with existing regulatory guidelines associated with the control and handling of heavy loads at nuclear power plants,

2. Request that all licensees review their plans and capabilities for handling heavy loads in accordance with existing regulatory guidelines and within their licensing basis as previously analyzed in the final safety analysis report, and

3. Require licensees to report to the NRC whether and to what extent they have complied with the actions requested in this bulletin.

Also, the bulletin requested that licensees determine whether current activities were within the licensing basis.

PNPP letter PY-CEI/NRR-2053L, dated May 13, 1996, provided the information required by NRCB 96-02. In a letter dated April 22, 1998, the NRC informed PNPP that the PNPP response to NRCB 96-02 was acceptable and therefore, TAC No. M95625 was closed.

In October 2005, the NRC issued Regulatory Issue Summary (RIS) 2005-25 followed by Supplement 1 on May 29, 2007. The purpose of RIS 2005-25 was to reemphasize the need to follow <NUREG-0612> guidelines, and identify issues associated with inconsistent licensing bases, calculation methodologies, assumptions and predicted consequences of load drop events throughout the industry and issues associated with upgrade of existing non-single-failure-proof cranes to meet the single-failure-proof criteria of <NUREG-0554>.

In September, 2007, the Nuclear Strategic Issues Advisory Committee approved an industry initiative to address the NRC concerns identified in RIS 2005-25 and its supplement. In July 2008, NEI 08-05 was issued to provide generic industry guidance for plants to use to ensure that heavy loads lifts continue to be conducted safely and that plant licensing bases accurately reflect plant practices. Specifically, NEI 08-05 provides criteria for performing vessel head load drop analyses and criteria for classification of existing cranes use for reactor vessel head lifts as equivalent to single-failure-proof cranes meeting <NUREG-0554>. In addition, NEI 08-05 requires and provides guidance for updating the plant FSAR to provide a summary description of the basis for conducting safe heavy load movements.

In letters from W. Ruland (NRC) to T. Houghton (NEI) dated May 16 and May 27, 2008, the NRC endorsed the NEI 08-05 guidelines as acceptable for implementation of the industry initiative and changes to plant licensing bases.

On September 5, 2008, the NRC issued a Safety Evaluation (SE) formally endorsing NEI 08-05 with the exception that the NRC staff considers the acceptance criteria of Appendix F to the ASME Boiler and Pressure Vessel (B&PV) Code, Section III, Division 1, appropriate for evaluation of coolant retaining component performance following a postulated reactor vessel head drop. The NRC has noted in the SE "The approval of the NRC staff may be important for licensees that conclude use of an NRC approved method would allow implantation of the initiative without a license amendment, pursuant to the requirements of <10 CFR 50.59>."

On December 1, 2008, the NRC issued RIS 2008-28 to notify industry that the guidance of NEI 08-05, as clarified by the NRC's September 2008 SE, may be used as methods approved by the NRC staff for evaluating changes to a facility's licensing basis related to reactor vessel head and other heavy load lifts.

To address concerns identified in RIS 2005-25, PNPP has performed a new plant specific head drop analysis that follows the NEI 08-05 guidance for reactor vessel head drop analyses. This new evaluation is intended to supplement the generic analyses provided in GE report NEDE-25525 (as applied to Perry in GE letter dated 9/17/1981), which was the prior PNPP design basis calculation for vessel head drop.

9.1.5.2 Safety Basis

The risk associated with load handling failures at PNPP is acceptably low based on:

- PNPP compliance with the <NUREG-0612> Phase I guidelines.
- The PNPP-specific reactor vessel head load drop analysis performed in accordance with the NRC-endorsed NEI 08-05 vessel head drop evaluation criteria demonstrates that fuel within the core remains covered and cooled.
- PNPP procedures control movement of heavy loads over plant SSCs required for plant shutdown, decay heat removal, and loads over irradiated fuel.

9.1.5.3 Scope of Heavy Load Handling Systems

The scope of heavy load handling systems applies to the Reactor Building Polar crane, Fuel Handling Building (FHB), Emergency Service Water (ESW) pump house, Radwaste overhead cranes, and numerous monorails in the safety-related areas of the plant. Refer to <Section 9.1.4.2.2> for crane descriptions. GAI Report No. 2329, "Control of Heavy Loads Study – Perry Nuclear Power Plant Units 1 and 2," Revision 2 provides the preapproved load paths and load handling system for major plant equipments.

9.1.5.4 Control of Heavy Loads Program

The Control of Heavy Loads Program consists of the following:

1. PNPP response to <NUREG-0612>, Phase I guidelines.

2. For reactor vessel head lifts, a new plant specific load drop analysis that meets the criteria of NEI 08-05 was performed. The analysis demonstrates that the reactor pressure boundary is not breached and that the fuel remains fully covered. Design inputs to this analysis which define the acceptable bounds of the load drop (i.e., lift height, load weight and medium present) were assumed to be beyond worst-case such that these design inputs bound what is physically possible in the plant.

3. PNPP design configuration prevents overhead crane and spent fuel cask to travel over irradiated fuel pool.

9.1.5.4.1 Licensee Response to <NUREG-0612>, Phase I Elements

<NUREG-0612>, <Section 5.1.1> (<NUREG-0612>, Phase I) requires compliance with the following seven criteria. These criteria are identified below with a brief description and/or reference to PNPP controlled documents which provide details regarding how each criterion is implemented at PNPP.

1. Definition of Safe Load Path - Safe Load Paths are defined for major pieces of equipment in GAI Report No. 2329, "Control of Heavy Loads Study – Perry Nuclear Power Plant Units 1 and 2," Revision 2 and in the Perry Plant Equipment Removal Scheme. PNPP procedure for "Control of Lifting Operations" requires heavy load movements to be conducted using the safe load path requirements within the Heavy Load Study and/or the Perry Plant Equipment Removal Scheme. The procedure requires that any load path deviating from or not addressed in the Heavy Load Study or Plant Equipment Removal Scheme

safe load paths be evaluated via a documented Engineering evaluation and a <10 CFR 50.59> review, as required.

2. Development of Load Handling Procedures - PNPP Procedure for "Control of Lifting Operations," has been developed to provide for control and handling of heavy loads and load over irradiated fuel. PNPP procedures, Control of Heavy Loads Study, and Equipment Removal Scheme covers handling of the loads in <Table 3-1> of <NUREG-0612> and includes:

   - Identification of required equipment and rigging devices,
   - Inspections and acceptance criteria required before movement of load, when required,
   - The steps and proper sequence to be followed in handling the load,
   - Definition of the safe load path, and
   - Other special precautions.

3. Qualifications, training and special conduct of crane operators are addressed in PNPP "Control of Lifting Operations" Procedure.

4. PNPP "Control of Lifting Operations" procedure requires special lifting devices to meet the requirements of ANSI N14.6-1978. In addition, as required in <NUREG-0612>, the procedure requires that special lifting devices be designed for combined static and dynamic loads imparted on the lifting device based on crane characteristics.

5. PNPP "Control of Lifting Operations" procedure requires lifting devices not specially designed are manufactured in accordance with the guidelines of ANSI/ASME B30 Series.

6. PNPP procedures require the Reactor Building polar crane, Fuel Handling Building crane, the Emergency Service Water Pump House

cranes and Radwaste Building crane are inspected in accordance with Chapter 2-2 of ANSI B30.2-1976.

7. Perry cranes used to lift heavy loads within the jurisdiction of <NUREG-0612> have been designed to meet CMAA-70, "Specifications for Electric Overhead Travelling Cranes," and ANSI B30.2-1976, "Overhead and Gantry Cranes" <GAI Report 2329, "Control of Heavy Loads Study – Perry Nuclear Power Plant Units 1 and 2">. As discussed in <Section 9.1.4.2.2.2>, Fuel Handling Area Crane, the design of the hoist for this crane's main hook that handles spent fuel casks has been upgraded to single-failure-proof in accordance with applicable guidelines of NRC <NUREG-0554> (Single-Failure-Proof Cranes for Nuclear Power Plants, May 1979) and NRC <NUREG-0612> (Control of Heavy Loads at Nuclear Power Plants, July 1980) [(Appendix C) of <NUREG-0612> applies to upgrade of existing cranes to single-failure-proof] to support spent fuel dry storage cask handling activities. The Fuel Handling Area Crane continues to comply with the requirements of CMAA-70, Specifications for Electric Overhead Travelling Cranes, 1975.

9.1.5.4.2 Reactor Pressure Vessel Head (RPVH) Lifting Procedures

PNPP procedures are used to control the lift (removal and installation) of the drywell head, reactor pressure vessel head, and reactor pressure internals. These procedures, existing load drop analysis and an additional supplementary analysis for the reactor head load drop analysis, prepared using the guidance and acceptance criteria of NEI 08-05 Industry Initiative on Control of Heavy Loads, provide additional assurance that the reactor pressure boundary is not breached and the core will remain covered and cooled in the unlikely event of a postulated reactor pressure vessel head drop.

Beyond worst-case assumptions were used in the supplementary load drop analysis as follows. The assumed load drop height of 40 feet is higher than the reactor polar crane is physically capable of lifting the head, the assumed load of 125 tons is greater than the actual lift weight of the combined vessel head, strongback, nut rack, tensioner carousel and lift block (approximately 118 tons) and the drop is conservatively assumed to occur totally in air such that the calculation takes no credit for fluid drag. Accordingly, since assumptions in the revised load drop analysis bound the worst case actual conditions, these assumptions are not identified as limitations in vessel head lifting procedures.

9.1.5.4.3 Single Failure Proof Crane for Handling Spent Fuel Casks

The original Fuel Handling Building crane furnished by P&H Harnischfeger did not meet current guidelines for designation as "single-failure-proof". The crane has a main hook rated for 125 tons that was originally qualified to "single-failure-proof" based upon NRC <Regulatory Guide 1.104> [Overhead Crane Handling Systems for Nuclear Power Plants, February 1976 (Withdrawn August 16, 1979)]. As discussed in <Section 9.1.4.2.2.2>, the crane was modified to comply with current guidelines for designation of the hoist for the main hook as single-failure-proof, including applicable guidelines of NRC <NUREG-0554> (Single-Failure-Proof Cranes for Nuclear Power Plants, May 1979) and NRC <NUREG-0612> (Control of Heavy Loads at Nuclear Power Plants, July 1980) to support spent fuel dry storage cask handling activities.

9.1.5.5 <u>Safety Evaluation</u>

Heavy loads are controlled and performed safely at PNPP. The bases for this are:

- Heavy load controls defined in <NUREG-0612> Phase I elements make the risk of a load drop very unlikely,
- As discussed in <Section 9.1.4.2.2.2>, Fuel Handling Area Crane, the hoist for this crane's main hook that handles spent fuel casks

has been upgraded to single-failure-proof in accordance with applicable guidelines of NRC <NUREG-0554> (Single-Failure-Proof Cranes for Nuclear Power Plants, May 1979) and NRC <NUREG-0612> (Control of Heavy Loads at Nuclear Power Plants, July 1980) to support spent fuel dry storage cask handling activities. With the hoist for the crane's main hook qualified as single-failure-proof, a cask drop accident is not a credible event and need not be postulated.

- In the event of a postulated heavy load drop, the requirements of plant procedures and administrative controls provide defense-in-depth to ensure the consequences are acceptable. For the reactor pressure head load drop, the revised load drop analysis performed in accordance with the NRC endorsed and accepted guidance within NEI 08-05 demonstrated that the consequences of reactor head drop will not result in breach of reactor pressure boundary. The analysis includes beyond worst-case assumptions such that the assumed drop height, load weight and medium under the load bound the actual worst case physical conditions that can exist at PNPP.

9.1.6 REFERENCES FOR SECTION 9.1

1. TGBLA06A; General Electric Lattice Physics Method, DRF A00-05526, October 1994.

2. Programmed and Remote Systems Corporation (PAR) Document DC-3156-1 "Design and Fabrication Criteria, Spent Fuel Storage Racks," for Perry Nuclear Power Plant Unit 1 and Unit 2, Revision 2, dated November 30, 1979.

3. Gilbert Associates Inc. Report No. 2329, "Control of Heavy Loads Study" for Perry Nuclear Power Plant Unit 1 and Unit 2, Revision 2, dated January 7, 1983.

4. PY-NRR/CEI-0743L, "Exemption From <10 CFR 70.24> Regarding Criticality Monitoring System Requirements for New Fuel at Perry

Nuclear Power Plant," J.W. Roe (NRC) to R.A. Stratman (Centerior), September 26, 1994.

5. "Evaluation of the Perry High-Density Storage Rack k Infinity Criterion," S.G. Walters, May 31, 1995.

6. GE14 – Spent Fuel Storage Rack Criticality Analysis for the Perry Nuclear Power Plant GNF/DRF J11-03861-00-SFP Class III, December 2000.

7. NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel", Rev. 15, September 2005.

8. GE14 - Spent Fuel Storage Rack Criticality Analysis for the Perry Nuclear Power Plant GNF/DRF 0000-0062-4559-SFP Class III, Rev. 1, December 2006.

9. Global Nuclear Fuel Calculation: Criticality Safety Analysis - Safe Bundle Number (Rev. 00) March 8, 2004.

10. Calculation 3:36.12, latest revision.

11. CEI letter from Dalwyn R. Davidson to Darrell G. Eisenhut NRC, dated 6/19/1981.

12. CEI letter from Dalwyn R. Davidson to Mr. A. Schwencer (NRC), dated June 9, 1982.

13. CEI letter from Dalwyn R. Davidson to Mr. A. Schwencer (NRC), dated September 15¸ 1982.

14. CEI letter from Dalwyn R. Davidson (CEI) to Mr. A. Schwencer (NRC), dated November 8, 1982.

15. CEI letter from Murray R. Edelman to Mr. B. J. Youngblood (NRC), dated January 14, 1983.

16. PNPP Report G58-S-R-L-006, Perry Fuel Handling Building Crane <NUREG-0554> Conformance Matrix.

17. PNPP Procurement Specification PRS-3216, Material and Equipment Specification for Fuel Handling Building Crane Upgrade.

18. Calculation G58-H-HI-2083913, "Structural Analysis of Perry Lift Yoke"

19. Calculation G58-H-HI-2084111, "Structural Analysis Details for Perry Lift Yoke Extension"

20. Calculation G58-H-HI-2084138, "Structural Analysis of Zero Profile Transporter for Perry"

21. Calculation G58-H-HI-2115002, "Simulation of the Response of HI-STORM/HI-TRAC Stack Configurations Using ANSYS Finite Element Code"

22. Calculation G58-H-HI-2115007, "Seismic Stability Analysis of the ZPT Loaded with HI-STORM 100 Version B at the Perry Nuclear Power Plant"

23. Calculation G58-H-HI-2115012, "Simulation of the Response of Freestanding Loaded HI-TRAC Configurations at PNPP Using ANSYS"

24. Calculation G58-H-HI-2084206, "Structural Evaluation of the Perry Lift Yoke Extension Storage Brackets"

25. Calculation G58-H-H1-2094276, "Structural Evaluation of the Perry Mating Device"

26. Calculation G58-S-M-001, "Assessment of the Fuel Handling Building Crane Hoist Rope Clearance Within the Transfer Cask"

27. Calculation G58-S-SC-002, "Evaluation of the Fuel Handling Building Floor and Spent Fuel Pit for Cask Loads"

28. Calculation G58-S-SC-003, "Design of the Fuel Handling Building Rail Exterior Mat Extension"

29. Calculation 5:05.010, "Evaluation of the Fuel Handling Building Crane Rail Anchorage"

30. ACI 318-71, Building Code Requirements for Structural Concrete, American Concrete Institute, 1971.

31. Final Safety Analysis Report for HOLTEC International Storage and Transfer Operation Reinforced Module Cask System (HI-STORM 100 Cask System), HOLTEC International Report No. HI-2002444, Docket 72-1014, Revision 7, August 2008.

32. "GNF2 Perry Nuclear Power Plant Fuel Transition Criticality Safety Analysis," 0000-0168-3098-R1, January 2014.

33. "MCNP01A Comparison to MCNP05P for Perry Nuclear Power Plant (KL1) GNF2 Fuel Transition Criticality Safety Analysis," GE Hitachi Nuclear Energy, ECO-0010648, November 12, 2014.

34. GNF Report 0000-0062-4559-SFP, Revision 1, "GE14 Spent Fuel Storage Rack Criticality Analysis for PNPP," May 2017.

35. GNF Report 0000-0166-3098-R2, Revision 2, "PNPP GNF2 Fuel Transition Criticality Safety Analysis," May 2017.

TABLE 9.1-1

DUAL UNIT FUEL STORAGE SCHEDULE (MAXIMUM NORMAL HEAT LOAD)

	Event	Time (Hours)	Bundles Stored
1.	Unit 1 Shuts down (0 year)	0	
	Unit 1 First assembly removed	24	
	Unit 1 310th bundle removal	120	310
2.	Unit 1 Shuts down (1.5 year)	13,140	
	Unit 1 First assembly removed	13,164	
	Unit 1 310th bundle removed	13,260	620
3.	Unit 2 Shuts down (2.0 years)	17,520	
	Unit 2 First assembly removed	17,544	
	Unit 2 310th bundle removed	17,640	930
4.	Unit 1 Shuts down (3 years)	26,280	
	Unit 1 First assembly removed	26,304	
	Unit 1 309th bundle removed	26,400	1,239
(Cycles Continue As Above On 1.5 Year Intervals)			
5.	Unit 2 Shuts down (3.5 years)		1,548
6.	Unit 1 Shuts down (4.5 years)		1,857
7.	Unit 2 Shuts down (5.0 years)		2,166
8.	Unit 1 Shuts down (6.0 years)		2,475
9.	Unit 2 Shuts down (6.5 years)		2,784
10.	Unit 1 Shuts down (7.5 years)		3,093
11.	Unit 2 Shuts down (8.0 years)		3,402
(Sequential Reload)			
12.	Unit 1 Shuts down (9.0 years)	78,840	
	Unit 1 First assembly removed	78,864	
	Unit 1 309th assembly removed	78,960	3,711
13.	Unit 2 Shuts down (9.0 years + 340 hours)	79,180	
	Unit 2 First assembly removed	79,204	
	Unit 2 309th assembly removed	79,544	4,020

TABLE 9.1-1a

SINGLE UNIT FUEL STORAGE SCHEDULE (MAXIMUM NORMAL HEAT LOAD)

	Event	Time (Hours)	Bundles Stored
1.	Unit 1 Shuts down (0 year)	0	
	Unit 1 First assembly removed	24	
	Unit 1 310th bundle removal	120	310
2.	Unit 1 Shuts down (1.5 year)	13,140	
	Unit 1 First assembly removed	13,164	
	Unit 1 310th bundle removed	13,260	620
3.	Unit 1 Shuts down (3.0 years)	26,280	
	Unit 1 First assembly removed	26,304	
	Unit 1 310th bundle removed	26,400	930
(Cycles Continue As Above On 1.5 Year Intervals)			
4.	Unit 1 Shuts down (4.5 years)		1,239
5.	Unit 1 Shuts down (6.0 years)		1,548
6.	Unit 1 Shuts down (7.5 years)		1,857
7.	Unit 1 Shuts down (9.0 years)		2,166
(Cycles Continue As Above On 2.0 Year Intervals)			
8.	Unit 1 Shuts down (11 years)		2,475
9.	Unit 1 Shuts down (13 years)		2,784
10.	Unit 1 Shuts down (15 years)		3,093
11.	Unit 1 Shuts down (17 years)		3,402
12.	Unit 1 Shuts down (19 years)		3,711
13.	Unit 1 Shuts down (21 years)	183,960	
	Unit 1 First assembly removed	183,984	
	Unit 1 309th assembly removed	184,664	4,020

TABLE 9.1-2

DUAL UNIT FUEL STORAGE SCHEDULE (MAXIMUM ABNORMAL HEAT LOAD)

	Event		Time (Hours)	Bundles Stored
1.	Unit 1	Shuts down (0 year)	0	
	Unit 1	First assembly removed	24	
	Unit 1	308th bundle removal	120	308
2.	Unit 1	Shuts down (1.5 year)	13,140	
	Unit 1	First assembly removed	13,164	
	Unit 1	308th bundle removed	13,260	616
3.	Unit 2	Shuts down (2.0 years)	17,520	
	Unit 2	First assembly removed	17,544	
	Unit 2	308th bundle removed	17,640	924
(Cycles Continue As Above On 1.5 Year Intervals)				
4.	Unit 1	Shuts down (3.0 years)		1,232
5.	Unit 2	Shuts down (3.5 years)		1,540
6.	Unit 1	Shuts down (4.5 years)		1,848
7.	Unit 2	Shuts down (5.0 years)		2,156
8.	Unit 1	Shuts down (6.0 years)		2,464
9.	Unit 2	Shuts down (6.5 years)		2,772
10.	Unit 1	Shuts down (7.5 years)		3,080
11.	Unit 2	Shuts down (8.0 years)	70,080	
	Unit 2	First assembly removed	70,104	
	Unit 2	308th bundle removed	70,200	3,388
12.	Unit 1	Shuts down (8.0 years + 340 hrs)	70,420	
	Unit 1	First assembly removed	70,444	
	Unit 1	748th bundle removed	70,076	4,136[1]

NOTE:

(1) 116 bundles stored in upper containment pool of Unit 1.

TABLE 9.1-3

FUEL SERVICING EQUIPMENT

Component No.	Identification	Essential Classification[1]	Safety Classification[2]	Quality Group	Seismic Category
1	Fuel prep machine[5]	PE	3	E[3]	I
2	New fuel inspection stand[5]	PE	3	E	I
3	Channel bolt wrench	NE	0	E	NA[4]
4	Channel handling tool	NE	0	E	NA
5	Fuel pool sipper	NE	0	E	NA
6	Channel gauging fixture	NE	0	E	NA
7	General purpose grapple[5]	PE	2	E	I
8	Deleted				
9	Fuel handling platform[5]	PE	2	E	I
10	Channel handling boom	NE	0	E	NA
11	4-Bundle Rack	PE	2	E	I
12	New Fuel Unloading Stand	PE	2	E	I

NOTES:

(1) NE - Non-essential
PE - Passive essential
(2) 0 - Not Safety Class 1, 2 or 3
(3) E - Industrial code applies
(4) NA - Not applicable
(5) Will be subject to the pertinent provisions of <10 CFR 50, Appendix B>, during the operations phase.

TABLE 9.1-4

FUEL TRANSFER SYSTEM COMPONENTS

Component No.	Identification	Essential Classification[1]	Safety Classification[2]	Quality Group[3]	Seismic Category[4]
1	Winch	NE	0	E	NA
2	Hydraulic power supply	NE	0	E	NA
3	Fluid stop	NE	0	E	NA
4	Vent pipe	NE	0	D	NA
5	Cable enclosures	NE	0	D	NA
6	Top horizontal guide arms	NE	0	E	NA
7	Upper pool upender	NE	0	E	NA
8	Trunnion box	NE	0	D	NA
9	Hydraulic cylinder	NE	0	E	NA
10	Upper pool framing	NE	0	E	NA
11	Sheave box cover	NE	0	D	NA
12	Hydraulic cylinder	NE	0	E	NA
13	Fill valve	NE	0	D	NA
14	Sheave box	NE	0	D	NA
15	Sheave pipe	NE	0	D	I

TABLE 9.1-4 (Continued)

Component No.	Identification	Essential Classification[1]	Safety Classification[2]	Quality Group[3]	Seismic Category[4]
16	Hydraulic cylinder	NE	0	E	NA
17	Manual gate valve	NE	0	D	I
18	Containment isolation[5]	PE	2	B	I
19	Containment bellows[5]	PE	2	B	I
20	Transfer tube[6]	NE	0	D	I
21	Hydraulic power supply	NE	0	E	NA[4]
22	Mid-support	NE	0	D	I
23	Wire rope (cables)	NE	0	E	NA
24	Carriage	NE	0	E	NA
24A	Tilt tube	NE	0	E	NA
24B	Follower	NE	0	E	NA
25	Gate valve	NE	0	D	I
26	Bellows	NE	0	D	NA
27	Drain valve[6]	NE	0	D	I
28	Horizontal guide arms	NE	0	E	NA
29	Valve support structure	NE	0	D	I
30	Lower pool framing	NE	0	E	NA

TABLE 9.1-4 (Continued)

Component No.	Identification	Essential Classification[1]	Safety Classification[2]	Quality Group[3]	Seismic Category[4]
31	Lower pool upender	NE	0	E	NA
32	Pivot arm framing	NE	0	E	NA
33	Control system	NE	0	I	NA
34	Local leak rate test valve[6]	NE	0	D	I
35	Drain pipe[6]	NE	0	D	I

NOTES:

(1) NE - Non-essential
PE - Passive essential
(2) 0 - Not Safety Class 1, 2, or 3
(3) B - ASME Code Section III, Class 2
D - ANSI B31.1
E - Industrial code applies
I - Electrical codes apply
(4) NA - Not applicable
I - Seismic Category I
(5) Will be subject to the pertinent provisions of <10 CFR 50, Appendix B>, during the operations phase.
(6) Will be subject to the pertinent provisions of <10 CFR 50, Appendix B>, during the operations phase, if the containment isolation blind flange (Component No. 18) is removed. In this case: these components are necessary to provide and maintain containment integrity.

TABLE 9.1-5

REACTOR VESSEL SERVICING EQUIPMENT

Component No.	Identification	Essential Classification[1]	Safety Classification[2]	Quality Group[3]	Seismic Category[4]
1	Reactor Vessel Servicing Tools	NE	0	E	NA
2	Steam Line Plug	PE	2	E	I[6]
3	Shroud Head Bolt Wrench	NE	0	E	NA
4	Head Holding Pedestal[5]	PE	0	E	I
5	Head Stud Rack	NE	0	E	NA
6	Dryer and Separator Strongback[5]	PE	1	E	I
7	Head Strongback Carousel[5]	PE	0	E	NA[7]
8	Temporary Isolation Devices[8]	PE	0	E	NA

NOTES:

(1) NE - Non-essential
PE - Passive essential
(2) 0 - Not Safety Class 1, 2 or 3
(3) E - Industrial codes apply
(4) NA - Not applicable
(5) Will be subject to the pertinent provisions of <10 CFR 50, Appendix B>, during the operations phase.
(6) Seismically qualified by static evaluation.
(7) The Head Strongback Carousel was not designed for seismic loads by the equipment supplier (General Electric). However, the Test Load used for proof load testing by the equipment supplier was sufficient to account for the seismic load from the RPV head.

TABLE 9.1-5 (Continued)

NOTES:

(8) These devices (such as N1 and N2 Nozzle plugs) used for maintenance activities used to block flow from the RPV during refueling are controlled by Technical Specification 3.5.2, RPV Water Inventory Control, and must be able to prevent an RPV draining event below TAF. Reference Technical Specification 3.5.2 Bases for additional detail.

TABLE 9.1-6

UNDER-REACTOR VESSEL SERVICING EQUIPMENT AND TOOLS

	Equipment/Tool	Classification	Safety Class	Seismic Category
1.	CRD handling equipment	Non-essential	NSC[1]	NA[2]
2.	Equipment handling platform	Non-essential	NSC	NA
3.	Water seal cap	Non-essential	NSC	NA
4.	Thermal sleeve removal tool	Non-essential	NSC	NA
5.	In-core flange seal test plug	Non-essential	NSC	NA
6.	Key bender	Non-essential	NSC	NA

NOTES:

(1) NSC - Nonsafety class
(2) NA - No seismic requirements

TABLE 9.1-7

TOOLS AND SERVICING EQUIPMENT

a. Fuel Servicing Equipment

Channel handling boom
Fuel preparation machines
New fuel inspection stand
Channel bolt wrenches
Channel handling tool
Fuel pool sipper
Fuel assembly sampler
Channel gauging fixture
General purpose grapples
Fuel handling platform
Incline fuel transfer system grapple

b. 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

c. Reactor Vessel Servicing Equipment

Reactor vessel servicing tools
Steam line plugs and installation tools
Shroud head bolt wrenches
Head holding pedestals
Head stud rack
Dryer-separator strongback
Head strongback/carousel (incl. stud tensioners

d. In-Vessel Servicing Equipment

Instrument strongback
Control rod grapple
Control rod guide tube grapple
Fuel support grapple
Grid guide
Control rod latch tool
Instrument handling tool
Control rod guide tube seal
In-core guide tube seals
Blade guides
Fuel assembly sampler
Peripheral orifice grapple
Orifice holder
Peripheral fuel support plug

e. Refueling Equipment

Refueling platform
Auxiliary platform

f. Storage Equipment

Fuel storage racks
Channel storage racks
Control rod storage racks
Defective fuel storage containers
In-vessel racks
Defective fuel storage racks
Control rod guide tube rack
Equipment storage rack

TABLE 9.1-7 (Continued)

g. Under-Reactor Vessel Servicing Equipment

Control rod drive servicing tools
CRD hydraulic system tools
Water seal cap
Control rod drive handling equipment
Equipment handling platform
Thermal sleeve installation tool
In-core flange seal test plug key bender

9.2 WATER SYSTEMS

9.2.1 EMERGENCY SERVICE WATER SYSTEM

9.2.1.1 Design Bases

The Emergency Service Water System (ESW) is designed to provide a reliable source of water to safety-related components required for certain modes of normal reactor operation, as well as for accident conditions and loss of normal auxiliary power. No operator action is required during the first ten minutes following a loss-of-coolant accident. Specific components supplied with emergency service water are listed in <Table 9.2-1>, <Table 9.2-3>, <Table 9.2-5> and <Table 9.2-7>.

The Emergency Service Water System (ESW) is capable of supplying water to:

a. Flood the containment for postaccident recovery (loop B only).

b. Provide emergency makeup to the fuel pool cooling and cleanup system surge tank (loops A and B).

c. De-ice the emergency service water pumphouse traveling screens (loops A and B).

d. Provide emergency makeup to the emergency closed cooling system surge tanks (loops A and B).

e. Provide a seismic backup water supply to fire protection system (loops A and B).

f. Provide backup water supply to standby liquid control auxiliary mixing tank (loop B only).

g. Provide emergency makeup source for the diesel jacket water cooling systems (Div. 1 and Div. 2).

<Table 9.2-1>, <Table 9.2-3>, <Table 9.2-5>, and <Table 9.2-7> define the system requirements for the various modes of operation.

The system is designed to have a "keep fill" feature to prevent drainage from the system piping during the time the system is shutdown. This feature prevents water hammer transients, during system startup, due to air pockets in the piping.

The emergency service water system is designed as three separate open loops, "A", "B" and "C," each taking its suction directly from Lake Erie. Sufficient quantity of water is provided at the pump intake structure to satisfy requirements for all modes of operation, with consideration given to operation under high and low water level conditions.

The system is designed such that the occurrence of any single active or passive failure will not reduce the safety-related functional performance of the Emergency Core Cooling System (ECCS). The Emergency Service Water System is capable of supplying cooling water to the equipment on any two of the three emergency service water loops, following a single failure. The applicable safety class for all Emergency Service Water System equipment is Safety Class 3, except for the equipment that interfaces with the Residual Heat Removal System, which is Safety Class 2 (Containment Flooding Mode). The appropriate seismic criteria are Seismic Category I. The code for pumps, piping, valves, and strainers is ASME Boiler and Pressure Vessel Code, Section III-3, Nuclear Power Plant Components.

The total system is designed to conform to <Regulatory Guide 1.48>. Conformance with regulatory guides is discussed in <Section 1.8>. Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with Branch Technical Position ASB3-1 is discussed in <Section 3.6>.

Low water considerations are discussed in <Section 2.4.11.5>. Heat sink dependability requirements are discussed in <Section 2.4.11.6>.

Dispersion, dilution and travel times of accidental releases of liquid effluents in surface waters is discussed in <Section 2.4.12>.

9.2.1.2 System Description

The emergency service water system is comprised of independent Loops A, B and C <Figure 9.2-1>.

The loops are defined as follows, with each loop supplying emergency service water to the equipment listed.

Loop A	Loop B	Loop C
a. RHR Heat Exchangers A & C	a. RHR Heat Exchangers B & D	a. HPCS Diesel Generator Heat Exchanger
b. Standby Diesel Generator A	b. Standby Diesel Generator B	b. HPCS Pump Room Cooler
c. Emergency Closed Cooling Heat Exchanger A	c. Emergency Closed Cooling Heat Exchanger B	
d. Fuel Pool Cooling Heat Exchanger A	d. Fuel Pool Cooling Heat Exchanger B	

These open loops take suction from Lake Erie. Each loop is supplied by a separate pump which is operated from a preferred power source or a standby power source (diesel-generator). <Section 8.3> gives a description of the preferred and standby power sources. The system incorporates the redundancy required of safety-related systems with regard to the power supply and equipment. In this manner, the operational objectives of the emergency core cooling system (ECCS) are satisfied. Redundancy characteristics are discussed in greater detail in <Section 9.2.1.3>.

Initiation of the emergency service water system is accomplished by automatic signal or remote-manual action, depending upon the operational requirements. Specifically, all loops of the system are initiated automatically by LOCA signals or by loss of power to the associated 1E bus. Loop C is initiated automatically with the initiation of the HPCS system. Loop A is initiated automatically with the initiation of the RCIC system. Remote-manual action can be employed at any time, but is not necessary for normal over-all plant operations.

Leakage containing radioactivity that could develop between the RHR system and the emergency service water system is detected by a radiation monitor on Loops A and B. On a “high” alarm signal, the affected loop of the system may be isolated by operator action from the control room.

As a contingency measure, the ESW system can be lined up to provide cooling water to the Fuel Pool Cooling and Clean Up Heat Exchangers (FPCC HXs as described in <Section 9.2.2.6>). Under normal operations, any tube failures in the FPCC Hxs will be identified by the Nuclear Closed Cooling radiation monitors and can be repaired expeditiously. Thus, it is unlikely that tube leaks will exist in the FPCC Hxs at the time ESW is valved into the FPCC Hxs. When in this configuration, periodic sampling is done to monitor for any radioactive leakage. In the unlikely event the FPCC Hxs are lined up with ESW and also develop a tube leak some potentially contaminated water could leak into the ESW system. The affected FPCC HX can be isolated, if necessary, from the ESW system upon detection of any leakage.

Each loop is equipped with various indications of pressure, temperature, and flow in addition to alarms on the pump and other major components of the system. These indications are monitored in the control room to substantiate that the emergency service water system is performing its intended function.

The emergency service water pumps, located in the emergency service water pumphouse, are of the vertical type. Emergency service water to the pump intake structure is taken from Lake Erie. The primary source of water to the emergency service water pumphouse is supplied by a branch tunnel taken off the main intake tunnel to the service water pumphouse. A backup supply is available by means of a branch tunnel from the main discharge tunnel. Self-cleaning strainers on the pump discharge minimize the entrance of foreign particles 0.0625 in. and larger into the system. The available NPSH is calculated based upon the conditions of low water level, emergency service water temperature and pressure of 85°F and 14.7 psia, respectively, and maximum system flow requirements.

Should normal emergency service water (ESW) supply from the intake tunnel be interrupted, sluice gates open automatically upon receiving a low water level signal from the ESW pumphouse forebay, allowing water from the discharge tunnel to flow into the forebay and supply the ESW system. Upon indication on a control room panel that the sluice gates are open, manual valves will be administratively closed to prevent warm ESW from dumping to the discharge tunnel. Leaving the manual valves open would create a recirculation loop that would cause an undesirable increase to the ESW forebay water temperature. With the manual valves closed, the ESW system discharges to the swale. Upon restoration of normal supply from the intake tunnel, the sluice gates are administratively closed and the valves are administratively opened to restore normal system operation.

During maintenance activities or other plant evolutions that require a sluice gate to be open, the ESW system will be pre-aligned for swale discharge for the following reason. If an ESW sluice gate is open during accident mitigation with the ESW pumps removing accident heat loads, the ESW inlet temperature will eventually rise above its design basis limit of 85°F if the ESW system has not been pre-aligned to discharge to the swale. Time does not permit for manual operator actions to be taken to close the sluice gates for all potential accident conditions, radiological conditions may not permit for manual alignment to the swale, and operator actions to assist in mitigating the postulated accident are not assumed.

The sluice gates provide a barrier between the discharge tunnel and the ESW pumphouse forebay to prevent recirculation of plant discharge water thereby maintaining the ESW forebay at or below its maximum allowable temperature of 85°F during all modes of plant operation including accident and transient mitigation. The inflated sluice gate seals also form part of this barrier when elevated lake temperature may cause the ESW forebay to approach its design temperature limit. During the summer months, the seals are required to be inflated and the sluice gate automatic opening feature is disabled. Inflation of the seals and the disabling of the sluice gate automatic opening feature will be limited to no more than five months per year, when elevated lake temperatures may cause the ESW forebay temperature to approach its maximum allowable design limit of 85°F. This operational configuration is deemed to be acceptable since it has been demonstrated that the probability of losing the normal intake tunnel is extremely low during the five-month period when the alternate ESW intake would be unavailable. This justification is consistent with <Regulatory Guide 1.27> regarding the requirement for an alternate intake. The closed ESW sluice gates and the inflated sluice gate seals perform a safety related function by providing the barrier that prevents mixing of the ESW pump inlet and plant discharge flows.

<Table 9.2-1>, <Table 9.2-3>, <Table 9.2-5>, and <Table 9.2-7> indicate the estimated heat loads dissipated to the emergency service water system for the various operating modes. The major heat load to the system is derived from the RHR heat exchangers. Approximate RHR heat

exchanger outlet temperatures, based on the maximum expected emergency service water temperature of 85°F, are listed in <Table 9.2-9>. Performance of the RHR heat exchangers is determined by monitoring the inlet flow in the control room. A low flow alarm indicates insufficient flow. Temperature elements on the heat exchanger outlets are also provided. The parameters of cooling water flow and temperature observed during normal shutdown give the operator sufficient tube side data to determine RHR heat exchanger function. Additionally, the heat exchanger performance is periodically assessed per the commitments to <Generic Letter 89-13>.

Emergency service water, loop B only, is interconnected to RHR loop B. This arrangement provides a water supply to flood the containment for postaccident recovery.

A liquid biocide injection system is used, as required, to minimize algae and plant growth. This is done on a regular basis at each individual pump suction. Sample points are provided in the discharge piping to determine biocide concentrations. Discharged effluent water quality will be maintained in accordance with Perry's National Pollution Discharge Elimination System (NPDES) permit.

Loops A and B, emergency service water piping is provided to supply a Seismic Category I source of emergency makeup water to the respective A and B surge tanks associated with the emergency closed cooling systems and the fuel pool cooling systems. Failure of the normal non-seismic makeup system has no effect on the ability to provide makeup water to the emergency closed cooling system or the fuel pool cooling system from the Seismic Category I system.

The emergency service water discharge piping from the auxiliary building empties into the discharge tunnel entrance structure. A standpipe on the discharge piping inside the auxiliary building discharges to the yard outside the auxiliary building. In the event of a collapse or blockage of the non-seismic portion of the discharge tunnel piping, the standpipe serves as an alternate discharge point in the system.

The standpipe “A”, “B” and “C” Loops are the system highpoints and provide inlet for a “keep fill” function to prevent air pockets forming in the piping due to leakage from the system when it is shutdown in the standby mode of operation. An interconnection with the normally operating service water system provides makeup water to the standpipe to compensate for system leakage and maintains the water levels in the standpipe. Pressure gauges are located on the standpipes, so indication of adequate standpipe water fill is available.

A connection off the ESW system B loop is provided to accept a 1-1/2 inch fire hose which can be connected to the standby liquid control transfer system. This arrangement is to provide an emergency backup water supply to the standby liquid control auxiliary mixing tank.

The ESW system is provided with connections to the fire protection system. This arrangement provides a backup water supply to hose stations in the vicinity of safety shutdown equipment.

The emergency service water piping from the emergency service water pumphouse to the plant is buried as shown on <Figure 9.2-2 (1)> and <Figure 9.2-2 (2)>. The piping is protected by a primer, followed by coal tar enamel and approved wraps. This is then electrically inspected for gaps in the piping protection in accordance with American Water Works Association C-203 before water resistant white wash is applied. In addition, cathodic protection is used. Backfill is equally distributed on both sides of the pipe and tamped in layers from 4 to 12 inches. Backfill of the trench is free of undesirable material such as rocks, debris, etc. and is of composition suitable for firm compaction.

Piping is founded on bearing materials as indicated in <Section 2.5.4>. The buried pipe is designed to provide the capability for rotation and extension in joints between buildings and anchor points to preclude damage to the piping system. Various load combinations include seismic loadings and significant soil settlements. The design also considers differential movement of the buildings. Joints which allow for differential movement at the connection to a structure are installed immediately adjacent to the structure. Movement and rotational allowance is provided in the several joints to compensate for the differential movement of two structures or between structure and ground. The articulated piping joints have limit stops to prevent joint separation during extension or rotation. Where the emergency service water piping crosses the circulating water piping, provisions are made to preclude a loss of support due to washout.

Adequate physical separation is provided between the emergency service water piping associated with the three ESF divisions. This is accomplished by having no two lines adjacent to each other.

The design of the emergency service water system considers the effects of surface loads on buried pipe. The following maximum surface loads are established for design of the pipe:

a.	Railways	Cooper E70 locomotive
b.	Reactor haul road	100 psi tire pressure or 75 psi distributed load (over 10 ft x 40 ft)
c.	Plant and access roads	H-20 live load
d.	All other portions of buried pipe (based on construction equipment loads)	50 psi tire pressure

To ensure that icing of the traveling screens poses no problem to system operation, de-icing lines are installed from the respective A and B loops for emergency service water outlets to the pump forebay area. In this manner, redundancy is always available to accomplish the de-icing function. Manual valves are located on the de-icing lines where they take-off from the normal discharge lines. The plant operator may open these valves as conditions require.

To prevent freezing of emergency service water piping, the pumphouse is maintained at a temperature no lower than 40°F. In addition, buried portions of the piping are located at a sufficient depth below the frost line.

Details for the emergency service water system pumps are listed in <Table 9.2-10>. The conditions upon which the design for these pumps is based are listed in <Table 9.2-11>.

The pumps are designed and constructed to Safety Class 3 and Seismic Category I requirements. Assurance of operability requirements given in <Regulatory Guide 1.48> apply. The pumps meet the requirement of a minimum of 30 day continuous operation following an SSE or OBE.

The emergency service water strainers are designed and constructed to Safety Class 3 and Seismic Category I requirements. Details for these strainers are listed in <Table 9.2-12>.

Traveling screens are designed to meet the requirements for Safety Class 3 and Seismic Category I equipment. Applicable construction and design codes are:

a. ASME B&PV Code, Section III, Nuclear Power Plant Components.

b. AISC Specifications for Design, Fabrication and Erection of Structural Steel for Buildings - 1969.

Details for the traveling screens are listed in <Table 9.2-13>.

The emergency service water system during any mode of operation provides cooling to all equipment, whether cooling water is required or not. No reliance is made on automatic flow control valves. System flow is initially balanced and the manually operated butterfly or globe valves are controlled administratively in their respective positions. This facilitates system operation and minimizes the possibility of system malfunction.

The emergency service water system is available for the modes of plant operations specified in <Table 9.2-1>, <Table 9.2-3>, <Table 9.2-5>, and <Table 9.2-7> and meets the flow requirements listed. The description of operational modes of this system is:

a. Hot Standby

Should the reactor be isolated from the turbine steam condenser, emergency service water is available to the following:

1. RHR Heat Exchangers

Emergency service water is available so that the RHR heat exchangers can maintain the suppression pool temperature within acceptable limits by direct cooling.

2. Standby Diesel Generators and HPCS Diesel Generator

For the hot standby mode accompanied by a loss of normal ac power, cooling water is required to dissipate heat from the diesel generators.

3. Emergency Closed Cooling Heat Exchangers

The cooling water on the primary side of these heat exchangers is required for the RHR room coolers when the RHR system is required to directly cool the suppression pool. In addition, the ECC system is used to cool the "A" and "B" Control Complex chillers.

4. Fuel Pool Cooling Heat Exchangers

With a loss of preferred ac power, and loss of NCC, the ESW system can be manually aligned to the FPCC heat exchangers by opening valves to provide cooling to the fuel stored in the spent fuel storage pools.

5. HPCS Room Cooler

HPCS room cooling is required if the HPCS pump operates to maintain reactor vessel water inventory.

b. Normal Shutdown

Normal shutdown of the reactor plant requires that emergency service water be supplied to the following:

1. RHR Heat Exchangers

Emergency service water to the RHR heat exchangers is required to remove residual heat from the nuclear boiler system in preparation for refueling or system maintenance.

2. Emergency Closed Cooling Heat Exchangers

The primary cooling water side of these heat exchangers is required for the RHR pumps and RHR room coolers since the RHR system is required for normal plant shutdown.

c. Postaccident (With Loss of Preferred AC Power)

For postaccident conditions emergency service water is supplied to the following:

1. <u>RHR Heat Exchangers</u>

   The LPCI function of the RHR system requires the operation of the RHR heat exchangers for removal of decay heat from the reactor vessel.

2. <u>Standby Diesel and HPCS Diesel Generator</u>

   The diesel generators are required for this condition and, therefore, require adequate emergency service water cooling.

3. <u>Emergency Closed Cooling Heat Exchangers</u>

   The primary side of these heat exchangers supplies the necessary cooling water to the ECCS and RCIC equipment, associated room coolers, and the control complex chillers.

4. <u>Fuel Pool Cooling Heat Exchangers</u>

   The ESW system is manually aligned to provide cooling to the fuel stored in the spent fuel storage pools.

5. <u>HPCS Room Cooler</u>

   As part of the ECCS network the HPCS room cooler is supplied with cooling water following a loss-of-coolant accident.

d. Support Testing

The emergency service water system is available to support any plant testing of equipment in which the system provides service water directly or indirectly. The initiation of the system is a manual operation and the frequency of operation is a function of the plant testing requirements. Support testing of other systems will be planned and performed so as not to impair or preclude the ability of the ESW system to perform its intended function.

9.2.1.3 Safety Evaluation

In general, the emergency service water system is classified as Safety Class 3 and Seismic Category I, with the primary safety function being to support the emergency core cooling system. At least one RHR heat exchanger train with 100 percent emergency service water flow is available to satisfy the performance objectives and the requirements for removal of decay heat from containment.

ESW System operation is intermittent over the full range of plant operations. To ensure the availability of this system, scheduled inspection of this equipment will be performed.

The ESW system consists of three entirely independent loops, A, B and C. Power for each loop is supplied from Class 1E electrical system. All loops are entirely independent with regard to system operation. Adequate physical separation is provided in pump location and piping.

The design of the ESW system pump forebay incorporates traveling screens for removing submerged debris that may have entered through the intake structure. The water inlet is located more than one quarter mile offshore and submerged more than 15’ below the surface of the lake. Referring to <Figure 3.8-65>, <Figure 3.8-66>, <Figure 3.8-67>, <Figure 3.8-68>, <Figure 3.8-69>, and <Figure 3.8-70>, it can be seen that in order for debris to enter the ESW pumphouse, the debris would have to be submerged to the elevation of the intake heads, travel approximately 100’ vertically downward, travel approximately 3,000’ almost horizontally and then rise vertically approximately 100’ to the ESW pumphouse. Also, the intake system is designed for an approach velocity of 0.5 fps which diminishes the uptake of debris. Because of these design features, it is highly unlikely that any significant amount of debris will enter the ESW pumphouse and clog the screens. Experience with the operation of ESW pumps prior to initial fuel load and during the first two years of commercial operation is supportive of this conclusion.

Two traveling screens are provided. Each screen has the capacity to supply water with all ESW pumps and fire protection pumps operating and still maintain a relatively low approach velocity minimizing debris accumulation and clogging potential. The maximum velocities were calculated assuming low lake level and 20’ of active screen height.

The ESW Screen Wash System (P49) traveling screens, P49-D001A and B, and their associated screen wash pumps, are automatically started electrically by a LOCA signal and will run continuously until the signal is cleared. The screen wash strainers are driven by 0.5 HP, nonsafety-related motors from safety-related power supplies. Therefore, these motors are prohibited from being operated electrically by the same LOCA signal discussed above. During a LOCA event, the screen wash strainer high differential pressure alarm will be monitored, and manual backwashing of the strainers will be performed as required. During a LOOP event, system logic and annunciator power are lost, necessitating a manual system startup. In the event of a LOCA concurrent with a LOOP, the traveling screens and their associated pumps will automatically start, and the screen wash strainers will be electrically prohibited from operating. P49 is only used as a spray to remove debris from the traveling screens, and is not as sensitive to flow rate as P45. For this reason, the backwashing of the P45 and P49 strainers can be done in series, with P45 being performed first.

The emergency service water strainers are driven by nonsafety-related motors from nonsafety-related power supplies. Manual backwash will, therefore, be required after a LOOP. Manual backwashing will be performed when required, as indicated by safety-related flow indication.

Major parameters, specifically radiation levels, pressure, temperature, and flow, are monitored in the control room. Appropriate alarms signal inconsistencies during system operation. Parameters of the A loop can also be monitored at the remote reactor shutdown panel. The operation of the A loop system is capable of initiation either automatically, manually from the control room, or manually from the remote shutdown panel. In addition, the loop B parameters can be monitored and initiated from the redundant remote reactor shutdown system, or manually initiated from the control room.

The system is designed for the various combinations of plant conditions and natural phenomena. It suffers no loss of safety functions under a loss-of-coolant accident and postulated earthquake condition. Also, the above criteria are met, assuming the following: a single failure within the system, the preferred power source is unavailable, and the safety function is accomplished using the standby power source.

The following failure analysis as it applies to the emergency service water system assumes a loss-of-coolant accident, a postulated earthquake condition and a loss of normal ac power. These assumptions will result in the greatest heat rejection rate to the ultimate heat sink. <Table 9.2-25> provides a listing of the ESW system cooling duty loads following a DBA.

The design of the emergency service water system is such that any two of the three loops are required for safe shutdown of the reactor. Each loop is part of a distinct ESF Division with no interdependency of loops present.

The design of the ESW system inlet and traveling screens is such that complete operability of the screen wash system (P49) is not required for the operability of the ESW system.

Electric power to the emergency service water system is such that Loops A, B and C receive power from ESF Division 1, Division 2 and Division 3, respectively.

In addition, the three loops of emergency service water system are adequately separated and protected to provide for the indirect consequences of pipe whip, jet forces and internally generated missiles. The emergency service water pumps are located in the emergency service water pumphouse. Their relative position is such that no two pumps of the same unit are adjacent to each other. The pumps are designed to operate at relatively low speeds, at low pressure and at low temperature. The pump motors, by construction, pose no potential missile threat. The pump impellers are located in the submerged portion of the column. Any missile threat created by a thrown impeller to incapacitate two pumps of the same unit is negated by the pump column, damping effects of the water, and separation of pumps. No experiences of missiles generated from a pump and motor assembly of this type are known. Also, potential missiles associated with the strainers, valving or piping within the pumphouse are not considered to exist.

Loops A, B and C must supply cooling water to equipment that is necessary for safe shutdown of the nuclear plant under the assumptions given for a single failure analysis. It can be concluded from the system design that:

a. A mechanical or electrical failure in the operation of any one ESW loop would not affect operation of the other two.

b. Operation of only two loops is sufficient to support necessary safety-related equipment. Therefore, by single failure criteria, no active or passive failure of any component within the emergency service water system would prevent safe shutdown of the reactor.

   Operation of ESW loop A or loop B alone will provide adequate cooling to the fuel pool cooling heat exchangers (except for a full core off-load as discussed in <Section 9.1.3.3>, thus allowing for the failure of loop A or loop B. The failure of loop C does not affect FPCC.

c. Operation of only one screen wash subsystem will ensure that one traveling screen is kept clean at all times. One screen is sufficient to provide the flow requirements for all ESW pumps and fire protection pumps.

d. If both screen wash subsystems become inoperable, there is a high degree of confidence that each traveling screen would remain clean for a period of at least 72 hours from the time its respective screen wash system became inoperable (reference: <10 CFR 50, Appendix R> deviations discussion in <Appendix 9A.7> G 8-6 and <Appendix 9A.7> G 8-7). There is more than sufficient time, therefore, to manually rotate screens and clean them using an alternate water supply as necessary.

Plant procedures require that the screens be inspected within 72 hours of a complete loss of the P49 backwash system and every 24 hours thereafter with manual cleaning being performed as necessary.

Radioactive leakage can develop in the RHR heat exchangers. Radiation monitors are provided to detect leakage into the emergency service water. Motor-operated isolation valves on the inlet and discharge lines to the RHR heat exchangers may be closed by operator action in the control room.

As a contingency measure, the ESW system can be lined up to provide cooling water to the Fuel Pool Cooling and Clean Up Heat Exchangers (FPCC HXs). Under normal operations, any tube failures in the FPCC Hxs will be identified by the Nuclear Closed Cooling radiation monitors and can be repaired expeditiously. Thus, it is unlikely that tube leaks will exist in the FPCC Hxs at the time ESW is valved into the FPCC Hxs. When in this configuration, periodic sampling is done to monitor for any radioactive leakage. In the unlikely event the FPCC Hxs are lined up with ESW and also develop a tube leak some potentially contaminated water could leak into the ESW system. The affected FPCC HX can be isolated, if necessary, from the ESW system upon detection of any leakage.

Over-pressurization protection is afforded on all heat exchangers by the use of relief valves. The discharge from each valve is routed to the nearest floor drain, except for the HPCS room cooler and the RHR heat exchangers. The discharge for the RHR heat exchangers is directed to the radwaste system. In addition, upstream of the first RHR heat exchanger equipment isolation valve, a relief valve is provided that discharges to the radwaste system. This valve affords over-pressure protection of the low pressure portion of the emergency service water piping. The discharge for the HPCS room cooler is returned to the line following the last equipment isolation valve.

9.2.1.4 Inspection and Testing Requirements

A preoperational test of the system was conducted in accordance with the provisions stated in <Chapter 14>. System pumps are operated on a regular scheduled basis to verify adequate performance and availability. Valves also are tested on a regularly scheduled basis and such capabilities as shutoff and flow control are of particular interest.

The instrumentation and controls associated with the ESW system undergo a program of periodic calibration inspection, and testing to verify accuracy and satisfactory operation.

A program of visual inspection is maintained. Attention is given to welded connections, leakage, corrosion, noise, vibration, etc.

Monitoring for possible flow blockage in the emergency service water system resulting from sources such as Asiatic Clams, will be accomplished through a program of lake water sampling, surveillance testing and maintenance inspections. A piping branch connection is provided for inspection of the buried Division 1 supply side piping.

9.2.1.5 Instrumentation Requirements

Local temperature indicators are provided on cooling water outlets of the standby diesel generator heat exchangers, HPCS room cooler and Loop C (HPCS) strainer. Local temperature indicators are provided on both the cooling water inlet and outlet of the HPCS diesel generator heat exchanger and emergency closed cooling heat exchangers.

RHR system temperature elements are provided on each (two temperature elements for each pair of heat exchangers) RHR heat exchanger cooling water outlet. These temperature elements provide signals to a temperature recorder in the control room. There are also temperature elements at the A&B Loop strainer outlet that provide signals to temperature indicators in the control room.

Temperature elements for local indication are provided on the cooling water inlet to both pairs of RHR heat exchangers, and HPCS room cooler. Temperature elements have been installed on the inlet and outlet cooling water piping of the RHR heat exchangers for performance testing.

Local pressure indicators are located on the upstream and downstream side of the ESW strainers. Pressure transmitters with a local indicator are provided on the pump discharge lines downstream of the system strainers. These pressure transmitters provide signals to pressure indicators and to low pressure alarms in the control room.

Differential pressure switches across the ESW strainers will start the strainer backwash operation on high ΔP.

Flow transmitters are provided on the cooling water outlets of the standby diesel generator heat exchangers, emergency closed cooling heat exchangers and HPCS diesel generator heat exchanger and on the RHR heat exchanger cooling water inlets. These flow transmitters provide signals to cooling water flow indicators in the control room for the ECC heat exchanger, HPCS diesel generator heat exchanger and RHR heat exchangers. Standby diesel generator heat exchanger cooling water flow is indicated on the diesel generator benchboard in the control room. Low flow alarms are provided in the control room for the ECC heat exchangers, HPCS diesel generator heat exchanger and RHR heat exchangers. Low flow alarms for the standby diesel generator heat exchangers are in the control room. A flow element and two pressure test connections are provided on the outlet of the HPCS room cooler for initial flow balancing. A flow element is provided on the inlet piping supplying the fuel pool cooling heat exchangers and bypass line.

Flow indication is provided on the remote shutdown panel for Loop A emergency closed cooling heat exchanger outlet flow and Loop A RHR heat exchanger inlet flow. Flow indication is provided on the redundant remote shutdown panel for Loop B emergency closed cooling water heat exchanger outlet flow and Loop B RHR heat exchanger inlet flow.

Local flow indication is provided on the suction side of the RHR heat exchanger tube side ESW drain pumps.

Radiation elements are provided on the RHR heat exchanger cooling water outlets (one monitor for each pair of heat exchangers). In the unlikely event there would be a leak from the RHR system into the ESW system, the radiation elements would detect the leak.

As a contingency measure, the ESW system can be lined up to provide cooling water to the Fuel Pool Cooling and Clean Up Heat Exchangers (FPCC HXs). Under normal operations, any tube failures in the FPCC HXs will be identified by the Nuclear Closed Cooling radiation monitors and can be repaired expeditiously. Thus, it is unlikely that tube leaks will exist in the FPCC HXs at the time ESW is valved into the FPCC HXs. When in this configuration, periodic sampling is done to monitor for any radioactive leakage. In the unlikely event the FPCC HXs are lined up with ESW and also develop a tube leak some potentially contaminated water could leak into the ESW system. The affected FPCC HX can be isolated, if necessary, from the ESW system upon detection of any leakage.

Position switches on the motor operated pump discharge and RHR heat exchanger isolation valves and motor operated sluice gates provide "OPEN" and "CLOSED" signals to position indicating lights in the control room. Loop A valves also have an "OPEN/CLOSED" indication at the remote shutdown panel. Loop B valves also have local "OPEN/CLOSED" indication with their redundant remote shutdown control switch. The sluice gates have local indication on their motor operator.

Each ESW strainer includes the following instrumentation to initiate and perform the backwash operation:

a. High ΔP across the strainer switch.

b. A timer permitting up to 48 hours between backwash cycles.

c. A manual control switch.

The high ΔP switch also activates an alarm in the control room.

Level switches are located in the ESW pumphouse forebay. These level switches provide a low level signal which automatically opens sluice gates between the discharge tunnel and the forebay to ensure a cooling water supply. When elevated lake temperatures may cause the ESW forebay temperature to approach its maximum allowable design limit of 85°F, the sluice gate seals are inflated and the automatic opening feature is disabled.

Additional details for instrumentation and controls is provided in <Section 7.3.1>.

9.2.2 EMERGENCY CLOSED COOLING SYSTEM

9.2.2.1 Design Bases

An emergency closed cooling (ECC) system serves Unit 1 and is designed to provide a reliable source of cooling water to safety-related components required for certain modes of normal reactor operation, as well as for accident conditions and loss of normal auxiliary power.

<Table 9.2-14> and <Table 9.2-16> summarize the cooling water requirements to those components serviced by the emergency closed

cooling system for the various modes of plant operation. The system is divided into two separate loops. For this discussion the loops are denoted by the letters "A" and "B."

The emergency closed cooling system is a closed system that has its heat exchangers cooled by the emergency service water system. It is designed to yield maximum expected equipment cooling water temperature of 95°F on the closed side.

The system is designed such that the occurrence of any single active or passive failure would not contribute to the inability of the emergency closed cooling system to perform its intended function. The system is classified as Safety Class 3 and Seismic Category I. The chemical addition tank and piping up to the last valve prior to the connection into the system is nonsafety class. Piping downstream of vents and drains is nonsafety class. Piping downstream of the isolation root valves for the control complex chillers pumpdown unit is nonsafety class. Two bed water storage and distribution system piping up to the last isolation valve in the normal supply line and bypass line is nonsafety class. The failure of any of these nonsafety-related portions of the ECC system would not jeopardize the operation of the system.

The system is operable under hot standby, normal shutdown, continuation of normal shutdown, and postaccident conditions. Minimum cooling water requirements to essential equipment under accident conditions is discussed under <Section 9.2.2.3>.

No operator action is required during the first ten minutes following a loss-of-coolant accident.

The applicable code for the safety class pumps, piping, valves, and the surge tank is ASME Boiler and Pressure Vessel Code, Section III-3, Nuclear Power Plant Components.

In addition, the components are designed to follow the guidance of <Regulatory Guide 1.48>.

Applicable codes for NSC components are:

Piping	ANSI 31.1.0 Power Piping
Valves	ANSI 31.1.0
Chemical Addition Tank	ASME Section VIII (except radiography and stamp)

Conformance with Branch Technical Position ASB3-1 is discussed in <Section 3.6>. Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with regulatory guides is discussed in <Section 1.8>.

Conformance with Branch Technical Position APCSB3-1 is discussed in <Section 3.6>. Protection of the ECC system from missiles is discussed in <Section 3.5>.

9.2.2.2 System Description

An emergency closed cooling system serves Unit 1 and is capable of supplying cooling water to the control complex chillers. These chillers support ventilation cooling in the control room, battery and switchgear rooms and miscellaneous control complex areas.

The ECC system associated with Unit 2 is abandoned except for the piping designed to provide cooling water to the fuel pool heat exchangers following a design basis accident, if required. This portion of the Unit 2 ECC piping is connected to the Unit 1 ESW system, as shown on <Figure 9.2-3>.

The emergency closed cooling system has two independent loops, each consisting of one pump, heat exchanger and a surge tank. A chemical addition tank is shared by both loops. The pumps may be operated from the preferred offsite power supply or from a standby onsite power source. Redundancy is provided in the electrical power supply and equipment in the same manner as is provided for in the emergency core cooling system (ECCS). This approach compliments the ECCS in satisfying its performance objectives.

Water from the two bed water storage and distribution system is used for initial system operation and system makeup. In addition, a source of emergency makeup water is provided from the emergency service water system. Loops A and B of the emergency service water system supply the emergency makeup water to Loops A and B of the emergency closed cooling system, respectively. In the event that demineralized water makeup does not adequately maintain the surge tank level, level alarms are annunciated in the control room to indicate that operator attention is required. Manual fill of the surge tank can be performed locally using either the demineralized water system or the emergency service water system.

Water quality is maintained through the use of chemicals added by a chemical addition vessel connected across the pump suction and discharge lines.

Sample points are provided within the system for determination of water quality and need for chemical addition.

Some leakage from the emergency closed cooling system can be expected from pump seals and valve stem packing. A conservative estimate of this leakage is 2.7 gal/hour. With this leakage rate and assuming a minimum 454 gallons of water in the surge tank (low level), the surge tank would not be emptied until after 7 days.

Details for the emergency closed cooling system pumps are found in <Table 9.2-18>.

The physical piping arrangement at the pumps' suction in conjunction with a closed loop system design, ensures adequate NPSH for the ECC system pumps. The pumps are specified to meet the requirement of a minimum of 30 day continuous operation following an SSE or OBE. Details for the emergency closed cooling system heat exchangers are found in <Table 9.2-19>.

Details for the emergency cooling system surge tank, chemical addition tank and system piping valves and fittings are found in <Table 9.2-20>, <Table 9.2-21>, and <Table 9.2-22>, respectively.

After major maintenance to the Unit 1 emergency closed cooling system, the system must be checked to ensure that the equipment throttle valves are in proper position. After flow is established, the system valves are balanced to ensure adequate flow to all equipment. Flow indicating devices are provided on main headers as well as on the particular equipment piping. Throttling valves are provided to regulate flow. The system is then inspected for leakage, excessive vibration, chemical addition, etc. After major maintenance to the portion of the Unit 2 emergency closed cooling system used to provide cooling water to the fuel pool heat exchangers, the system must be checked to ensure that the cross-tie isolation valves to the nuclear closed cooling system are in proper position.

The emergency closed cooling system is available, when required, to supply cooling water during the operation of the RHR system and portions of the emergency core cooling system for hot standby, normal shutdown, loss-of-coolant accident, and under loss of normal ac power.

Consideration is given to the following reactor modes supported by the emergency closed cooling system:

a. Hot Standby

The system is required to supply equipment cooling to the RHR pumps and room coolers and the RCIC room cooler during reactor isolation. The initiation of the system is a remote-manual function.

b. Normal Shutdown

The emergency closed cooling system is required to supply cooling water to support the RHR system in the normal shutdown mode. The initiation of the emergency closed cooling system for this mode is a manual operation and dependent upon the specific RHR system requirements for cooling water.

c. Postaccident

The emergency closed cooling system has a primary safety function of supporting the emergency core cooling system and other safety-related equipment following an accident. The design is such that, in the event of any single active or passive failure in the emergency closed cooling system, cooling water can be supplied to either ESF Division 1 or Division 2 ECCS equipment, specifically Loop A or Loop B, respectively.

d. Support Testing

The emergency closed cooling system is available to support any plant testing in which the system must perform a cooling function. Frequency of operation is a function of plant testing requirements. Initiation of the system is a manual operation.

9.2.2.3 Safety Evaluation

The emergency closed cooling system is classified as Safety Class 3 and Seismic Category I. Its primary safety function is to support the emergency core cooling system and other safety-related equipment following an accident.

The design is such that, in the event of any single active or passive failure in the emergency closed cooling system, cooling water can be supplied to either Loop A or Loop B. Seal water cooling to RHR pumps A, B and C is required whenever the RHR pumps are running. System design permits seal cooling under all operating modes, including postaccident conditions.

The design of the system reflects redundancy in pumps, piping and power supply. Referring to <Figure 9.2-3>, it is shown that system pump A feeds Loop A which includes the LPCS room cooler, RHR pump A and room cooler, RCIC room cooler, control complex chiller A, and hydrogen analyzer A. The power supply for this header is from ESF Division 1. Also shown is system pump B which feeds Loop B, where Loop B supports RHR pumps B and C, associated room coolers, control complex chiller B, and hydrogen analyzer B. The power supply for header B is from ESF Division 2.

Each emergency closed cooling heat exchanger is cooled by one of the independent loops of the emergency service water system. Thus, there is no interdependency in the emergency service water supply.

An emergency source of makeup water is provided to the emergency closed cooling surge tank from the emergency service water system. The design maintains complete independence in piping and power supply. Power for each loop is supplied from the Class 1E electrical system, wherein each of the redundant ESF divisions has access to both a preferred offsite power supply and a standby onsite power source. This is accomplished by using Loop A (with components powered from ESF Division 1) and Loop B (with components powered from ESF Division 2) to supply the emergency makeup water to the surge tanks associated with Loop A (with components powered from ESF Division 1) and Loop B (with components powered from ESF Division 2) of the emergency closed cooling system. In addition, the emergency closed cooling surge tanks are designed to maintain a 7 day supply of water with normal system leakage without the need to provide makeup water.

The emergency closed cooling system contains a bypass around the control complex chillers. This bypass is employed only during maintenance and testing conditions. At all other times, the bypass line is closed and both the “A” and “B” chiller receive cooling water from the emergency closed cooling system. It should be noted that each Control Complex Chilled Water chiller is 100 percent capacity and, therefore, redundant. The Control Complex Chilled Water C chiller which is not diesel backed can be operated as a front line chiller, and chiller A and B can be used as standby chillers. During a LOOP/LOCA event, the Control Complex Chilled Water C chiller and its associated pump are tripped. The A and B Control Complex Chilled Water chillers and pumps are automatically started upon receiving a LOOP/LOCA signal.

For the ECC system associated with the non-abandoned Unit 2 piping, the bypass provided around the fuel pool heat exchangers is employed during all normal operating modes. The fuel pool heat exchangers are normally cooled by the nuclear closed cooling system <Figure 9.2-4>. Upon receipt of a LOOP or LOCA accident signal, the fuel pool heat exchangers NCC isolation valves automatically close. Any time after the start of ESW flow through the non-abandoned Unit 2 piping, cooling may be restored to the fuel pool heat exchangers by operator action. This involves opening the supply and return valves and closing the bypass valve in each loop of the emergency closed cooling system. Fuel pool heat exchangers A and B are supplied with cooling water from ESW loops A and B, respectively. Operation of these valves to supply these heat exchangers with ESW cooling is described in <Section 9.2.2.6>.

All major cooling water parameters, specifically pressure, temperature and flow are monitored in the control room during system operation and alarm to signal irregularities. The operation of the emergency closed cooling system is initiated automatically and simultaneously with the initiation of the ECCS resulting from a loss-of-coolant accident. In addition, provisions are made for manual initiation from the control room or remotely, if required.

The emergency closed cooling system is designed for various combinations of plant conditions and natural phenomena. The system will suffer no loss of safety function as a result of a loss-of-coolant accident, loss of offsite power, or postulated earthquake condition.

Also, the above criteria are met, assuming the following: a single failure within the system, the preferred power source is unavailable and the safety function is accomplished using the standby power source.

The following failure analysis as it applies to the emergency closed cooling system assumes a loss-of-coolant accident, a postulated earthquake and a loss of preferred ac power.

Using these assumptions, it must be shown that either loop A or loop B will remain functional following any active or passive failure to the emergency closed cooling system. The remaining functional loop (A or B) operating in conjunction with the emergency service water system will meet the requirements necessary for safe shutdown of the reactor.

Electrical power to the emergency closed cooling system is such that loops A and B receive power from ESF Division 1 and Division 2, respectively.

In addition, the two loops of the emergency closed cooling system are adequately separated and protected to provide for the indirect consequences of pipe whip, jet forces and internally generated missiles.

On the basis that there is complete independence between loops, mechanically and electrically, a single active or passive failure of one loop would not affect the operation of the other.

9.2.2.4 Inspection and Testing Requirements

The emergency closed cooling system operation is intermittent over the full range of plant operations. To ensure the availability of this system, scheduled inspection and testing of system equipment is performed. A preoperational test of the system was conducted in accordance with the provisions stated in <Chapter 14>.

The system pumps are operated on a regular, scheduled basis to verify adequate performance and availability. Valves are tested on a regularly scheduled basis. Such capabilities as shutoff and flow control are of particular interest.

The instrumentation and controls associated with the emergency closed cooling system undergoes a program of periodic calibration inspection, and testing to verify accuracy and satisfactory operation.

A program of visual inspection is maintained. Attention is given to welded connections, leakage, corrosion, noise, and vibration.

Cooling water is tested regularly, by samples taken from the system, to determine water quality and need for chemical addition.

9.2.2.5 Instrumentation Requirements

The emergency closed cooling system is a safety-related system supporting other safety systems, particularly the ECCS. Therefore, the instrumentation and controls provide the ability to monitor the status of major parameters during system operation.

The emergency closed cooling pumps are initiated automatically under accident conditions, but also can be initiated for RHR supporting operations manually from the control room. In the unlikely event that the control room becomes uninhabitable, emergency closed cooling system loop A can also be operated from the remote shutdown panel. Likewise, loop B is provided controls for operation from the redundant remote shutdown system. Each pump suction and discharge is provided with a pressure indication to ensure that the developed head meets system requirements. Pump discharge pressure is monitored in the control room and also signals a low pressure alarm.

Loops A and B are each instrumented with flow transmitters; low flow alarms are provided in the control room.

Each component supplied with emergency closed cooling water, except the hydrogen analyzers, has a temperature element and flow element on the discharge side. The temperature elements installed downstream of the control complex chillers are spared in place.

The surge tanks have level instrumentation. One instrument provides level alarms which are annunciated in the control room. The other instrument sends high and low level signals to the system's makeup water valves. Operation of the makeup water valves allows demineralized water to fill the surge tanks. The operation of the makeup valves depends upon the level in the respective surge tanks.

Administrative control or locks ensure that all system valves are in proper position when required for operation. The positions of power operated valves (except the temperature control valves upstream of the ECC heat exchangers) are indicated in the control room.

Additional details for instrumentation and controls are provided in <Section 7.3.1>.

9.2.2.6 Cross-Tie Between Unit 1 ESW and Unit 2 ECC

The Unit 2 ECC system was originally designed to supply safety-related cooling water for the Fuel Pool Cooling Heat Exchangers (FPCHX) however, the active cooling functions of the Unit 2 was abandoned. Since a Seismic Class I, safety-related cooling water source to the FPCHX's must be operational to support Unit 1 operation, piping cross-ties are provided between the A and B loops of the Unit 1 ESW system and the corresponding A and B loops of the Unit 2 ECC system. The Unit 1 ESW system provides a safety grade source of cooling water to the FPCHX through portions of piping in the Unit 2 ECC System <Figure 9.2-3>.

Operator action at some point following the first ten minutes of the postaccident condition is needed to realign the FPCHX/ESW supply, return, and bypass valves.

The physical connection between the Unit 1 ESW and Unit 2 ECC system is depicted on <Figure 9.2-3 (4)>. Each cross-tie pipe contains two spectacle flanges in the open position to allow flow between the Unit 1 ESW and Unit 2 ECC systems. Blind flanges have been added to the 4 inch supply and return piping to isolate the abandoned Unit 2 RCIC, LPCS and RHR system loads. The additional heat load on the Unit 1 ESW system is described in <Section 9.2.1>. A bypass line with an orifice provides a flowpath for ESW operation when the non-abandoned Unit 2 ECC isolation valves are closed (NCC cooling FPCC heat exchangers).

9.2.3 DEMINERALIZED WATER MAKEUP SYSTEM

The primary water source for the demineralized water makeup system is raw Lake Erie water supplied by the service water system. An alternate and/or supplemental water supply is from the potable water system.

The Lake Erie water is pretreated and transferred to a clearwell. Potable water can also be used as makeup to the clearwell in whole or part. Part of the clearwell water is used for miscellaneous services and the remainder is used for plant makeup to the demineralizers. The demineralizer system is not safety-related. The system is designed to produce sufficient water to meet plant makeup requirements.

The demineralized water is used to supply miscellaneous services and makeup to the condenser, or alternatively, the condensate storage tank.

Demineralized water quality measured at the inlet of the distribution header will be as follows:

a.	pH	5.8-7.5 at 25°C
b.	Specific conductivity	≤0.5 µmho/cm at 25°C
c.	Chloride (Cl)	≤0.05 ppm
d.	Silica (SiO_2)	≤0.02 ppm

The specific conductivity of the demineralizer effluent is continuously monitored and recorded. When the conductivity exceeds a preset value the train is alarmed at the local control panel and shut down. All local panel alarms are relayed to the main control room as a common trouble alarm.

Safety showers and eyewashes are provided as required for personnel safety in handling the chemicals stored and used in the Water Treatment Building.

System diagrams of the demineralized water makeup system are shown on <Figure 9.2-5>, <Figure 9.2-6>, <Figure 9.2-7>, <Figure 9.2-8>, and <Figure 9.2-9>.

9.2.4 POTABLE WATER SYSTEM

The potable water system supplies and distributes both hot and cold water throughout the plant for potable and sanitary purposes.

9.2.4.1 Design Bases

Design bases for the potable water system are:

a. The system is not safety-related.

b. The system supplies hot and cold water in sufficient quantities for potable and sanitary purposes to the service building, control complex, turbine building, and numerous other buildings inside and outside of the protected area.

c. The system supplies cold water for safety (emergency personnel) showers and eye washes in various plant locations as required.

d. Malfunction or failure of any system component or piping does not adversely affect any safety-related system or equipment or the ability to achieve and maintain safe shutdown.

e. The system supplies flushing and dilution water to several chemical addition subsystems. Additionally, the potable water system is a backup source of water to the demineralized water makeup system clearwell.

f. The system is designed such that no interconnections exist with any process system containing radioactive or potentially radioactive liquid.

9.2.4.2 System Description

The supply of potable and sanitary water is obtained from the Lake County Department of Utilities water main, which is extended onto the site. Potable water is distributed to the plumbing fixtures located in the plant.

Hot water is generated by two large electric hot water storage heaters located in the service building and the control complex. Small electric water heaters are located in the turbine buildings. Hot water recirculating systems are used where excessive lengths of hot water piping warrant inclusion of such systems to maintain water temperature.

9.2.4.3 Safety Evaluation

The potable water system is not nuclear safety-related. No interconnections exist between the potable and sanitary water system and any process system containing radioactive or potentially radioactive liquid.

Backflow preventers are located in the system's connection with the offsite water source. The backflow preventers inhibit flow from the site to the offsite water supply. If the potable water system became potentially contaminated, the backflow preventers would ensure that the offsite supply would not be affected.

Malfunction or failure of any potable and sanitary water system component or piping does not adversely affect any safety-related system or equipment or the ability to achieve and maintain safe shutdown.

9.2.4.4 Inspection and Testing Requirements

Drinking water quality is tested on a regular basis by the Lake County Department of Utilities.

9.2.4.5 Instrumentation Requirements

Hot water storage tank temperature is maintained at a predetermined temperature by a temperature controller which activates the tank heater, as required.

9.2.5 ULTIMATE HEAT SINK

9.2.5.1 Design Bases

Heat rejected from the turbine cycle during normal operation will be discharged to the atmosphere by a natural draft cooling tower, 516 feet high. During startup, shutdown and emergency operation, heat will be rejected to Lake Erie through the emergency service water system. This system draws water from the lake, cools the plant and returns the water to the lake. The lake has been shown to have a sufficiently high level to assure that it is always available to qualify as a single source of cooling water <Section 2.3.1> and <Section 2.4.11>. All features necessary to provide cooling water for emergency purposes have been designed to Quality Group C, Safety Class 3 and Seismic Category I <Section 3.2>, and have been provided with redundant features to assure availability. Cooling water supply to the ESW intake structure is available at all times even though the physical redundancy of the ESW cooling water supplies may not be available during periods of elevated lake temperature when the sluice gate seals are inflated and the automatic opening feature is disabled. In compliance with <Regulatory Guide 1.27>, it has been demonstrated that there is an extremely low probability of normal intake failure during the time that the automatic opening feature of the sluice gates is disabled and the alternate intake tunnel is unavailable.

The structures and components used to take water from and return water to the lake are sized for the service water system (turbine plant and nonsafety nuclear requirements) flow rate of 70,500 gpm, and the emergency service water system (RHR and nuclear safety requirements) flow rate of 45,400 gpm.

9.2.5.2 System Description

The ultimate heat sink for Perry is shown schematically by <Figure 9.2-10>. Water is taken from Lake Erie by means of intake structures located approximately 2,650 feet off shore and 13.3 feet below the surface of the lake based on low water datum level at Elevation 570.5’. A 10-foot ID intake tunnel conveys the water to two onshore pumphouse structures, the service water pumphouse and the emergency service water pumphouse. Water will be returned to the lake after accomplishing its cooling function through the discharge tunnel entrance structure. The discharge nozzle is located approximately 1,520 feet off shore and 12.2 feet below the water surface based on the low water datum elevation. Intake structures and the discharge nozzle have been sized to carry a normal flow of 45,400 to 70,500 gpm. Intake velocity will vary from approximately 0.5 to 0.7 feet per second. The discharge nozzle has been designed so that the maximum flow of approximately 116,000 gpm can be adequately handled if both the emergency service water and the normal service water systems are operating simultaneously.

A 10-foot diameter cross tie tunnel between the discharge tunnel and the emergency service water pumphouse is provided as a redundant water supply for the emergency service water pumps. Either tunnel will supply sufficient water to permit simultaneous safe shutdown and cooldown of two reactor units and, if an accident occurs in one unit, permits control of this accident with simultaneous, safe shutdown and cooldown of the other unit.

9.2.5.3 Safety Evaluation

Ultimate heat sink design reflects the operation of two reactor units. This design is conservative because only the heat load from a single unit needs to be removed. The ultimate heat sink design complies with the safety functions for heat dissipation as stated in <Regulatory Guide 1.27>. The design is based on simultaneous safe shutdown and cooldown of two reactor units and, if an accident occurs in one unit, permits control of this accident with simultaneous, safe shutdown and cooldown of the other unit.

If an accident occurs in one unit, the maximum total rate of heat input from both units to the ultimate heat sink from all sources (decay heat, sensible heat, auxiliary system heat, and pump work) will be a peak of 3.0×10^9 Btu/hr followed by an asymptotic decrease over the 30-day period. <Figure 9.2-11>, <Figure 9.2-12>, and <Table 9.2-23> show the combined total heat release rate from both units, and the combined total integrated heat input from both units for the 30-day period following a LOCA in one unit and the simultaneous cold shutdown of the other unit. The total heat release rate is further broken down into its three major parts: decay heat rate, sensible heat rate and the auxiliary system heat rate (all two unit totals). The decay heat rate is taken directly from GE Licensing Topical Report NEDO-10625, Class I, March 1973. The auxiliary system heat load including pump work has been taken as the total energy equivalent of the fuel oil used by the diesel generators following a LOCA, since this is the sole source of energy for the auxiliary systems. This approach is conservative because a substantial portion of the fuel oil energy is actually rejected to the atmosphere from the diesel exhaust. The total heat rejected will have only a negligible thermal effect in the localized area and no thermal effects on the lake as a whole.

The portions of the tunnels that supply water to the emergency service water cooling system, as well as the intake structure, discharge tunnel and emergency service water pumphouse, are designed as Seismic Category I structures. All safety-related emergency service water discharge structures and piping are either tornado missile protected or have been evaluated for the probability of tornado missile strikes as described in <Section 3.5.1.4.2.1>.

System operability is maintained during and subsequent to a seismic failure of the external discharge piping by standpipes located inside the auxiliary building. Upon blockage of the discharge lines, the standpipes maintain full emergency service water flow by relieving the flow to the plant yard area.

A redundant water supply to the emergency cooling water pumps is provided by a 10 foot diameter cross tie tunnel which allows an inflow of water to the emergency service water pumphouse forebay from the discharge tunnel in case flow through the normal intake tunnel is blocked off. Entry to this pumphouse forebay is accomplished by the opening of either one of two motor-operated gates which are normally closed, but will open automatically upon detection of low water level in the pumphouse forebay. When elevated lake temperatures may cause the ESW forebay temperature to approach its maximum allowable design limit of 85°F, the sluice gate seals are inflated and the automatic opening feature is disabled.

Refer to <Section 9.2.1.2> for a discussion of this operational configuration.

The effects of natural phenomena on the heat sink water level or water volume are presented in <Section 2.3.1> and <Section 2.4.11>, including an evaluation of Lake Erie Canal lock failures. <Figure 1.2-18> and <Figure 3.8-65> present the intake and discharge structure orientation and location.

9.2.6 CONDENSATE STORAGE FACILITIES

9.2.6.1 Design Bases

The condensate storage system is designed to store and provide adequate demineralized water to accommodate main cycle makeup and to provide a minimum of 150,000 gallons for the RCIC and HPCS Systems at all times. The tank is designed to AWWA D100.

9.2.6.2 System Description

The condensate transfer and storage system is shown in <Figure 9.2-13>. It consists of one 500,000 gallon capacity storage tank with associated makeup and distribution systems. The tank is located outdoors adjacent to the turbine building.

Makeup to the condensate storage tank will come from the 400,000 gallon capacity mixed bed water storage tank. Makeup is cyclical in nature, i.e., the makeup control valve opens on low level (which is still above the 150,000 gallon reserve) and closes on high level. The normal makeup from the mixed bed water storage tank is sprayed into the main condenser, and returned to the condensate storage tank. The alternate makeup is pumped directly to the condensate storage tank whenever the condenser is not in operation.

The main function of the condensate storage system is to provide makeup to the main turbine cycle or to store excess water returned from the main turbine cycle. A gravity header is provided to distribute water to the main condenser on a low water level signal in the condensers. On high water level in the main condenser, the condensate booster pumps discharge water back to the condensate storage tank through the same 12-inch line used for makeup.

The gravity header also supplies water to the suction of three transfer pumps which provide pressurized water for the fuel pool cooling and cleanup system (FPCCS) filter backwash, the spent fuel pool, the radwaste system, the reactor water cleanup system, the refueling water (upper pool) system, and other miscellaneous uses that cannot be gravity fed. A freeze protection heater is provided in a recirculation line from the pump discharge back to the condensate storage tank to protect the tank during cold weather.

A separate Safety Class 2, Seismic Category I header is provided near the bottom of the tank and sized to supply water simultaneously to the RCIC and HPCS systems. The 150,000 gallon reserve for these two systems is ensured by the operator isolating all nonsafety uses of condensate supply before the storage tank level drops below this reserve. This 150,000 gallon reserve is also based on the suction sources of other systems which draw from the tank being at levels above the region dedicated for HPCS/RCIC use. A low level alarm is provided to alert the operator. The alternate water supply to these systems for safe shutdown is the suppression pool <Section 5.4.6>. A high level annunciator is provided to alert the operator of a potential tank overflow condition.

A header is provided to return water from the RCIC and HPCS pumps during testing and from the control rod drive pumps during minimum recirculation.

The storage tank is constructed of carbon steel; it is lined with .006 inch flame sprayed aluminum topped with .006 inch dry film thickness of PPG Aquapon for corrosion protection. The tank is vented and does not contain a membrane.

9.2.6.3 Safety Evaluation

This system is not classified as a safety class system; however, certain components of the system are safety-related. The portion of the system between the containment isolation valves and the supply header to the RCIC and HPCS systems are Safety Class 2, Seismic Category I.

The water contained in the storage tank will normally come in directly from the mixed bed water storage tank through the cycle. The cycle water will have passed through the condenser hotwell where it is held up for a minimum of two minutes for radioactive decay.

To preclude an uncontrolled release of the content of the condensate storage tank, the tank is located within a concrete retaining structure designed to Seismic Category I requirements. This retaining structure is designed to accommodate the total liquid capacity of the condensate storage tank with at least one foot freeboard.

Condensate storage tank water level is monitored and displayed by plant computer systems, which also display alarms for high and low water levels.

In addition, a low low level alarm is annunciated to ensure inventory for HPCS and RCIC systems and a high level alarm is annunciated to prevent tank overflow.

Tank overflows are directed to the retaining basin structure surrounding the tank. This water is then transferred to the liquid radwaste system for processing.

9.2.6.4 Inspection and Testing Requirements

Preoperational testing has demonstrated that each condensate transfer pump can provide design flow at design pressure. In addition, setpoints, miscellaneous controls and interlocks have been verified.

9.2.6.5 Instrumentation

The storage tank has all necessary level instrumentation for controlling the makeup required to maintain adequate tank operating level and to initiate alarms in the control room if level in the tank falls below the point where the RCIC/HPCS system reserve requirements are met. Pressure indicators and temperature indicators are provided where necessary to monitor system operation. Additional discussion of instrumentation and controls is provided in <Chapter 7>.

9.2.7 SERVICE WATER SYSTEM

Note that Unit 2 has been retired from service and is therefore no longer functional. Although designed for two unit operation, the Service Water System currently only needs to handle Unit 1 and common loads. Also note that the Unit 2 30″ supply and 24″ return lines have been blanked off as shown in <Figure 9.2-14>. Also, the 14″ line which returns service water from the Unit 2 turbine building and the 36″ line which supplies make-up to the Unit 2 cooling tower have been blanked off as shown in <Figure 9.2-14>.

9.2.7.1 Design Bases

The service water system is designed to remove the heat given up by the following components in Unit 1:

a. Turbine lube oil coolers (two).

b. Turbine building closed cooling heat exchangers (two).

c. Nuclear closed cooling heat exchangers (three).

d. Auxiliary steam conductivity sample panel.

e. Auxiliary steam radwaste evaporator condensate coolers.

f. Auxiliary steam drain cooler.

g. Alternate Decay Heat Removal heat exchanger.

The service water system provides keepfill water to each of the three trains (A, B, and C) of emergency service water when the respective emergency service water pump is not running.

The system also supplies makeup water to the cooling tower basin of Unit 1, in addition to supplying water to the screen wash pumps and cycle makeup system.

9.2.7.2 System Description

The service water system is shown in <Figure 9.2-14>. The system consists of an open loop piping network in which lake water from the cooling water intake structure is pumped through the tube side of the shell and tube type heat exchangers being cooled and directed as necessary to the cooling tower basin as makeup. That amount of water not required for makeup is returned to the lake by way of the discharge tunnel water return line. The system includes four one-third capacity vertical wet pit pumps, automatic self-cleaning strainers and a piping network to distribute cooling water to the tube side of the heat exchangers being cooled. A bypass at the heat exchangers is utilized to ensure an adequate makeup water supply for the cooling tower and a minimum flow for effective operation of the plant discharge diffusers in the lake.

Supply side piping in the yard and piping inside buildings for the service water system is carbon steel (A106 Grade B) or stainless steel (A312 or A376, Gr. TP304) and conforming to ANSI B31.1. Return side service water piping in the yard (including the service water strainer blowdown line) is fiberglass-reinforced plastic in accordance with ASCE Manuals and Reports on Engineering Practices No. 37 for plastic pipe and ASME Boiler and Pressure Vessel Code, Section X. The majority of return side piping is structural Cured-In-Place-Pipe (CIPP) installed internal to the fiberglass reinforced plastic (host pipe) of the original construction. The CIPP is designed as a stand alone application in accordance with ASTM F1216 and does not take any credit for the host pipe. Other sections of original construction that remain have been structurally enhanced by hand lay-up or have been replaced with new FRP piping in accordance with AWWA C950-88. Flanged connections are used at the pumps, heat exchangers, strainers, and other apparatus as required to facilitate removal for maintenance. Flanged connections are also used in the 3” ESW keepfill supply line.

The following are the performance requirements for the principal components of the service water system:

Service Water Pumps (Two required and one for standby use)

Type	Vertical wet pit turbine
Design capacity	23,500 gpm
TDH	140 ft
Temperature (max. design)	81°F

Strainers (one per pump)

Type	Automatic self-cleaning
Rated flow	23,500 gpm
Pressure drop clean (est.)	0.8 psi

A liquid biocide injection system is used, as required, to minimize algae and plant growth. Discharged effluent water quality will be maintained in accordance with Perry's National Pollution Discharge Elimination System (NPDES) permit.

9.2.7.3 Safety Evaluation

The service water system is nonsafety-related and is not required for the safe shutdown of the reactor. The system is, however, necessary for the operation and orderly shutdown, without damage to equipment, of the balance of the plant. The service water system therefore, is arranged to take power from buses supplied by the diesel generators so as to ensure service water availability within ninety seconds following a loss of offsite power. During a LOOP, Unit 1 diesel generator supplies power to pump B and valves 0P41-F040B, 1P41-F390 and 0P41-F400.

For the postulated case of expansion joint rupture and resultant turbine building flooding, two Safety Class III, Seismic Category I motor-operated butterfly valves provided in the makeup line to the cooling towers will be automatically closed, thereby limiting the flooding to the water volume in the cooling tower basin. See <Section 10.4.5> and <Section 2.4.13> for further details.

The strainers have self-cleaning mechanisms which are controlled manually or automatically by timers or by a differential pressure switch connected across the strainers.

9.2.7.4 Tests and Inspections

The heat exchangers in the system were hydrostatically tested, prior to startup, in accordance with ANSI B31.1.

Proper operation of the service water pumps, the self-cleaning strainers and the system instrumentation is checked at scheduled intervals to ensure their availability and accuracy.

9.2.7.5 Instrument Application

Sufficient instrumentation is included in the system to provide indication of all necessary temperatures and pressures to allow for the proper control of the system under all phases of operation.

9.2.8 NUCLEAR CLOSED COOLING SYSTEM

9.2.8.1 Design Bases

The nuclear closed cooling system is designed to provide a reliable source of cooling water to the auxiliary nuclear plant equipment. This system is not required for safe shutdown of the reactor plant after a loss-of-coolant accident. This system may be used to mitigate high drywell pressure LOCA’s. Refer to <Section 9.2.8.3> for further discussion.

The system consists of a closed loop which acts as a barrier to prevent direct leakage of reactor water into the open service water. The service water is supplied to the closed loop heat exchangers from the service water system at a maximum expected temperature of 81°F. In turn, the closed loop side supplies cooling water to each individual component at a maximum temperature of 95°F. The maximum total heat load expected is 145 x 10^6 Btu/hr and the maximum flow requirement is 23,000 gpm. These values reflect operation of two reactor units starting-up simultaneously and full utilization of shared facilities.

<Table 9.2-24> summarizes the equipment cooled by the nuclear closed cooling system. The system is depicted on <Figure 9.2-4 (1)>, <Figure 9.2-4 (2)>, <Figure 9.2-4 (3)>, and <Figure 9.2-4 (4)>.

The system is not safety-related and has no safety classification, except for three portions.

These portions are the:

a. Piping and valves forming part of the containment boundary (Safety Class 2 and Seismic Category I).

b. Piping and valves associated with the control room chillers (Safety Class 3 and Seismic Category I) <Figure 9.2-3>.

c. Piping and valves associated with the fuel pool heat exchangers (Safety Class 3 and Seismic Category I) <Figure 9.2-3>.

The system is designed for operability under the full range of normal plant operations including the loss of normal ac power.

The following construction codes are applicable for individual components:

<u>For Safety Class 2</u>

Piping and valves	ASME Boiler and Pressure Vessel Code Section III-2, Nuclear Power Plant Components

<u>For Safety Class 3</u>

Piping and valves	ASME Boiler and Pressure Vessel Code Section III-3, Nuclear Power Plant Components

For Nonsafety Class

Piping	ANSI B31.1.0, Power Piping
Valves	ANSI B31.1.0
Heat exchangers	ASME Boiler and Pressure Vessel Code Section VIII, Div. 1, and TEMA-C.
Pumps	ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1
Surge tank	ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.
Chemical addition tank	ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.

9.2.8.2 System Description

The nuclear closed cooling system is comprised of the necessary pumps, heat exchangers, piping, valves, and a surge tank <Figure 9.2-4> to adequately supply cooling water to the auxiliary nuclear equipment specified in <Table 9.2-24>.

The system flow is maintained by the necessary combinations of three 50 percent capacity pumps with three 50 percent capacity heat exchangers dissipating a two unit heat load to the service water system. A surge tank is also provided to account for system volume variations.

Indicators for flow and temperature monitoring are located in appropriate locations to ensure that the valving is properly balanced to attain desired system operation. Two pumps are powered from Unit 1 diesel backed ac power sources; the third pump is powered from the Unit 2 stub bus.

The cooling water pumps are the horizontal centrifugal type. The pumps are manually initiated and operated. Under a loss of preferred ac power, the system can be manually restarted and loaded onto the emergency diesel stub bus.

The piping, leaving the nuclear closed cooling heat exchangers, is split into three main headers. Two of the headers are identical in that each supplies cooling water to the respective Unit 1 and Unit 2 components. The third header services common equipment such as the evaporator condensers in the radwaste building, control room chillers, the fuel pool heat exchangers, containment chillers, and miscellaneous auxiliary and reactor buildings heat exchangers.

Major equipment is provided with temperature and flow elements on the discharge piping to observe local system characteristics. For inaccessible equipment within containment, system parameters and/or alarms are transmitted to the control room. Each piece of equipment can be isolated from the system by the valves provided and over-pressurization of equipment is prevented by relief valves.

Materials of construction are carbon steel with material requirements satisfying the specification dictated by the applicable construction codes.

Demineralized water is used for initial system operation and system makeup. Quality is maintained by chemical addition to the system through a chemical addition tank.

The following components are part of the Nuclear Closed Cooling System:

Heat Exchangers

Quantity	3
Type	Single pass-shell and tube
Material	
Shell	Carbon steel
Tube	Admirality
Design flow	
Shell	13,500 gpm
Tube	17,000 gpm
Design pressure drop	
Shell	22 psi
Tube	9 psi
Design pressure (shell & tube)	150 psig
Design temperature (shell & tube)	150°F
Duty	81×10^6 Btu/hr
Max. tube velocity	6.9 ft/sec
Shell side outlet temp.	95°F
Tube side inlet temp.	81°F
Tube side outlet temp.	89.5°F

There are three 50% heat exchangers.

Surge Tank

Quantity	1
Capacity (gal.)	3,197
Materials	Carbon steel
Design pressure	atm
Design temperature	195°F

Chemical Addition Tank

Quantity	1
Capacity (gal.)	5
Materials	carbon steel
Design pressure	150 psi
Design temperature	195°F

The ammonia hydrazine is added through a chemical addition tank. The tank is on a bypass line around the nuclear closed cooling pumps. If chemical addition is needed the bypass valves are opened and the chemicals are flushed into the system.

Pumps

Quantity	3
Type	Horizontal, centrifugal
Design flow rate	13,500 gpm
TDH (ft) at design flow	165 ft
Design pressure	150 psig
Design temperature	150°F

Three 50% system capacity pumps are provided. Pumps are remotely controlled from the control room.

The nuclear closed cooling system is in operation during all modes of normal plant conditions.

The maximum flow required and the maximum heat load is well within the design capacity of two pumps and two heat exchangers which can deliver 27,000 gpm and 162 x 10^6 Btu/hr respectively. Since the system always has a pump and heat exchanger available for use, any pump or heat exchanger can be out-of-service without affecting system performance.

9.2.8.3 Safety Evaluation

The nuclear closed cooling system is not required for safe shutdown of the reactor following a loss-of-coolant accident.

Upon a signal in the control room of accident conditions, the Unit 1 powered "A" and "B" NCC pumps are shut down and the containment isolation valves are closed (refer to <Section 6.2.4> Containment Isolation Systems). The Unit 2 powered "C" pump will remain operating, if in service. The fuel pool heat exchanger equipment isolation valves are also automatically closed. Cooling is then restored from the Unit 2 emergency closed cooling system. This involves operator action at some point following the first ten minutes of the postaccident condition to align cooling to fuel cooling heat exchangers from the Unit 1 ESW System via the cross-tie to Unit 2 emergency closing cooling water system piping <Section 9.2.2.6>.

Should the control room operators determine that a high drywell pressure condition caused system isolation, system isolation bypasses may be operator initiated in order to cool the drywell and thereby mitigate the high drywell pressure problem. Bypassing the system isolation signals is accomplished by operating the control room located keylocked NORMAL-BYPASS switches and the additional operations listed below:

a. One bypass switch is provided to bypass the electrical Division 1 containment and drywell cooling isolation valves. When the bypass switch is in the BYPASS position, each valve can be manually opened or closed by operating the valve's control room located, control switch.

b. One bypass switch is provided to bypass the electrical Division 2 containment and drywell cooling isolation valves. The operation of this switch and these valves is the same as that described in Item a. above.

c. The bypass switches described in <Section 8.3.1.1.2.5> are provided to bypass the isolation signal to the Division 1 or Division 2, 4.16kV, Class 1E switchgear's stub bus breaker. The Division 1 or Division 2 stub bus can then be energized by operating the stub bus breaker's control room located, control switch. Once the Division 1 or Division 2 stub bus is energized, the "A" or "B" NCC pump can be energized by turning the control room located, pump motor's control switch.

d. The "C" NCC pump is powered from a Unit 2 stub bus and will not be affected by the Unit 1 bypass switches.

When the containment and drywell isolation valves are opened and one train's cooling water pump is operating, the drywell will become cooled and the drywell pressure will be reduced.

Under loss of preferred ac power with no accident, the system may be manually restarted in order to maintain the cooling function to all components and to prevent seal damage to the reactor water recirculation pumps.

A radiation monitor is installed in the nuclear closed cooling system to detect inleakage of radioactive water to the system. Sample points are provided throughout the system downstream of each component carrying radioactive fluid to enable the faulty component to be isolated. Once the leaking component has been identified, it can be isolated if necessary, by valves provided in the cooling water inlet and discharge lines.

9.2.8.4 Tests and Inspection

During normal plant operation, a program of testing and inspection is maintained to ensure adequate system performance. Since the system is in continuous operation through the full range of reactor operation, performance adequacy is determined by constant monitoring of the system instrumentation. Components not in operation, are operated on a regularly scheduled basis to ensure availability.

Valves are inspected and tested regularly for flow control and shutoff capabilities whether the equipment is in constant operation or not.

Instrumentation and controls associated with the system undergo a program of periodic calibration and testing to verify accuracy and satisfactory operation.

A program of visual inspection is maintained. Attention is given to welded connections, leakage, corrosion, noise, and vibration.

Cooling water is sampled at regular intervals to determine water quality and need for chemical addition.

9.2.8.5 Instrument Application

The Nuclear Closed Cooling System is continuously monitored to ensure adequate performance. All major system characteristics are monitored with appropriate alarms in the control room, including local flow and temperature measurements for that equipment located within the containment.

The cooling water pumps are equipped with pressure gauges on the suction and discharge lines with a low pressure alarm on the discharge line to signal inadequate system performance.

Temperature gauges on the inlet and discharge sides of the cooling water heat exchangers indicate the effectiveness of the system to dissipate the required heat load. To ensure adequate flow, flow elements with low flow alarms are provided on the main system supply lines.

The cooling water discharge line of the RWCU non-regenerative heat exchangers is equipped with a low flow alarm and temperature indicator. A major heat load given up to the Nuclear Closed Cooling System is from these heat exchangers.

The NCC discharge piping from the main recirculation pumps for motor, seals and bearing cooling is provided with temperature transmitters and low flow alarms.

Provisions for administrative control or locks, ensure that all valving is in proper position during system operation. For power operated valves, such as those for containment isolation, the position is indicated in the control room.

9.2.9 TURBINE BUILDING CLOSED COOLING SYSTEM

9.2.9.1 Design Bases

The turbine building closed cooling system is designed to provide cooling water for the removal of heat produced by the following turbine plant components:

a. Generator stator cooler.

b. Generator hydrogen cooler.

c. Exciter duplex cooler.

d. Bus duct coolers.

e. Condensate hogging pump coolers.

f. Hotwell pump motor coolers.

g. Motor driven feedwater pump lube oil coolers.

h. Feedwater booster pump motor coolers.

i. Glycol coolers.

j. Condensate booster pump lube oil coolers.

k. Hydraulic power unit coolers.

l. Offgas vault refrigeration units.

m. Electro-hydraulic fluid coolers.

n. Reactor feedwater pump turbine lube oil coolers.

o. Turbine plant sample rack.

p. Aux. boiler feedwater pump seal coolers.

q. (Deleted)

r. Main steam primary sampling cooling coils.

s. Feedwater corrosion analyzer.

t. Auxiliary steam drain return pump seal water cooler.

9.2.9.2 System Description

The turbine building closed cooling system is shown in <Figure 9.2-15>. The system consists of a closed cycle network in which treated condensate quality water is cooled with lake water in a heat exchanger and is circulated through the components being cooled.

The system includes three half-capacity pumps, two full-capacity closed loop cooling heat exchangers, a system surge tank, a chemical treatment tank, and a piping network to circulate the cooling water through the components being cooled.

The three half-capacity pumps used for circulating cooling water in the system are of the single stage, horizontal, split-case centrifugal type.

Two full-capacity heat exchangers are provided to cool the closed loop cooling water, one of which is normally in service. The heat exchangers are of the shell and tube type with lake water in the tubes and closed loop cooling water in the shell.

The necessary combinations of pumps and heat exchangers are maintained to provide the required cooling.

A surge tank is provided to maintain the required pump suction head and to provide for system surge capacity. The tank is vented to atmosphere and is at the highest point in the system to ensure positive pressure in all system components. Level in the surge tank is maintained with a pneumatic level controller and a diaphragm operated makeup valve.

A chemical treatment tank is provided for adding chemicals to the closed loop cooling water. The tank is connected to the suction and discharge of the closed loop cooling pumps in order to utilize the pump head for adding chemical to the system.

Piping throughout the system is carbon steel (A106 Grade B) with welded joints and conforming to ANSI B31.1. Flanged connections are used at the pumps, heat exchangers and other apparatus as required to facilitate removal for maintenance.

The following are the performance requirements for the principal components of the turbine building closed cooling water system:

Turbine building closed cooling pumps

Type	Horizontal split-case
Design flow	3300 gpm
TDH	113 ft

Turbine building closed cooling heat exchangers

Type		Horizontal shell and tube	
		1P44B0001A	1P44B0001B
Water flow:	Tube side	9,000 gpm	9,000 gpm
	Shell side	7,000 gpm	6,580 gpm

Turbine building closed cooling heat exchangers (Continued)

		1P44B0001A	1P44B0001B
Temperatures (max. operating):			
	Tube side in	81.5°F	81.5°F
	out	90°F	93°F
	Shell side in	110°F	110°F
	out	95°F	95°F
Design pressure:			
	Tube side	150 psig	150 psig
	Shell side	150 psig	150 psig
Pressure drop (max):			
	Tube side	7.5 psig	5.6 psig
	Shell side	10 psig	8.8 psig

Turbine building closed cooling surge tank

Type	Cylindrical, vertical
Pressure	Atmospheric (vented)
Volume	760 gal.
Material	Carbon steel

9.2.9.3 Safety Evaluation

The turbine building closed cooling system is nonsafety-related and is not required for the safe shutdown of the reactor.

9.2.9.4 Tests and Inspection

The turbine building closed cooling heat exchangers, and the chemical treatment tank have been hydrostatically tested, prior to shipment, in accordance with Section VIII Division I of the ASME Boiler and Pressure Vessel Code.

Proper operation of the turbine building closed cooling pumps and the system control and instrumentation is checked at scheduled intervals to assure their availability.

9.2.9.5 Instrument Application

Sufficient instrumentation is included in the system to provide complete coverage of all necessary temperature, pressure, flow, and level indications, to allow for the proper control of the system under all phases of operation.

9.2.10 ALTERNATE DECAY HEAT REMOVAL SYSTEM

9.2.10.1 Design Bases

The Alternate Decay Heat Removal (ADHR) System is a non-safety related, seismic Category I system. The ADHR system is designed to provide additional decay heat removal options through a non-safety related alternate decay heat removal system that can be used in MODE 4 and MODE 5 with the reactor depressurized and the reactor coolant system temperature ≤ 200°F. The system is designed to remove the decay heat load that exists approximately 24 hours after plant shutdown from 100% power.

9.2.10.2 System Description

The ADHR system is shown in <Figure 9.2-16>. The system consists of an ADHR heat exchanger and pump, suction and return lines with tie-ins to the Low Pressure Core Spray (LPCS) system, Residual Heat Removal (RHR) system, and Condensate Transfer and Storage (CTS) system with the associated piping, valves, instrumentation and appurtenances.

The ADHR pump is a single stage, 1800 rpm, horizontal, end suction, centrifugal type that is designed to produce 200 feet of head at 3000 gpm. The pump is manufactured to provisions contained in API 610. The pump casing is stainless steel with stainless steel wetted parts. The pump is designed to allow for dismantling and removal of rotating elements without removing the pump from its base or disturbing the suction or discharge connections.

The ADHR heat exchanger is a plate-and-frame type heat exchanger installed on the east end of the 599’ Auxiliary Building. The cooling water for the ADHR heat exchanger is provided by the Service Water (SW) system with tie-ins to the SW system piping downstream of the Turbine Building Closed Cooling (TBCC) heat exchanger and associated piping, valves, instrumentation and appurtenances as shown in <Figure 9.2-14>.

The ADHR system is limited to a heat removal rate of 85.35 MBTU/hr, which bounds the decay heat production rate of the core 24 hours after a scram from sustained 100% power. Once the plant has been shutdown for 24 hours or greater, is in MODE 4 or MODE 5 and the reactor is depressurized, ADHR may be placed in service.

9.2.10.3 Safety Evaluation

The Alternate Decay Heat Removal System is non-safety-related and is not required for the safe shutdown of the reactor.

9.2.10.4 Tests and Inspection

Piping system pressure testing shall be done in accordance with the ASME Boiler and Pressure Vessel (B&PV) Code Section III Subsections NC/ND and ANSI/ASME B31.1 as applicable. Inspection and examination of safety class piping systems shall be in accordance with ASME B&PV Section III, Subsection NC/ND. ADHR filter pressure testing shall be in accordance with Article UG-99 of ASME Section VIII, Division 1.

9.2.10.5 Instrument Application

The ADHR System requires eight RTDs, two flow transmitters, and one pressure transmitter. These instruments are connected to the Foxboro Series remote I/O in the ADHR Local Panel.

TABLE 9.2-1

EMERGENCY SERVICE WATER SYSTEM

HOT STANDBY (WITH LOSS OF PREFERRED AC POWER) - MODE A

Equipment	LOOP A Heat Load [4] (x 10^6 Btu/hr)	LOOP A Flow (gpm)	LOOP B Heat Load [4] (x 10^6 Btu/hr)	LOOP B Flow (gpm)
RHR heat exchangers (two in series)	83.149[1]	5,896	83.149[1]	5,896
Diesel generator heat exchangers	20.650	787	20.650	787
Emergency closed cooling heat exchangers	0.401 (7.503)[2]	2,012	0.320 (7.421)[2]	2,012
Fuel pool cooling heat exchangers	0.0 (14)[3]	632	0.0 (0.0)[3]	632
TOTALS	104.200 (125.302)	9,327	104.119 (111.220)	9,327

Equipment	LOOP C Heat Load (x 10^6 Btu/hr)	LOOP C Flow (gpm)
HPCS room cooler	0.473	85
HPCS diesel generator heat exchangers	8.580	526
TOTALS	9.053	611

NOTES:

(1) With a loss of preferred AC Power, the plant will be in a hot standby condition. During Hot Standby with LOOP, the Suppression Pool Cooling Mode of RHR will be initiated.

(2) The values in parentheses identify the heat load for the ECC heat exchanger if this loop of ECC is being used to supply cooling to the Control Complex Chillers. Either loop of ECC may be used to remove the heat from the Control Complex Chillers.

NOTES (Cont.):

(3) Not required during first 10 minutes of operation. This assumes that NCC cooling is not available and operators have lined up the ESW flow path for alternate cooling of FPCC. Although NCC is restored during a LOOP, P41 Service Water System cooling for NCC may not be available. Either fuel pool cooling heat exchanger may be used to remove the decay heat load from the spent fuel.

(4) The heat loads identified in Loop A and in Loop B represent the maximum heat loads that could be present for each heat exchanger, assuming that the other loop is unavailable.

<TABLE 9.2-1a>

<TABLE 9.2-2>

DELETED

TABLE 9.2-3

EMERGENCY SERVICE WATER SYSTEM

NORMAL SHUTDOWN - MODE B

Equipment	LOOP A Heat Load [1] ($x 10^6$ Btu/hr)	LOOP A Flow (gpm)	LOOP B Heat Load [1] ($x 10^6$ Btu/hr)	LOOP B Flow (gpm)
RHR heat exchangers (two in series)	135.100	6,607	135.100	6,607
Diesel generator heat exchangers	0	875	0	875
Emergency closed cooling heat exchangers	0.507	2,211	0.524	2,211
Fuel pool cooling heat exchanger bypass	0	708	0	708
TOTALS	135.607	10,401	135.624	10,401

Equipment	LOOP C Heat Load ($x 10^6$ Btu/hr)	LOOP C Flow (gpm)
HPCS room cooler	0	0
HPCS diesel generator heat exchanger	0	0
TOTALS	0	0

NOTE:

[1] The heat loads identified in Loop A and in Loop B represent the maximum heat loads that could be present for each heat exchanger, assuming that the other Loop is unavailable.

<TABLE 9.2-3a>

<TABLE 9.2-4>

DELETED

TABLE 9.2-5

EMERGENCY SERVICE WATER SYSTEM

CONTINUATION OF NORMAL SHUTDOWN - MODE C

	LOOP A		LOOP B	
Equipment	Heat Load [1] (x 10^6 Btu/hr)	Flow (gpm)	Heat Load [1] (x 10^6 Btu/hr)	Flow (gpm)
RHR heat exchangers (two in series)	46.900	6,607	46.900	6,607
Diesel generator heat exchangers	0	875	0	875
Emergency closed cooling heat exchangers	0.203	2,211	0.216	2,211
Fuel pool cooling heat exchanger bypass	0	708	0	708
TOTALS	47.103	10,401	47.116	10,401

	LOOP C	
Equipment	Heat Load (x 10^6 Btu/hr)	Flow (gpm)
HPCS room cooler	0	0
HPCS diesel generator	0	0
TOTALS	0	0

NOTE:

[1] The heat loads identified in Loop A and in Loop B represent the maximum heat loads that could be present for each heat exchanger, assuming that the other Loop is unavailable.

<TABLE 9.2-5a>

<TABLE 9.2-6>

DELETED

TABLE 9.2-7

EMERGENCY SERVICE WATER SYSTEM

POSTACCIDENT (WITH LOSS OF PREFERRED AC POWER) – MODE D AND MODE E[3]

Equipment	MODE D - LOOP A OR B Heat Load [4] (x 10^6 Btu/hr)	MODE D - LOOP A OR B Flow (gpm)	MODE E - LOOP A OR B Heat Load [4] (x 10^6 Btu/hr)	MODE E - LOOP A OR B Flow (gpm)
RHR heat exchangers (two in series)[1]	158.400	5,896	158.400	5,896
Diesel generator heat exchangers	20.650	787	20.650	787
Emergency closed cooling heat exchangers[2]	8.291	2,012	8.291	2,012
Fuel pool cooling heat exchanger	0.000	632	14.000[3]	632
TOTALS	187.341	9,327	201.341	9,327

Equipment	LOOP C Heat Load (x 10^6 Btu/hr)	LOOP C Flow (gpm)
HPCS room cooler	0.473	85
HPCS diesel generator	8.580	526
TOTALS	9.053	611

NOTES:

(1) Either loop A or B is sufficient to remove 100% residual heat.

(2) The heat load from the Control Complex Chillers can be removed by either loop A or B.

(3) Mode E includes an additional heat load from the cross-tie to the Fuel Pool heat exchangers. This is not required during the first 10 minutes of system operation. The heat load can be removed by either loop A or loop B.

NOTES (Cont.):

(4) The heat loads identified for Mode D and Mode E represent the maximum heat loads that could be present for each exchanger in a given Loop, assuming that the other Loop is unavailable. It is also assumed that the Control Complex Chillers are lined up to each of their respective loops. These are the maximum possible heat load line-ups for either loop in each of the respective modes of operation shown.

<TABLE 9.2-7a>

<TABLE 9.2-8>

DELETED

TABLE 9.2-9

EMERGENCY SERVICE WATER SYSTEM RHR HEAT EXCHANGER HEAT LOAD AND OUTLET TEMPERATURES

		RHR Heat Exchanger Loop A		RHR Heat Exchanger Loop B	
	Mode	Heat Load (Btu/hr)	ESW Outlet Temp. (°F)[2]	Heat Load (Btu/hr)	ESW Outlet Temp. (°F)[2]
A.	Hot standby[1]	83.149×10^6	113	83.149×10^6	113
B.	Normal shutdown	135.1×10^6	127	135.1×10^6	127
C.	Continuation of normal shutdown	46.9×10^6	100	46.9×10^6	100
D.	Post-accident[3]	158.4×10^6	139	0.0	85

NOTES:

(1) During a Pressure Isolation Event (PIE), the Residual Heat Removal System will be operated in the Suppression Pool Cooling Mode.

(2) Inlet temperature equals 85°F.

(3) For this mode, single loop failure of ESW is assumed. The post-accident heat load can be removed by either loop A or loop B.

TABLE 9.2-10

EMERGENCY SERVICE WATER SYSTEM PUMPS

	Loop A	Loop B	Loop C
Quantity	1	1	1
Type	vertical, turbine, wet pit, non-pull out type with discharge above mounting base	vertical, turbine, wet pit, non-pull out type with discharge above mounting base	vertical, turbine, wet pit, non-pull out type with discharge above mounting base
Pump total dynamic head at design flow, ft	210	210	160
Design flow rate, gpm	11,500	11,500	960
Shutoff head, ft	360	360	258
Manufacturer	Goulds	Goulds	Goulds
Model	20x30 BLC	20x30 BLC	8x12 JMC

TABLE 9.2-11

EMERGENCY SERVICE WATER PUMP DESIGN BASIS

Design pressure, psig	
Loop A/B/C Piping	140 and 150
Loop A and B	205
Loop C Pump	185
Screen Wash Pumps	225
Design temperature range, °F	33 to 85[(1)]
Pump mounting base elevation, ft-in.	586’-6”[(2)]
Minimum water level in suction chamber, ft-in.	557’-0”[(3)]
Pump suction chamber bottom elevation, ft-in.	537’-0”

NOTES:

(1) The design temperature range in the table represents the design temperature range of the ESW system. The pump design temperature meets or exceeds the range identified.

(2) The elevation in the table represents the ESW pump house floor elevation. The ESW pumps are mounted on individual pedestals that are slightly higher than the pump house floor elevation.

(3) The elevation for which the pumps were originally designed for is 557’-0”. The actual minimum forebay water level elevation is 562.09 feet.

TABLE 9.2-12

EMERGENCY SERVICE WATER STRAINERS[1]

	Loop A, B	Loop C
Quantity	2	1
Type	Automatic Self-cleaning	Automatic Self-cleaning
Design flow rate, gpm	12,000	1,000
Backwash flow rate, gpm	650 minimum	250 minimum
Design pressure drop at design flow, psi	1.0 (clean)	1.0 (clean)
Design temperature Range, °F	32 to 85	32 to 85
Design pressure, psig	150	150
Straining element Opening size, in.	0.0625	0.0625
Manufacturer/model	R. P. Adams/ 24″ VDWS-68	R. P. Adams/ 8″ VWS-7NS

NOTE:

(1) Table reflects initial design data.

TABLE 9.2-13

TRAVELING SCREENS[1]

Number of screens	2
Approximate water flow each screen, at low level conditions:	
Emergency flow (6 ESW pumps/screen), gpm Plus all fire water and screen wash pumps	50,000
Maximum velocity approaching screen face at design flow and low water level, fps	1.0
Screen wash flow rate (at 100 psig), gpm	392
Screen travel speed (2-speed), fpm	10.0/2.5
Width of trays, ft	6.0
Screen openings, in.	0.375
Manufacturer	Rexnard, Envirex, Inc.
Elevations for which the screens are designed, ft.-in:	
a. Screen chamber floor Elevation,	537’-0”
b. Operating floor Elevation	586’-6”
c. Maximum water level	580’-6”[2]
d. Minimum water level	557’-0”[3]

NOTE:

[1] Table reflects initial design data based on two Units consisting of 6 ESW pumps.
[2] The actual maximum forebay water level elevation is 583.61 feet.
[3] The actual minimum forebay water level elevation is 562.09 feet.

TABLE 9.2-14

UNIT 1 EMERGENCY CLOSED COOLING SYSTEM

HOT STANDBY (WITH LOSS OF PREFERRED AC POWER) - MODE A
NORMAL SHUTDOWN - MODE B
CONTINUATION OF NORMAL SHUTDOWN - MODE C

UNIT 1 OPERATION

Loop	Component	Minimum Flow Rate (gpm)	Heat Load ($x 10^6$ Btu/hr) MODE A	MODE B	MODE C
A	ECCW pump heat	-	0.040	0.040	0.040
A	LPCS room cooler	33	0.000	0.000	0.000
A	RHR A pump seals	10	0.050	0.136	0.020
A	RHR A room cooler	30	0.247	0.331	0.143
A	Chiller A	1,700	0.000 (7.102)[2]	0.000	0.000
A	RCIC room cooler	13	0.064	0.000	0.000
TOTAL		1,786	0.401 (7.503)	0.507	0.203
B	ECCW pump heat	-	0.040	0.040	0.040
B	RHR B pump seals	10	0.050	0.136	0.020
B	RHR B room cooler	33	0.230	0.348	0.156
B	RHR C pump seals	10	0.000	0.000	0.000
B	RHR C room cooler	20	0.000	0.000	0.000
B	Chiller B	1,700	0.000 (7.102)[2]	0.000	0.000
TOTAL		1,773	0.320 (7.422)	0.524	0.216

NOTES:

[1] (Deleted)

[2] Either Loop A or Loop B is sufficient for removing the heat load from the Control Complex Chillers.

<TABLE 9.2-14a>

<TABLE 9.2-15>

DELETED

TABLE 9.2-16

UNIT 1 EMERGENCY CLOSED COOLING SYSTEM

LOCA (WITH LOSS OF PREFERRED AC POWER) – MODE D AND MODE E

UNIT 1 OPERATION

Loop	Component	Minimum Flow Rate (gpm)	Heat Load (x 10^6 Btu/hr)
A	ECCW pump heat	-	0.040
A	LPCS room cooler	33	0.365
A	RHR A pump seals	10	0.050
A	RHR A room cooler	30	0.247
A	Chiller A[(1)]	1,700	7.102
A	RCIC room cooler[(2)]	13	0.064
A	H_2 Analyzer	5	0.002
TOTAL		1,791[(4)]	7.870[(3)]
B	ECCW pump heat	-	0.040
B	RHR B pump seals	10	0.050
B	RHR B room cooler	33	0.230
B	RHR C pump seals	10	0.050
B	RHR C room cooler	20	0.243
B	Chiller B[(1)]	1,700	0.000[(1)]
B	H_2 Analyzer	5	0.002
TOTAL		1,778[(4)]	0.615

NOTES:

(1) Either control complex chiller may be in operation.
(2) Not required for postaccident condition.

NOTES (Cont.):

(3) A conservative heat load (8.291×10^6 Btu/hr) was used in design calculations to determine the minimum required ESW Flow shown in <Figure 9.2-1 (Sheet 3)>.

(4) Note that the minimum required total ECCW flow rate is 1850 gpm, as per design basis heat exchanger performance calculations. The individual minimum flow rate values shown are acceptable for the individual components, however, a higher total ECCW system flow rate is required for adequate ECCW heat exchanger performance during design basis accident (DBA) conditions. This is based on having the minimum ESW cooling water flow rate present during the DBA.

<TABLE 9.2-16a>

<TABLE 9.2-17>

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TABLE 9.2-18

EMERGENCY CLOSED COOLING SYSTEM PUMPS[1]

Quantity	2
Type	Horizontal split-case centrifugal
Materials	steel casing
Design flow rate, gpm	2,300
TDH at design flow, ft	130
BHP at design point	93.2
Shutoff head, ft	160
Design pressure, psig	150
Design temperature, °F	150
Manufacturer	Ingersoll-Rand

NOTE:

[1] Table reflects initial design data. See <Figure 9.2-3 (3)> for latest operating data.

TABLE 9.2-19

EMERGENCY CLOSED COOLING SYSTEM HEAT EXCHANGERS[1]

Quantity	2
Type	single pass shell side, two pass tube side
Material	
shell	carbon steel
tube	stainless steel
Operating flow rate, lb/hr	
shell	910,000 lb/hr
tube	1,364,088 lb/hr
Design pressure drop, psi	
shell	10
tube	1.9
Design pressure, shell and tube, psig	150
Design temperature range, shell and tube, °F	33-150
Design duty, (Btu/hr)	13.6×10^6
Temperatures, °F	
shell in	110
shell out	95
tube in	85
tube out	91
Max. tube velocity, ft/sec	2.54
Manufacturer	Struthers Wells

TABLE 9.2-19 (Continued)

<u>NOTE</u>:

[1] Table represents initial design data.
See <Figure 9.2-3 (3)> for latest operating data.

TABLE 9.2-20

EMERGENCY CLOSED COOLING SYSTEM SURGE TANK

Quantity	2
Type	horizontal
Capacity, gal.	660
Materials	carbon steel
Design temperature, °F	110
Design pressure, psi	atm.
Manufacturer	Bishopric

TABLE 9.2-21

CHEMICAL ADDITION TANK

Quantity	1
Capacity, gal.	5
Materials	carbon steel
Design pressure, psig	150
Design temperature, °F	150

TABLE 9.2-22

EMERGENCY CLOSED COOLING SYSTEM
PIPING, VALVES AND FITTINGS

Material	carbon steel
Design temperature, °F	150
Design pressure, psig	150

TABLE 9.2-23

HEAT REJECTION TO ULTIMATE HEAT SINK FOLLOWING LOCA[1]

Time After LOCA (Sec)		Total Decay Heat Release From Both Units (Btu/hr x 10^9)	Total Sensible Heat Release From Both Units (Btu/hr x 10^9)	Total Auxiliary System (incl. pump work) Heat Release From Both Units (Btu/hr x 10^9)	Total Heat Release From Both Units (Btu/hr x 10^9)	Total Inegrated Heat Input From Both Units (Btu x 10^6)
0.1		2.14			2.14	
0.2	0.2 sec	2.04	0.00	0.00	2.04	.058
0.4	0.4 sec	1.96	0.00	0.00	1.96	.114
1.0	1.0 sec	1.85	0.00	0.00	1.85	.556
4.0	4.0 sec	1.70	0.00	0.00	1.70	2.04
10.	10.0 sec	1.56	0.00	0.162	1.72	4.76
30.	30.0 sec	1.35	1.50	0.162		13.75
40.	40.0 sec	1.24	1.48	0.162	2.88	21.92
100.	1.7 min	1.06	1.35	0.162	2.57	67.2
300.	5.1 min	0.830	0.90	0.162	1.89	191.2
400.	6.7 min	0.776	0.60	0.162	1.54	239.
10^3	16.7 min	0.610	0.26	0.162	1.03	452.
$2x10^3$	33.4 min	0.488	0.16	0.118	0.766	702.
$3x10^3$	50.1 min	0.390	0.08	0.118	0.588	890.
$4x10^3$	1.1 hr	0.342	0.04	0.118	0.500	1040.
10^4	2.8 hr	0.322	0.00	0.118	0.440	1690.
10^5	1.2 days	0.178	0.00	0.118	0.296	10,960.
10^6	12 days	0.076	0.00	0.118	0.194	72,660.
$3x10^6$	35 days	0.056	0.00	0.118	0.174	175,660.

NOTE:

(1) Totals are for both units.

TABLE 9.2-24

EQUIPMENT COOLED BY THE NUCLEAR CLOSED COOLING SYSTEM

1. Recirculation pump
    a. Motor bearing oil coolers
    b. Motor winding coolers
    c. Pump seal cooler
2. CRD pumps
3. RWCU pumps
4. Non-regenerative heat exchanger
5. Instrument air dryers
6. Containment building sampling rack
7. Drywell equipment drain sump heat exchanger
8. Containment sump heat exchanger
9. Drywell coolers
10. Turbine building chillers
11. Service air compressors
12. Instrument air compressors
13. Fuel pool heat exchangers
14. Radwaste evaporator/condensers
15. "C" Control complex chiller
16. Containment chillers
17. Radwaste evaporator drain pump bearing coolers
18. Postaccident sampling system heat exchangers
19. Zinc addition sampling system heat exchanger

TABLE 9.2-25

EMERGENCY SERVICE WATER SYSTEM COOLING DUTY LOAD FOLLOWING A DBA[1]

Time	Component	DUTY LOAD (10^6 Btu/hr)[2][3] Loop A Unit 1	Loop B Unit 1	Loop C Unit 1
0-10 minutes	Standby Diesel Generator hx	20.650	20.650	-
	Emergency Closed Cooling hx (except Spent Fuel hx	8.291	0.614	-
	HPCS Room Cooler	-	-	0.473
	HPCS Diesel Generator	-	-	8.580
	TOTALS	28.941	21.264	9.053
10-30 minutes	Same as 0-10 minutes plus Fuel Pool Cooling hx	14.000	0.000	
	TOTALS	42.941	21.264	
30 minutes - 6 hrs	Same as 10-30 minutes Plus RHR hx	158.400	0.000	
	TOTALS	201.341	21.264	
6 hrs-24 hrs	Same as 30 minutes to 6 hrs			
24 hrs - 30 days	Same as 6 hrs to 24 hrs			

NOTES:

[1] LOCA with loss of normal ac power.
[2] See <Table 9.2-7>.
[3] Table information illustrates condition where all primary loads are addressed by Loop A.

<TABLE 9.2-25a>

DELETED

9.3 PROCESS AUXILIARIES

9.3.1 COMPRESSED AIR SYSTEMS

The compressed air systems include the instrument air system and the service air system. The safety-related instrument air system is discussed separately in <Section 6.8>.

9.3.1.1 Design Bases

Except for that portion between the containment isolation valves, the instrument air and service air systems are nonsafety-related. All safety-related components using compressed air are either designed to fail to a condition that corresponds with the safe shutdown of the reactor plant or are equipped with accumulators to satisfy their required air demands.

9.3.1.2 System Description

The instrument and service air systems are shown in <Figure 9.3-1>, and <Figure 9.3-29>, and <Figure 9.3-31>.

The service air system consists of two motor driven compressors each with an integral intercooler and aftercooler, an air intake filter silencer, lube oil subsystem, filters, condensate traps, controls, a receiver tank, and a piping network for distribution throughout the plant. A cross-tie header between each compressor discharge is included, in which distribution connections to the various plant areas are provided. An isolation valve is provided between each compressor discharge and the cross-tie header.

Each service air compressor is sized to provide the normal load capacity for the entire plant. During normal operation, the service air compressor discharges are cross connected with one compressor running and the other in the automatic standby mode. The system normal operating band for both the Unit 1 and Unit 2 service air units is 120 to 125 psig. If the service air system pressure drops below a set value, a standby compressor will auto start and maintain system pressure in the normal operating band. When the radwaste system and the water treatment systems are operated concurrently, both operating and standby compressors may be required to supply the higher air demand due to the concurrent use of these, intermittent/high air load, systems.

A separate instrument air systems is provided to supply clean, dry, oil free air for control purposes throughout the plant. The system meets the design guidelines of ANSI Standard MC-11-1 (ISA-S7.3), with the exception that the maximum allowable particle size for air to safety-related equipment is 40 microns.

The normal supply of air to the instrument air system is from the respective service air system for the unit, and two instrument air compressors are used as backups. The instrument air system for each unit also includes an after cooler (integral with each compressor), a receiver tank, a prefilter, an air dryer, an after-filter, and a piping network for distribution throughout the plant. All instrument air leaving the receiver tank passes through the filters and the air dryer.

The instrument air distribution system is cross-tied so that all components can be supplied by either service or instrument air compressors <Figure 9.3-1> and <Figure 9.3-31>.

The standby compressor auto starts at 107 psig and maintains system pressure at the normal operating band of 120 to 125 psig. A diaphragm operated isolation valve is provided in the air supply line from the service air system. This valve closes automatically when the instrument air system pressure drops below 90 psig and is opened by a switch in the control room when the system pressure rises above 90 psig.

9.3.1.3 Safety Evaluation

The instrument and service air systems have no safety-related functions as defined in <Section 3.2>. Failure of these systems will not compromise any safety-related system or component and will not prevent safe reactor shutdown.

Safety-related devices supplied with compressed air from this system are designed for the fail-safe mode and do not require continuous air supply from this system under emergency or abnormal conditions. <Table 9.3-1> gives a list of pneumatically operated valves required for safe shutdown and prevention or mitigation of accidents and shows that these valves assume the safe position in the event of a loss of instrument air pressure.

NOTE: Reference <Section 6.8> for a description of the postaccident safety-related air source for the outboard MSIVs.

The containment penetrations of the instrument and service air systems are of Seismic Category I design, and have redundant isolation valves to satisfy single-failure criteria <Section 6.2.4>. The containment penetration piping is fabricated and installed in accordance with

Section III of the ASME Boiler and Pressure Vessel Code. The effects of pipe break on safety-related systems are discussed in <Section 3.6>. The effects of internally generated missiles on safety-related systems are discussed in <Section 3.5.1>.

9.3.1.4 Inspection and Testing Requirements

Preoperational testing has demonstrated that each compressor can provide design flow at design pressure. In addition, setpoints, miscellaneous controls and interlocks have been verified. A preoperational test to simulate loss of instrument air was performed for all pneumatically operated components which have a safety function.

During operation, instrument air quality is tested on an annual basis, at the filter discharge for dewpoint and particulate contamination. The required air quality to safety-related components supplied from this system is: zero particulates larger than 40 microns, dewpoint less than -40°F. On failure to meet acceptable air quality, branch lines are tested to determine the extent of the problem and corrective action needed.

9.3.1.5 Instrumentation Application

Instrumentation for the instrument and service air systems is primarily local, consisting of pressure, differential pressure and temperature indication and/or control. Local control and instrumentation is provided by the compressor and instrument air dryer vendors for the complete operation and protection of their equipment. Pressure transmitters and pressure and temperature switches provide control room indication of the system condition for both air systems. Both systems are intended to be maintained within a nominal pressure band, with local pressure reduction occurring as required.

9.3.2 PROCESS SAMPLING SYSTEM

A process sampling system is provided to permit monitoring of equipment and system performance during normal plant operation. Information gathered by the process sampling system is used to make operational decisions for the plant, but is not used for reactor shutdown or accident mitigation.

9.3.2.1 Design Bases

The process sampling system is designed to meet the following criteria:

a. Sampling points are designed to assure that representative samples of the process fluid will be obtained.

b. Sampling lines are sized to provide sufficient sample quantities to the sampling stations. The sample flow rates will satisfy the requirements of analytical instruments mounted on sample panels at sampling stations and for samples taken to the laboratory for analysis. The lines are designed to prevent plate out or contamination of the sample during transfer to the sample stations and will be as short a run as possible to each sample station.

c. Sampling flows are generally discharged to the radwaste system for processing, however, some clean balance-of-plant cycle samples are returned to the condensate storage tank.

d. The sampling system is designed to preclude hazards to operating personnel from high pressure, temperature or radiation levels in the process fluid during all modes of normal operation.

e. The design is such that the sampling stations will not affect plant safety. Sample lines connected to reactor coolant piping are isolated automatically under a LOCA condition.

f. Valves and piping in safety class lines are designed to the applicable requirements of Section III of the ASME Code. Valves and piping in nonsafety class lines are designed to the requirements of ASA B31.1.

9.3.2.2 System Description

9.3.2.2.1 Sample Locations

Sampling stations are located in the turbine, radwaste and containment building areas to handle process samples. A connection from each condensate filter effluent line is tied into a common sample header having a single local sample connection. Samples from the condensate mixed bed demineralizers are directed to a sample panel in the turbine building. In addition, samples for analyses at each location are located as follows:

a. One sample station in the turbine building for:

    1. Condenser hotwell (each section).

    2. Each auxiliary condenser hotwell.

    3. Condenser hotwell pump discharge header.

    4. High pressure heater drains.

    5. Inlet and outlet of d.c. heater.

    6. Each condensate mixed bed demineralizer bed and outlet.

    7. Condensate filter outlet header.

    8. Feedwater.

    9. Main steam.

    10. Condensate storage.

11. Two Bed Demineralizer Distribution System.

12. Mixed Bed Demineralizer Distribution System.

13. Condensate Demineralizer System Effluent Header.

14. Low Pressure Feedwater Heater Drains.

b. One sample station in the containment building for:

1. Reactor water cleanup filter/demineralizer inlet header.

2. Each reactor water cleanup filter/demineralizer outlet.

3. One reactor water recirculation loop.

c. One sample station in the radwaste building for:

1. Waste collector and waste sample tanks.

2. Floor drains collector and sample tanks.

3. Chemical waste tanks.

4. Chemical waste distillate tanks.

5. Detergent drains tanks.

6. Fuel pool filter/demineralizer inlet header.

7. Fuel pool filter/demineralizer outlet header.

d. One sample station in each turbine power complex for:

   1. Cation regeneration tank effluent.

   2. Anion regeneration tank effluent.

   3. Resin mix/hold tank effluent.

e. Various sample stations in the water treatment building.

This tabulation does not include sample points provided for process and effluent radiological monitoring. Such sample points are discussed in <Section 11.4>. In addition, there are numerous local grab samples not included in this listing.

9.3.2.2.2 Sample Probe Design

For pipe sized less than six inches in diameter, there is no probe required (however, sample probes are used in the four inch reactor water cleanup system process lines). The main steam sample probe is in accordance with ASTM D 1066-59T, "Tentative Method of Sampling Steam," Volume 10 Pages 1273-1281. Where practicable, a sample connection is located after a run of straight process pipe of at least ten pipe diameters, but in no case less than three pipe diameters. On horizontal process pipes, the connection is be made on the side or top of the pipe rather than on the bottom.

Sample points for the turbine power complex, nuclear sampling system and reactor plant sampling system are shown on <Figure 9.3-21>, <Figure 9.3-22>, <Figure 9.3-23>, <Figure 9.3-24>, <Figure 9.3-25>, <Figure 9.3-26>, <Figure 9.3-27>, <Figure 9.3-28>.

9.3.2.2.3 Sample Piping Design

Sample lines are routed to be as short as possible, avoiding traps, dead legs and dips upstream of the sample station. Lines are sized to maintain turbulent flow. Reynolds number will be ≥4000 at the minimum required flow for each sample line and the minimum sample flow for any line will be 200 ml/min, measured at 100°F.

For non-critical samples where sample temperatures are expected to be below 77°F, then the conductivity instrumentation's temperature compensation unit will be utilized. Primary roughing coolers are provided as necessary to maintain samples below 107°F, and heat tracing is provided on lines where a minimum temperature must be maintained to prevent dissolved solids from plating out. Secondary coolers are also provided where conductivity instrumentation requires constant temperatures of 77 ±1°F.

9.3.2.2.4 Operator Protection

Temperature and pressure of all process samples at the sampling stations are maintained below 107°F and 200 psig. As an additional safety precaution, pressure relief valves are provided on all sample lines with pressure reducing devices.

Separate chemical fume exhaust hoods are provided at each turbine sampling station, at each reactor water sampling station and at the radwaste building sampling station. The exhaust hoods are vented to the building ventilation system.

9.3.2.3 Safety Evaluation

Sample lines in safety class systems out to and including the first isolation valve are designed to Seismic Category I requirements and fall under the same safety classification as the process system being sampled. The reactor coolant sample line, in addition to being designed to these requirements, is designed to Seismic Category I, Safety Class 2 requirements downstream of the root valve, to and including two redundant solenoid operated isolation valves that close automatically on a LOCA signal.

The sample probe interfacing with the safety class process line is designed to preclude jeopardizing the safety function of the process line for all safety class systems. In all such cases, the sample probe is fabricated from 3/4 inch, double extra strong, Type 316 or 304 stainless steel that is designed to withstand the combination of all operational and seismic loads.

9.3.2.4 Inspection and Testing Requirements

Preoperational testing and inspection of the system were conducted to demonstrate the ability of the system to perform its function.

9.3.3 EQUIPMENT AND FLOOR DRAINAGE SYSTEM

9.3.3.1 Design Bases

The equipment and floor drainage system (EFDS) is designed to provide for collecting radioactive and potentially radioactive liquid wastes from floor drains and equipment drains throughout the plant, and convey these wastes to building sumps located in the basemats of the major structures.

The EFDS consists of five separate, independent drain piping networks for segregating wastes into one of five categories as follows:

a. Floor drains (medium-to-low purity with medium conductivity).

b. Equipment drains (high purity with low conductivity).

c. Chemical drains (high conductivity).

d. Detergent drains.

e. Oil drains.

Separate building sumps are provided for the collection of each of these types of waste. The equipment and floor drainage collection system to the building sumps is shown on <Figure 9.3-5>, <Figure 9.3-6>, <Figure 9.3-7>, <Figure 9.3-8>, <Figure 9.3-9>, <Figure 9.3-10>, <Figure 9.3-11>, <Figure 9.3-12>, <Figure 9.3-13>, <Figure 9.3-14>, <Figure 9.3-15>, <Figure 9.3-16>, <Figure 9.3-17>, <Figure 9.3-18>.

<Section 11.2> describes the building sumps and the sump pumps that are provided to convey the collected wastes for disposal. Piping and instrumentation for the system are shown on <Figure 11.2-1>.

Piping in the basemats is embedded in the concrete; piping is also embedded in the upper concrete floors where thickness of the floors permit. The EFDS is designed for gravity flow at atmospheric pressure with the piping sloped downward to the building sumps. In general, the tops of floor drains and floor sumps are located one and one-half inches below the nominal high point of the floor. Traps are provided on floor drains to prevent the spread of an oil fire through the drain piping in areas where oil is contained in the equipment.

9.3.3.2 System Description

9.3.3.2.1 Floor Drains

Drains of medium to low purity and medium conductivity (normally low radioactivity), will be collected in the floor drainage system. These miscellaneous vents, unidentified leakage, certain equipment drains, and floor area drains discharge into floor drain sumps (dirty radwaste) located in the basemat of the drywell, containment, auxiliary building, heater bay, turbine power complex, intermediate building, and radwaste building.

The fluid collected in these sumps will be discharged by sump pumps to the liquid radwaste system <Section 11.2> for processing. Provisions are made for removal of oil from this sump water discharge before entering the liquid radwaste system.

The annulus is provided with a floor drain sump with no additional floor drains, since very little drain water is anticipated in this area.

The turbine power complex floor drain sump receives wastes from the turbine power complex, turbine building, offgas building, heater bay (Elevation 600’-6” and above), auxiliary boiler building, and the auxiliary building pipe chase at Elevation 565’-6”.

The turbine lube oil area and turbine laydown area drains are discussed in <Section 9.3.3.2.5>.

The heater bay floor drain sump receives wastes from floors at Elevations 542'-0", 560'-0" and 580'-6" only.

The intermediate building floor drain sump receives wastes from the intermediate building, control complex ventilating equipment floor at Elevation 679'-6" certain areas of the control complex controlled access floor at Elevation 599'-0". Floor drains located in the control complex (Elevation 599'-0") which are sent to the intermediate building floor drain sump are the nuclear closed cooling heat exchanger and pump area, safety showers in laboratories, shop facility area, and the corridors.

Floor and equipment drains from Elevation 574'-10" and portions of Elevation 599'-0" and 620'-6" of the control complex will be included in the discussion of the detergent drains in <Section 9.3.3.2.4>. The control complex floor drains for fire protection service at the control room floor Elevation 653'-6", and cable spreading area and battery room drains at Elevation 638'-6", discharge by gravity to the exterior yard catch basin system. Manual gate valves, normally closed, are provided for each of the four drains in the control room recessed concrete floor. These valves prevent the loss of carbon dioxide from the fire protection system for the power generation control center (PGCC) floor modules. The valves would be opened to drain fire water in case the fire hoses discharge into the control room.

In the auxiliary building, common mode flooding of the emergency core cooling system (ECCS) equipment rooms (i.e., flooding in one room which results in flooding of redundant ECCS equipment in adjacent rooms) is precluded by the design of the drainage piping. All drainage connections to equipment (flushing, relief valve discharge, seals, etc.) are hard piped to either a manifold, which connects directly into a sump external to the pump rooms, or to the drainage sumps within each pump room. Since no portion of the equipment drains or manifold is open to the atmosphere, it is not possible for flooding in one room to extend or communicate to an adjacent room by drainage lines. Also, discharge from the pump room drainage sump is controlled by a remote-manual actuator on the drainage line valve which is normally closed. This ensures that drainage of the sumps to the main auxiliary building sumps is completely controllable. Open floor drains connect directly to the respective ECCS pump room sump. Discharge from the sump is actuated and controlled as noted above.

Redundant nonsafety grade level switches are installed in each drainage pit which will alarm in the control room on high water level in the pit. If leakage from a seal or gasket in the ECCS system is detected in one of the pump rooms during normal plant conditions, the remotely operated isolation valve installed in the pump's suction line would be closed, thereby preventing drawdown of the suppression pool below the minimum level (Elevation 589'-0") <Section 6.3.2.6>.

The piping and manual isolation valves meet seismic criteria. The manually operated valve in the drain line for each ECCS pump room will be periodically verified closed during normal plant operation. This administratively controlled shutoff valve will prevent back flooding following a safe shutdown earthquake that would cause failure of non-seismic piping systems.

Each ECCS pump compartment is provided with watertight doors which are normally dogged closed and an indication is provided to the control room via the Plant Computer Alarm Display when the doors are opened. Provisions for preventing the flooding of essential equipment from groundwater are discussed in <Section 3.4> and <Section 2.4.13>.

The water treatment building, located at the west end of the Unit 1 turbine building, has a sludge holding sump. The floor and equipment drains, except for the acid and caustic tank area, drain to this sump.

A drainage trench to this sump is provided for the makeup water pretreatment gravity filter drains. The drainage sumps at each of the two makeup water pretreatment coagulators are piped directly to the sludge holding sump. The floor drains, caustic soda and acid storage tank drain, overflow drains and pump drains located within the acid brick-lined curbed area enclosing these two tanks and pumps, all drain directly through the floor into the neutralizing tank. The pumps in the sludge holding sump discharge to the exterior sludge lagoons.

9.3.3.2.2 Equipment Drains

Drains of high purity and low conductivity (normally high radioactivity) are collected in the equipment drainage system. These equipment drains and residual heat removal system flush drains discharge into an equipment drain sump (clean radwaste) located in the basemat of the drywell, containment, auxiliary building, turbine power complex, intermediate building, radwaste building, and control complex. The turbine power complex clean radwaste equipment sump also receives drains from the turbine building and the offgas building.

The Turbine Building Ventilation System (TBVS) plenum drains produce non-contaminated condensate when they are in the cooling mode. The condensate is produced when outside air is passed over the cooling coils. The water produced by the condensation of outside air is uncontaminated, and is routed to the storm drain system. The TBVS plenum drains also have a means of directing flow to the equipment drain sump. During the winter months when the plenums are being used to heat the buildings, the piping will be aligned to the equipment drains. Prior to switching the flow to the storm drain, the drainage water will be sampled to ensure that it is uncontaminated. The water from this drain will also be sampled in accordance with plant instructions during the time period that it is aligned to the storm drain system.

The fluid collected in these sumps discharges by sump pumps to the liquid radwaste system <Section 11.2> for processing. Provisions are made for removal of oil from this sump water discharge before entering the liquid radwaste system.

Major items of equipment and the building sump into which they drain are as follows:

a. Containment building

   1. Fuel pool leak detection drain.

   2. Fuel pool overflow drain.

   3. RWCU heat exchangers drains.

   4. RWCU holding pump seal drains.

   5. RWCU containment sample drain.

   6. Containment vessel air handling cooling water drain.

   7. RWCU backwash transfer pump seal leakage.

b. Drywell

   1. Reactor recirculating system maintenance drains.

   2. Drywell cooling supply plenum cooling coil drain.

   3. Reactor vessel drain.

   4. Miscellaneous CRW drains.

c. Auxiliary building

1. HPCS flush drain.

2. RHR flush drain and RHR pump relief valve.

3. LPCS flush drain.

4. RWCU flush drain.

5. RWCU pump drain.

6. Turbine building water chiller and pump drain.

7. NCC pump relief valve.

8. RCIC pump relief valve.

d. Turbine power complex

1. Offgas cooler condenser and inlet piping drain.

2. Offgas loop seal drain.

3. Condensate booster pump drain.

4. Condensate heaters drain.

5. Condensate filter holding pump drain.

6. Condenser hogging pump drain.

7. Sample extraction pump drain.

8. Feedwater seal injection pump drain.

9. Generator stator cooling unit drain.

10. Turbine building closed cooling heater exchanger and pump drain.

11. Condensate transfer pump drain.

e. Intermediate building

1. Drivewater filter and pump drains.

2. Cask storage pit drain.

3. Cask pit drain pump drain.

4. Fuel transfer tube drain tank and pump drain.

5. Circulating pump drain.

6. Fuel pool cooling and cleanup heat exchanger, post-filter and holding pump drains.

7. FPCC surge tank overflow.

8. NCC maintenance drain and relief valve.

9. Containment chiller pump drain.

10. Fuel pool F/D backwash transfer pump seal water.

f. Radwaste

1. RWCU sludge decant pump drain.

2. Condensate sludge decant pump drain.

3. Waste sample pump drain.

4. Fuel pool sludge decant pump drain.

5. Waste collector transfer pump drain.

6. WCT tank overflow.

7. WCTP drain.

8. WCT flush drain.

9. WST overflow.

g. Control complex

1. Service and instrument air receiver drains.

2. Service and instrument air compressor drains.

3. Emergency closed cooling heat exchanger shell drain.

4. Emergency closed cooling pump drain.

5. Control complex water chiller and pump drains.

6. Nuclear closed cooling heat exchanger shell drain.

7. Nuclear closed cooling pump drain.

8. Instrument air dryer drain.

9.3.3.2.3 Chemical Drains

A chemical waste sump is located in the basemat of the turbine power complex. Drains from the condensate demineralizer regeneration chemical waste tank and the waste transfer pump are collected in this sump.

In the control complex, drains from the fume hoods and the laboratory sinks located in the high and low level laboratories, and the sink in the health physics and radiation protection service room are directed by gravity to the liquid radwaste system chemical waste tank located in the radwaste building.

9.3.3.2.4 Detergent Drains

A laundry and floor drain sump is located in the basemat of the control complex. Inputs to this sump consist of personnel decontamination solutions from the personnel decontamination room and the respiratory cleaning facility, floor drains from nonradioactive areas of the control complex and drains from the lake water side of the nuclear closed cooling system heat exchangers.

The fluid collected in these sumps discharges by sump pumps to the liquid radwaste system detergent drains tanks.

The detergent drain tank waste is processed via the radwaste floor drain system.

9.3.3.2.5 Oil Drains

A lube oil area floor and equipment drain sump is located in the east end of the turbine building basemat at Elevation 593'-6". Equipment drains and floor drains for the turbine lube oil system and other hydraulic operated equipment located in this area are directed to this sump. In addition, floor and equipment drains are collected in this sump from the floor trench at fuel oil pumps in the auxiliary boiler building, from the feedwater turbine lube oil purifier room and turbine-driven feedwater pump rooms in the heater bay, and from the battery room in the turbine power complex.

The turbine building laydown area floor drain sump located in the west end of the turbine building basemat at Elevation 620'-6" receives the drainage from the floor sumps in the laydown area and the railroad track area.

Drainage collected in the turbine lube oil area and turbine laydown area sumps is normally pumped (remote manual initiation) to the liquid radwaste system. There is also a piping interconnection to the industrial waste disposal system. To prevent inadvertent discharge to industrial waste, administrative procedures require the contents of both sumps to be sampled before transfer to industrial waste, and each line interconnecting these sumps with the industrial waste disposal system is isolated by a valve that is normally locked closed.

Floor and equipment drains from each of the three diesel generator rooms drain separately by gravity to the industrial waste disposal system. A trap is provided in the drain header discharging from each of the diesel generator rooms.

Provisions are made for removal of oil from the diesel generator room drains in the industrial waste disposal system.

9.3.3.2.6 Miscellaneous Drains

The main reheat, extraction and miscellaneous drains are shown in <Figure 9.3-34>.

9.3.3.3 Safety Evaluation

Flooding of the ECCS rooms by backflow through the floor drains from a rupture of non-seismic designed fluid lines is prevented by the installation of a normally closed shutoff valve in the floor drain line from each of the six compartments. The normally closed shutoff valve in the drain lines is located in a drainage pit inside each compartment. It is controlled remote-manually by an extension stem passing through a watertight penetration in the wall of the cubicle to an accessible area outside the cubicle. A level switch in the drainage pit will alarm in the control room on high water level in the pit. Each ECCS pump compartment is provided with watertight doors which are normally dogged closed and an indication is provided to the control room via the Plant Computer Alarm Display when the doors are open.

9.3.3.4 Testing and Inspection Requirements

The floor and equipment drainage piping to the sumps is tested after installation but prior to embedment in concrete. This is accomplished by filling the pipes and floor drains with water up to the floor line and observing the water level for one hour.

The procedure and acceptance standards for visual examination of buttwelds, fillet and socket welds, piping and piping components is in accordance with Paragraph 136.4 of ANSI B31.1.

9.3.3.5 Instrumentation Requirements

Instrumentation for all the floor and equipment drain collecting sumps and sump pumps located in the basemats of the various buildings is discussed in <Section 11.2>. Piping and instrumentation for this is shown on <Figure 11.2-1>.

9.3.4 CHEMICAL AND VOLUME CONTROL SYSTEM

This section is not applicable to PNPP.

9.3.5 STANDBY LIQUID CONTROL (SLC) SYSTEM

9.3.5.1 Design Bases

9.3.5.1.1 Safety Design Bases

The standby liquid control (SLC) system has a safety-related function and is designed as a Seismic Category I system. It will meet the following safety 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.

   The shutdown margin provided for each cycle is verified to meet Technical Specification requirements as part of the reload safety analysis <Appendix 15B>.

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 ensure 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 also ensures compliance with criteria imposed for postulated 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 redundant control system.

e. The neutron absorber will be dispersed within the reactor core in sufficient quantity to provide a reasonable margin for leakage or imperfect mixing.

f. The system is reliable to a degree consistent with its role as a backup safety system; the possibility of unintentional or accidental shutdown of the reactor by this system is minimized.

g. For the LOCA analysis, the SLCS is used to maintain the suppression pool pH at 7 or above to minimize the conversion of cesium iodide to elemental iodine following a design basis LOCA <Section 15.6.5.5.1.8>.

9.3.5.2 System Description

The standby liquid control system <Figure 9.3-19> is manually initiated in the main control room to pump a boron neutron absorber solution into the reactor if the operator determines the reactor cannot be shut down or kept shut down with the control rods. Once the operator decision for initiation of the SLC system is made, the design intent is to simplify the manual process by providing a keylocked switch. This prevents inadvertent injection of neutron absorber by the SLC system. However, the reactor scram function of the control rod drive system <Section 4.6.1.1.2.5> backed up by the alternate rod insertion function is expected to ensure prompt shutdown of the reactor when required.

A keylocked switch for each pump is provided in the control room to ensure positive action from the main control room should the need arise. Procedural controls are applied to the operation of the keylocked control room switches.

The SLC system is needed only in the improbable event that not enough control rods can be inserted in the reactor core to accomplish shutdown and cooldown in the normal manner. A second function for SLC is to provide a pH buffering solution for injection into the reactor vessel and suppression pool following a design basis LOCA.

The boron solution tank, the test water tank, the two positive displacement pumps, the two explosive valves, the two motor-operated tank shutoff valves, and associated local valves and controls are located in the containment. The solution is pumped into the HPCS piping downstream of a check valve. It enters the reactor vessel and is discharged from the HPCS core spray spargers radially over the top of the core (see <Section 6.3.2> for a description of the HPCS system design) so that it mixes with the cooling water circulating within the vessel <Section 5.3>, <Section 3.9.3>, and <Section 3.9.5>.

The boron absorbs thermal neutrons and thereby terminates the nuclear fission chain reaction in the uranium fuel.

The specified neutron absorber solution is a mixture of sodium borate (borax-$Na_2B_4O_7 \bullet 10H_2O$) and boric acid ($H_3BO_3$). The solution is prepared by dissolving borax and boric acid in demineralized water in a nominal Na_2O:B_2O_3 molar ratio of 0.229. 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.

In operating states, when it is possible to make the reactor critical, the SLC system will be able to deliver enough boron solution into the reactor <Figure 9.3-20> to ensure reactor shutdown. This is accomplished by placing a borax-boric acid solution in the SLC tank and filling with demineralized water to at least the low level alarm point. The solution can be diluted with water up to the high level alarm volume to allow for evaporation losses or to lower the saturation temperature. A boron solution auxiliary mixing tank is provided outside containment to permit preparation of additional batches for transfer into the SLCS storage tank within 24 hours, if needed.

The limiting saturation temperature of the fluid in the tank and piping will be consistent with that obtained from <Figure 9.3-20> for the solution temperature. The limiting saturation temperature of the recommended solution is 61.5°F at the low level alarm volume and a lower temperature at six inches below the tank overflow volume. The equipment containing the solution is installed in a room in which the air temperature is to be maintained within the range as listed on <Figure 3.11-22> and <Figure 3.11-23>. An electrical resistance heater system provides a backup heat source which maintains the solution temperature at 75°F (automatic operation) to 85°F (automatic shutoff) to prevent precipitation of the borax-boric acid from the solution during storage. High or low temperature, or high or low liquid level, causes an alarm in the control room.

There are two pumps for boron solution injection in the SLCS operation. Each positive displacement pump is sized to inject 43 gpm of solution into the reactor, with a specified minimum flow of 32.4 gpm per pump. The pump and system design pressure between the explosive valves and the pump discharge is 1,400 psig. The two relief valves are set at approximately 1,400 psig. To prevent bypass flow from one pump in case of relief valve failure in the line from the other pump, a check valve is installed downstream of each relief valve line in the pump discharge pipe.

The two explosive-actuated injection valves provide assurance of opening when needed and ensure that boron 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 the end will readily shear 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 will 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 SLC system is actuated by two key-locked switches on the control room panel. This ensures that switching from the “off” position is a deliberate act. Operation of both switches starts the injection pumps, actuates the explosive valves, opens each pump suction motor-operated valve, and closes the reactor cleanup system isolation valve to prevent loss or dilution of the boron.

A 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). Another light indicates that the contactor is energized (pump running).

Storage tank liquid level, tank outlet valve position, pump discharge pressure, and loss of continuity on the explosive valves indicate that the system is functioning.

The local switch is wired in parallel with the control room switch and cannot inhibit start from the control room switch.

Pump discharge pressure and valve status are indicated in the control room.

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 to prevent any trace of boron from inadvertently reaching the reactor.

Instrumentation consisting of solution temperature indication and control, and heater system status is provided locally at the storage tank. <Table 9.3-2> contains the process data for the various modes of operation of the SLC. Seismic category and quality group are included in <Table 3.2-1>. Principals of system testing are discussed in <Section 9.3.5.4>.

Although SLCS injection capabilities from the initial contents of the SLC storage tank are sufficient to shutdown the reactor and meet the design basis requirements for the system, a standby liquid control transfer system is also provided.

The function of the SLC Transfer System <Figure 9.3-19 (2)> is to provide a means of adding additional borax-boric acid (neutron absorber, boron solution) solution for long term boration of the reactor in the unlikely event of SLCS injection. Long term boration may be required to assure that the minimum specified concentration of boron solution in the reactor is maintained to keep the reactor shut down assuming that the control rods have not been inserted.

Following SLCS injection, the SLC Transfer System supports the Main Injection System by providing capability to add additional batches of borax-boric acid to the main SLC storage tank. The Transfer System allows plant personnel to mix these additional batches of borax-boric acid without entering the containment.

The normal supply of water to the SLC Transfer System is from the Two-Bed Demineralized Water System. This water will be used for the following purposes:

a. Fill the auxiliary mixing tank for mixing of boric acid and borax to make boron solution.

b. Provide seal water to transfer pumps.

c. Provide source of cleaning water for components when the need for SLCS is over.

An emergency supply of water is available from the Emergency Service Water (ESW) System if a seismic event should disable the nonsafety-related Two Bed Demineralized Water System. In the event of a seismic occurrence, the seal water to the transfer pumps may be lost, but the process fluid will lubricate the seals.

The SLC Transfer System auxiliary mixing tank and pump are located in the Intermediate Building and are accessible to the operator during an ATWS event. A check valve inside the containment and a manual valve outside the containment is provided for containment isolation.

The SLC Transfer System piping is connected to the SLC storage tank above the overflow nozzle elevation.

An Alternate Boron Injection System is provided to address an ATWS event coupled with the loss of both trains of the Standby Liquid Control (SLC) System, which is a beyond design bases event. The system tie-ins and the major equipment are shown on <Figure 6.3-7> and <Figure 9.3-19>. The Alternate Boron Injection System design is nonsafety related. The alternate boron injection pump will be powered from a non-class 1E electrical bus.

9.3.5.3 Safety Evaluation

The standby liquid control system is a reactivity control system (and a pH 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 system is designed to bring the reactor from rated power to a cold shutdown at any time in core life (and for postaccident pH control). 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 rod worth as the moderator cools.

The ability of the SLC system to achieve reactor shutdown is analyzed for each operating cycle (with the reload core configuration) as part of the reload safety analysis. For the results of this analysis refer to

<Appendix 15B>, Reload Safety Analysis. Calculation of the minimum quantity of borax-boric acid to be injected into the reactor is based on the required 816 ppm average concentration in the reactor coolant including recirculation loops, at 68°F and reactor water level at Level 8. This result is increased by 25 percent to allow for imperfect mixing and leakage. Additional boron solution is provided to accommodate dilution by the RHR system in the shutdown cooling mode. This concentration will be achieved if the solution is prepared as defined in <Section 9.3.5.2> and maintained above saturation temperature. The storage tank is located in an area where the minimum environmental temperature is 70°F.

Cooldown of the nuclear system will require approximately 6 to 24 hours depending on the use of main condenser and various shutdown cooling systems 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.

The SLC system equipment essential for injection of neutron absorber solution into the reactor is designed as Seismic Category I for withstanding the specified earthquake loadings <Section 3.8>. The system piping and equipment are designed, installed and tested in accordance with requirements stated in <Section 3.6>.

The SLC system is required to be operable in the event of a plant offsite power failure; therefore, the pumps, motor-operated and explosive valves, and controls are powered from the standby ac power supply. The pumps and valves are powered and controlled from separate buses and circuits so that a single active failure will not prevent system operation.

The SLC system and pumps have sufficient pressure margin, up to the system relief valve setting of approximately 1,400 psig, to ensure solution injection into the reactor above the normal pressure in the bottom of the reactor. The nuclear system relief and safety valves begin to relieve pressure above approximately 1,100 psig. Therefore, the SLC system positive displacement pumps cannot overpressurize the nuclear system.

For non ATWS events, only one of the two standby liquid control pumps is needed for plant operation. If a redundant component (e.g., one pump) is found to be inoperable, there is no immediate threat to shutdown capability, and reactor operation can continue during the repairs. The time during which one redundant component upstream of the explosive valves may be out of operation should be consistent with the following: the probability of failure of both the control rod shutdown capability, the alternate rod insertion system and the additional component in the SLC system; and the fact that nuclear system cooldown takes several hours while liquid control solution injection takes approximately two hours. Since this probability is small, considerable time is available for repairing and restoring the SLC system to an operable condition while reactor operation continues. Assurance that the system will still fulfill its function during repairs is obtained by verifying operability of the redundant pump.

The SLC system is evaluated against the applicable General Design Criteria as follows:

a. Criterion 2

   The SLCS is located in the area outside of the drywell and below the refueling floor. In this location it is protected by the containment and compartment walls from external natural phenomena such as earthquakes, tornadoes, hurricanes, and floods and internally from effects of such postulated events (e.g., DBA-SSE).

b. Criterion 4

The SLCS is designed for the expected environment in which it is located. It is located in the containment, and is not subject to the more violent conditions postulated in this criterion such as missiles, whipping pipes and discharging fluids. This system is capable of performing its function under expected environmental conditions.

c. Criterion 21

Criterion 21 is applicable to protection systems only. The SLC system is a reactivity control system and should be evaluated against Criterion 29 (item f).

d. Criterion 26

The SLCS is the second reactivity control system required by this criterion. The requirements of this criterion do not apply within the SLCS itself.

e. Criterion 27

This criterion applies no specific requirements onto the SLCS and therefore is not applicable. See <Section 3.1> for discussion of combined capability.

f. Criterion 29

The SLCS pumps and injection valves are arranged to provide high functional reliability.

The SLCS also has test capability. A test tank is supplied for providing test fluid for the surveillance injection test. Pumping capability and suction valve operability may be tested any time. A trickle current continuously monitors continuity of the firing mechanisms of the injection squib valves.

The SLC system is evaluated against the following applicable guides and positions:

a. <Regulatory Guide 1.26> (Revision 2)

   Because the SLCS is a reactivity control system, all mechanical components required for boron injection are at least Quality Group B. Those portions which are part of the Reactor Cooling Pressure Boundary are Quality Group A. This is shown in <Table 3.2-1>.

b. <Regulatory Guide 1.29> (Revision 1)

   All GE supplied components of the SLCS which are necessary for injection of neutron absorber into the reactor are Seismic Category I. This is shown in <Table 3.2-1>.

c. Branch Technical Positions APCSB 3-1 and MEB 3-1

   Since the SLC system equipment is located within the containment, it is adequately protected from flooding, tornadoes and internally and externally generated missiles <Section 3.5>. SLC system equipment is protected from pipe break by providing adequate separation between the seismic and non-seismic SLC system equipment where such protection is necessary. In addition, appropriate separation is provided between the SLC system and other piping systems <Section 3.6>.

This system is used in special plant capability demonstration events cited in <Appendix 15A>, specifically Events 51, 52 and 53, which are extremely low probability non-design basis postulated incidents. The analyses given there demonstrate additional plant safety consideration far beyond conservative assumptions.

Due to the nature of the fission products that are predicted to be released in the event of a LOCA, the SLC system has also assumed a post-LOCA function of providing a pH buffering solution for the reactor vessel and suppression pool water. This will help to retain the fission products in the water post-LOCA <Section 15.6.5.5.1.8>.

9.3.5.4 Inspection and Testing Requirements

Operational testing of the SLC system is performed in at least two parts to avoid inadvertently injecting boron into the reactor.

With the valves to the reactor and from the storage tank closed and the valves to and from the test tank opened, demineralized water in the test tank can be recirculated by locally starting either pump from the MCC. This test can be accomplished with the reactor operating without affecting the ability of the other pump to inject borated water.

During a refueling or maintenance outage, the injection portion of the system can be functionally tested by valving the suction line to the test tank and actuating the system from the control room. System operation is indicated in the control room.

After functional tests, the injection valve shear plugs and explosive charges must be replaced and all the valves returned to the normal positions as indicated in <Figure 9.3-19>.

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 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 from the reactor through the first check valve can be detected by opening the same test connection in the line between the check valves when the reactor is pressurized.

The test tank contains demineralized water for approximately 3 minutes of pump operation. Demineralized water from the mixed bed demineralized water system is available for refilling or flushing the system.

Should the boron solution ever be injected into the reactor, either intentionally or inadvertently, the boron is removed from the reactor coolant system by flushing for gross dilution followed by operating the reactor cleanup system (after the operator makes certain that the normal reactivity controls will keep the reactor subcritical). There is practically no effect on reactor operations when the boron concentration has been reduced below approximately 15 ppm.

The concentration of the borax-boric acid in the solution tank is determined periodically by chemical analysis.

Electrical supplies and relief valves are also subjected to periodic testing.

The SLC system preoperational test is described in <Section 14.2.12>.

9.3.5.5 Instrumentation Requirements

The instrumentation and control system for the SLC is designed to allow the injection of liquid poison into the reactor and the maintenance of the liquid poison solution well above the saturation temperature. A further discussion of the SLC instrumentation may be found in <Section 7.4>.

The SLC Transfer System is provided with appropriate instrumentation and controls to facilitate safe and reliable operation. Because of the infrequent and short duration nature of the operation, all instruments and controls are located adjacent to the tank or pumps.

9.3.6 POSTACCIDENT SAMPLING SYSTEM

The Postaccident Sampling System (PASS) permits sampling of the containment building environments and the reactor coolant systems after a loss-of-coolant accident (LOCA). Sample analysis can be performed by using either onsite or offsite analytical instruments.

9.3.6.1 Design Bases

The PASS is designed to permit sampling following a small break, intermediate break or design basis LOCA. The PASS design and operation are consistent with <NUREG-0737>, <Regulatory Guide 1.97> and GDC-19 as described in <Table 1.8-1> and <Table 7.1-4>.

a. Sampling points are designed to ensure that representative samples of the process fluid will be obtained.

b. Sampling lines are sized to provide sufficient sample quantities to the sampling stations. The sample flow rates will satisfy the requirements of either onsite or offsite analytical instruments. The lines are designed to prevent plate-out or contamination of the sample during transfer to the sample stations. Runs will be as short as possible to each sample station.

c. The sampling system is designed to preclude hazards to operating personnel from high pressure, temperature or radiation levels in the process fluid during all modes of normal operation.

d. The design is such that the sampling stations will not affect plant safety. Sample lines connected to reactor coolant piping are normally isolated under all conditions. All sample lines are controlled by remote-manual normally closed, fail closed valves.

e. Each sampling line tie-in and its associated root valve are designed to meet the seismic and quality group classification of the system to which it is connected. All other components and piping are designed to meet Quality Group D but are not required to meet Seismic Category I requirements.

f. The PASS is separate from any normal sampling system. It is designed to minimize radiation exposure to operating personnel during postaccident conditions. The maximum exposure to each operator during sampling, transport and analysis is limited to 5 rem whole body and 75 rem to the extremities (hands and feet).

g. Radiation shielding and remote controls are provided in order to meet radiation exposure limits.

h. All sample tubing is constructed of Type 304 stainless steel with long radius bends and welded connections. Plate-out and sample loss or distortion is minimized by heat tracing and nitrogen purging the gas sample lines and also by cooling, pressure reduction and flushing the liquid sample lines with demineralized water.

i. Electrical power supplies for automatic and remotely operated equipment and valves including the containment penetration isolation valves, all other solenoid valves, the sample pumps, and the sample panels will have reliable non-Class 1E power supplies (ac from the stub-bus and dc from non-Class 1E batteries).

9.3.6.2 System Description

9.3.6.2.1 Sample Locations

The sampling station is centrally located in the intermediate building along the wall which separates the control complex from the intermediate building at Elevation 574’-10”. Samples are drawn individually from the following points:

- Drywell atmosphere
- Containment atmosphere
- Suppression pool atmosphere
- Annulus atmosphere
- Reactor water recirculation system - 2 points
- Reactor water cleanup system – 1 point
- Residual heat removal system - 2 points
- Drywell floor drain sump
- Suppression pool

The location and routing of the sample points and lines are shown on <Figure 9.3-33>.

The postaccident sampling system is manually controlled by an operator from the process control/monitor panel located near the sampling station.

Liquid sample streams drawn from selected sample locations pass through a remotely located cooler rack to the grab sample panel. Five individual sample streams can be collected for analysis.

Atmospheric samples drawn from any one of the four selected sample locations flow to the grab sample panel. Each sample is collected in a sample bottle for analysis.

Demineralized water is supplied to the sampling station for decontamination of the sampling station plenums, flushing of liquid sample lines and dilution of liquid samples. Nitrogen is supplied to the sampling station for drying of the sample lines and various components, and purging of gas sample lines.

All remote actuated valves and pumps are controlled from the process control/monitor panel. Flow, pressure and temperature indicators for the entire system with alarm lights and audible signals for cooler rack cooling water fault conditions and sample pump operation are located on this panel.

9.3.6.3 Safety Evaluation

The Grab Sample Panel (GSP) portion of the sampling station includes several modules designed to collect and prepare various samples for analysis. Most of the GSP components are contained in a plenum behind an eight inch radiation shield consisting of seven inches of lead shot between two 1/2 inch thick steel plates. Additional shielding is provided by lead bricks placed on top and a removable lead brick shield on the one side of the GSP. The other side is against a shield wall. A splashbox, waste sample collection tank and decontamination spray system are provided for spill and leakage containment and panel decontamination. A sump pump, housed in the GSP panel waste sample collection tank, discharges samples and leakage to the radwaste treatment system or the appropriate Unit’s suppression pool. Gases are removed from the panel by the station ventilation system equipped with charcoal adsorbers and HEPA filters. This ventilation system maintains a negative pressure in the panel to prevent outward gas leakage.

The Chemical Analysis Panel (CAP) portion of the sampling station accepts depressurized liquid sample flow from the GSP for analysis. Radiation shielding is provided on the front of the CAP panel by 7 inches of lead shot contained between 1/2 inch steel plates. Additional radiation shielding is provided by lead bricks placed on top of the CAP and on one side by 5 inches of lead shot between the side panel and a 1/2 inch steel plate. The other side is against a shield wall. The CAP is similar to the GSP in terms of component mounting in a plenum with drip tray, decontamination spray system and ventilation system. A sump pump, housed in the CAP panel waste sample collection tank, discharges samples and leakage to the radwaste treatment system or the appropriate Unit's suppression pool.

High temperature and pressure samples are cooled and pressure reduced prior to being routed to the sampling station.

Reactor coolant sample lines have reducing orifices at the source points to restrict flow in the event of a sample line rupture.

Sample lines in safety class systems out to and including the root valve are designed to the Seismic Category requirements and fall under the same safety classification as the process system. The reactor coolant sample line, in addition to being designed to these requirements, is designed to Seismic Category I, Safety Class 2 requirements upstream of the root valve, and inside the penetration between two redundant solenoid operated isolation valves.

9.3.6.4 Testing and Inspection

Testing and inspection of all sample lines out to and including the first root valve, comply with the testing and inspection requirements for the process system. Beyond the root valve, testing and inspection are in accordance with the requirements of ANSI/ASME B31.1.

9.3.7 ZINC INJECTION SYSTEM

9.3.7.1 Design Bases

The zinc injection system injects zinc oxide into the reactor feedwater. The zinc transported in the reactor water replaces Co-60 as the species in the oxide film layer formed on stainless steel. Lower Co-60 build-up results in lower radiation levels in such areas as the drywell and the reactor water cleanup pump rooms.

The dissolution column is designed in accordance with Section VIII, Division I of the ASME Boiler and Pressure Vessel Code. All other system piping conforms to ANSI B31.1. A strainer is provided on the effluent of the dissolution column to prevent the release of zinc oxide pellets into the feedwater.

9.3.7.2 System Description

The zinc injection system consists of a zinc injection skid which injects a dilute concentration of zinc oxide into the feedwater A stream of water taken from the feedwater pump discharge is routed through a column containing zinc oxide pellets. The dissolution of the zinc pellets into the diverted feedwater stream provides the dilute concentration of zinc oxide. The dilute zinc oxide solution is returned to the feedwater pump suction and is blended with the main feedwater flow.

The injection rate of zinc into the feedwater is adjusted by controlling the rate of water flow through the dissolution column, and by the amount of zinc oxide pellets available in the column.

Grab samples are withdrawn from the final feedwater and from reactor water. Zinc concentration is measured using standard industry methods.

9.3.7.3 Safety Evaluation

The zinc injection system is nonsafety-related and is not required for safe shutdown of the reactor. The zinc or oxygen contribution from the zinc oxide does not appreciably alter either the BWR water chemistry or the radiological inventory of the reactor coolant. The addition of the zinc has an insignificant effect on the shielding in the plant, offsite doses, total fractional maximum permissible concentrations in liquid and gaseous effluents, and consequences of accidents due to radioactive releases from subsystems and components. (Radiological assessments performed prior to October 4, 1993 that were used for the plant design bases as discussed in this USAR were evaluated against the <10 CFR 20> regulations prior to October 4, 1993. Radiological assessments for plant design bases modifications that are performed after October 4, 1993 will be evaluated using the revised <10 CFR 20>, dated October 4, 1993.)

9.3.7.4 Testing and Inspection

Periodic preventive maintenance and calibration will be performed on all major equipment and instruments to ensure proper in-service operation.

9.3.8 HYDROGEN WATER CHEMISTRY SYSTEM

9.3.8.1 Design Basis

The hydrogen water chemistry system injects hydrogen into the Feedwater system. The hydrogen, in conjunction with Zinc Injection, Noble Metals Chemical Addition (NMCA), and the On-Line NobleChem System (OLNC), combines with oxygen and oxides in the reactor water, lowering the Electrochemical Corrosion Potential (ECP) to below the -230mV Standard Hydrogen Electrode threshold to mitigate the potential and growth of Intergranular Stress Corrosion Cracking (IGSCC) of the stainless steel piping and reactor internal components. Due to recombining of free hydrogen and oxygen, this injection also results in a substantial reduction of oxygen levels, thereby reducing a critical contributor to IGSCC.

The hydrogen injection into the Feedwater system results in an offgas mixture exiting the condenser that contains excess hydrogen. To prevent discharging this mixture and creating a potential fire or explosion hazard, a stoichiometric amount of oxygen is added upstream of the recombiner to recombine the hydrogen in the offgas system.

Lower dissolved oxygen content in the associated water system can result in accelerated general corrosion and flow-assisted corrosion (FAC) of carbon steel piping systems such as Feedwater, Condensate, Main Steam, Extraction Steam, and Heater Drain Systems. Low oxygen concentration values in fluids passing through carbon steel piping results in accelerated corrosion due to stripping of the oxide layer. To mitigate this effect in the carbon steel water system piping most susceptible to flow-assisted corrosion, Feedwater and Condensate Systems, a small amount of oxygen is also injected into the Hotwell suction pipe header.

The addition of moderate amounts of hydrogen will result in the increase of shutdown dose rate radiation due to the movement of cobalt-60 on to the reactor external piping. This effect is mitigated by the addition of Depleted Zinc Oxide (DZO).

Moderate HWC can also produce increases in N-16 radiation in the steam areas of the plant. The effect of HWC on Main Steam Line Radiation (MSLR) level can be mitigated by Noble Metals Chemical Addition (NMCA) and the On-Line NobleChem System (OLNC). NMCA and OLNC treat the reactor surfaces with a catalytic material, thereby reducing the amount of hydrogen required to achieve the same level of IGSCC protection. In combination with NMCA and OLNC the hydrogen flow, and therefore the N-16 radiation increase, is reduced.

9.3.8.2 System Description

The hydrogen water chemistry system is shown schematically by <Figure 9.3-35>. The hydrogen water chemistry system consists of a storage subsystem, a supply subsystem, and an injection subsystem.

Liquid Hydrogen (H_2) and Oxygen (O_2) are cryogenically stored. The liquid hydrogen is pumped into supplemental gaseous storage tanks. The gaseous and cryogenic storage tanks are designed, fabricated, tested, and stamped in accordance with ASME Section VIII, Division 1. Hydrogen and oxygen piping complies with standard industrial code requirements as specified by EPRI NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations-1987 Revision". The cryogenic piping is designed to ANSI B31.3 and all other system piping is designed to ANSI B31.1.

The storage tanks are designed to withstand tornado missiles and design basis seismic loading. The associated foundations are designed to ensure that tanks remain in place for seismic, design basis tornado, site-specific flood, and ice and snow conditions. Drainage between the separate hydrogen and oxygen storage areas ensures that a liquid spill from either tank storage area will not flow toward, pond or accumulate within 75 ft. of each other.

The liquid hydrogen and oxygen are cryogenically stored in separate storage facilities remote from the nearest safety-related structure and air intakes into safety-related structures. The location of the storage facility complies with the separation distance outlined in EPRI NP-5283-SR-A, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations-1987 Revision" as well as OSHA Standards 29 CFR 1910.103 and 29 CFR 1910.104. This separation distance ensures that the thermal flux from a potential hydrogen gas fireball or the blast overpressure from a potential hydrogen blast will not cause failure of any safety-related structures. The routing for the hydrogen delivery truck meets the requirements of <Regulatory Guide 1.91> as specified in EPRI NP-5283-SR-A.

Excess flow check valves are provided at the storage facility to limit any hydrogen or oxygen release that may develop in the supply or injection subsystems.

The supply subsystem includes the hydrogen and oxygen pipelines and instrumentation lines between the storage facility and the turbine building. The hydrogen and oxygen is delivered to the Unit 1 Turbine Building and Heater Bay Building by two 2-inch diameter pipes (one for each commodity). The supply subsystem piping is not routed inside or attached to the outside of safety-related structures. All the HWC supply globe valves installed inside the plant buildings are equipped with zero leakage bellows seals.

The injection subsystem consists of hydrogen and oxygen injection modules, control stations, and associated interfaces required to monitor and control the injection of hydrogen and oxygen. Various parameters are monitored, which isolate the flow of oxygen and hydrogen or shutdown the HWC System in order to preclude the potential for the development of a flammable or explosive atmosphere.

A Programmable Logic Controller (PLC) controls the HWC System. A number of monitored system parameters, including those parameters that could indicate a problem with hydrogen/oxygen leakage, are received by the PLC and result in an alarm of the HWC System. In addition to Control Room or Local shutdown signals, the PLC will shutdown the HWC System based on input signals from the HWC System and selected interfacing systems.

The HWC System includes a cross-tie connection to the Generator Hydrogen Supply System to provide an alternate hydrogen supply to the main generator from the HWC storage facility.

The On-Line NobleChem (OLNC) system is a nonsafety-related sub-system to the HWC system. The OLNC system is comprised of an injection system and a Mitigation Monitoring System (MMS). The injection portion injects a noble metal compound into the reactor feedwater system during plant operation, to produce catalytic deposits on the reactor internal surfaces. The MMS analyzes the amount of noble metal remaining on the monitor's sample coupons, which is representative of the amount of noble metal remaining on the internal surfaces of the reactor vessel.

9.3.8.3 Safety Evaluation

The hydrogen water chemistry system is nonsafety-related and is not required for safe shutdown of the reactor.

The hydrogen injection system is located in a portion of the Heater Bay (hydrogen injection) and Turbine Building (oxygen injection) remote from safety-related equipment. In the event an accident occurs, there is no interaction between the HWC injection system and other plant components which may need to perform a safety-related function.

Liquid Hydrogen (H_2) and Oxygen (O_2) are cryogenically stored in separate storage facilities remote from the nearest safety-related structure and air intakes into safety-related structures. Excess flow check valves are provided at the storage facility to limit any hydrogen or oxygen release that may develop in the supply or injection subsystems.

Possible effects of explosions or toxic gases without damage that would prevent a safe and orderly shutdown of the plant are evaluated in <Section 2.2.3>.

The HWC System is designed, installed, operated, and maintained in accordance with the provisions of <Regulatory Guide 8.8> and <Regulatory Guide 8.10> to assure that occupational radiation exposures and doses to the general public will be maintained “as low as reasonably achievable.”

In normal BWR water chemistry, N-16 combines with oxygen to form water-soluble, nonvolatile nitrates and nitrites. However, when hydrogen is injected into the feedwater, N-16 forms a more volatile species (NH_3). Therefore the steam phase N-16 levels are increased. The effect of HWC on Main Steam Line Radiation (MSLR) level is mitigated by NMCA and OLNC, as less hydrogen is required to provide a given level of IGSCC protection. In combination with NMCA and OLNC, hydrogen flow is reduced to the point where N-16 radiation increases are negligible.

9.3.8.4 Testing and Inspection

Periodic preventative maintenance and calibration will be performed on all major equipment and instruments to ensure proper in-service operation.

Appropriate helium leak tests shall be performed on all portions of the system following any modifications or maintenance activity that could affect the pressure boundary of the system.

The storage facility will be maintained by the storage facility vendor.

TABLE 9.3-1

PNEUMATICALLY OPERATED VALVES WHICH HAVE A SAFETY FUNCTION

	Valve Application	Failure Mode
a.	Main steam isolation valves	Accumulators supply air to assist spring force in closing valves.
b.	Main steam relief valves	Accumulators supply air for operating valves. Spring loaded pop-action provides over-pressure protection.
c.	Scram valves	Loss of air causes a reactor scram.
d.	Scram volume vent and drain valves	Valves fail closed which is the position desired for a reactor scram.
e.	Control rod drive flow regulator	Results in full control fluid flow which does not affect normal rod drive operation.
f.	RCIC system drain valves	Drain valves fail closed allowing normal operation of system.
g.	Containment vessel purge supply isolation valves	Valves close by spring force.
h.	Drywell purge supply isolation valves	Valves close by spring force.
i.	Containment vessel and drywell purge exhaust isolation valves	Valves close by spring force.
j.	Control room outside air intake isolation valves	Valves close by spring force.

TABLE 9.3-2

STANDBY LIQUID CONTROL SYSTEM OPERATING CONDITIONS FOR VARIOUS OPERATING MODES[1]

Piping	Standby Mode[1] Pressure (psig)[3]	Temp (°F)	Circulation Test Pressure (psig)[3]	Temp (°F)	Injection Test[2] Pressure (psig)[3]	Temp (°F)	Operating Mode[1] Pressure (psig)[3]	Temp (°F)
Pump Suction	Storage Tank Static Head	70/100 See Note[4]	Test Tank Static Head[5]	70/100 See Note[4]	Test Tank Static Head[5]	70/100 See Note[4]	Storage Tank Static Head	70/100 See Note[4]
Pump Discharge to Explosive Valve Inlet	Storage Tank Static Head	70/100	0/1220	70/100	70 Plus Reactor Static Head	70/100	(70 Plus Reactor Static Head) to 1220	70/100
Explosive Valve Outlet to But Not Including First Isolation Check Valve	Reactor Static Head To 1162[6]	70/100	Reactor Static Head To 1162[6]	70/100	<70 Plus Reactor Static Head	70/100	(<70 Plus Reactor Static Head) to <1220	70/110
First Isolation Check Valve To The Reactor	Reactor Static Head To 1150[6]	70/560 See Note[7]	Reactor Static Head	70/560 See Note[7]	Reactor Static Head[2]	125[2]	Reactor Static Head To 1162[6]	70/560 See Note[7]

NOTES:

(1) The pump flow rate will be zero (pump not operating) during the standby mode and at rated during the test and operating modes.

(2) Reactor to be at 0 psig and 125°F before changing from the standby mode to the injection test mode.

TABLE 9.3-2 (Continued)

NOTES: (Continued)

(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 elevation difference and pressure drop between such intermediate points and the 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 Isolation Check Valve to The Reactor	Reactor Sparger Outlet

(4) During chemical mixing, the liquid in the storage tank will be at a temperature of 150°F maximum.

(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 1,162 psig at reactor high pressure core spray sparger outlet.

(7) Maximum sustained operating temperature is 560°F.

9.4 AIR CONDITIONING, HEATING, COOLING, AND VENTILATING SYSTEMS

9.4.1 CONTROL COMPLEX HVAC SYSTEMS

The control complex heating, ventilating and air conditioning (HVAC) systems are as follows:

a. Motor control center (MCC), switchgear and miscellaneous electrical equipment areas HVAC system.

b. Battery room exhaust system.

c. Controlled access and miscellaneous equipment area HVAC system.

d. Computer rooms HVAC system.

9.4.1.1 Design Bases

9.4.1.1.1 MCC, Switchgear and Miscellaneous Electrical Equipment Area HVAC System

Design bases for the MCC, switchgear and miscellaneous electrical equipment areas HVAC system are as follows:

a. This system, excluding the electric reheat coils, is classified as Safety Class 3, Seismic Category I. The electric reheat coils are classified as nonsafety-related and non-seismic category. The design of this system complies with the requirements of General Design Criteria (GDC) 1, 2, 3, 4, and 5 of <10 CFR 50, Appendix A> and <10 CFR 50, Appendix B>. The requirements of <Regulatory Guide 1.26>, <Regulatory Guide 1.29>, <Regulatory Guide 1.47>, and <Regulatory Guide 1.53>, National Fire Protection

Association (NFPA) 90A, and Branch Technical Position APCSB 9.5-1 have also been considered in the system design and equipment procurement.

b. This system is:

1. Required to operate during normal, shutdown, loss of offsite power periods, and following a LOCA.

2. Started manually from local panels with automatic start of redundant system components upon indication of low system air flow.

3. Designed to maintain areas served by this system at the conditions given in <Figure 3.11-17>.

4. Designed to remove heat generated in the dc switchgear rooms, HPCS switchgear rooms, reactor protection rooms, cable spreading areas, and HVAC equipment rooms.

5. Continuously monitored to indicate system operating status, outside air, return air, relief air damper position, system malfunction, smoke in the supply and return air ducts.

6. Provided with redundant and separated equipment, controls and power supplies so that a single active component failure will not prevent satisfactory system operation.

7. Designed with system components located in an area not affected by internally generated missiles. Pipe whip, jet impingement and flooding effects resulting from breaks in high or moderate energy piping are reviewed in <Section 3.6> and are insufficient to cause a loss of system redundancy.

8. Provided with outside air intake ducts and relief air ducts with structural missile barriers to prevent external missiles from entering the control complex.

9. Provided with smoke exhaust capabilities for the cable spreading, MCC and switchgear rooms, and the control complex chase.

9.4.1.1.2 Battery Room Exhaust System

Design bases for the battery room exhaust system are as follows:

a. The design bases listed for the HVAC system discussed in <Section 9.4.1.1.1>, Items a, b1, b2, b5, b6, and b7 are applicable to the battery room exhaust system. Maximum indoor design temperature is 85°F.

b. The battery room exhaust system is:

1. Designed to prevent the accumulation of combustible gas in the battery rooms, and to exhaust the control room lavatories, control room conference room and kitchen to the outside during normal plant operation and plant shutdown.

2. Provided with structural missile barriers on the relief air ducts to prevent external missiles from entering the control complex.

9.4.1.1.3 Controlled Access and Miscellaneous Equipment Areas HVAC System

Design bases for the controlled access and miscellaneous equipment areas HVAC system are as follows:

a. This system, excluding the filter plenum and tornado dampers, is classified as nonsafety-related and non-seismic category. However, the cooling coils and related piping of this system will not rupture during a safe shutdown earthquake or an operating basis earthquake. The filter plenum is classified as nonsafety-related, Seismic Category I. The tornado dampers are classified as Safety-Related, non-seismic. The design of the HVAC system complies with the requirements of GDCs 60 and 61 of <10 CFR 50, Appendix A>. <Regulatory Guide 1.29>, <Regulatory Guide 1.140>, and <Regulatory Guide 3.2>, NFPA 90A, and Branch Technical Position APCSB 9.5-1 have also been considered in the system design and equipment procurement.

b. The design bases listed for the HVAC system discussed in <Section 9.4.1.1.1>, Items b2, b6, b7, and b8 are applicable to this system.

c. This system is:

   1. Required to operate during normal plant operation and during plant shutdown periods.

   2. Designed to maintain offices, laboratories and equipment areas served by this system at the temperatures given in <Figure 3.11-18>.

   3. Designed to remove heat generated in the various offices, laboratories and shop areas of the controlled access area, and from the miscellaneous equipment areas such as the nuclear

closed cooling pump and heat exchanger rooms, emergency closed cooling pump and heat exchanger areas, and from the HVAC equipment area.

4. Monitored continuously to indicate system operating status, system malfunction, smoke in the supply-return exhaust ducts, and high temperature in the filter plenums.

5. Designed to direct all exhaust flow from this system through a charcoal filter plenum to ensure that the release of radioactivity to the environment is below permissible discharge limits.

9.4.1.1.4 Computer Rooms HVAC System

Design bases for the computer rooms HVAC system are as follows:

a. This system is classified as nonsafety-related and non-seismic category. However, the cooling coils and related piping of this system will not rupture during a safe shutdown earthquake or an operating basis earthquake. The requirements of NFPA 90A and Branch Technical Position APCSB 9.5-1 have also been considered in the system design and equipment procurement.

b. The design bases listed for the HVAC system discussed in <Section 9.4.1.1.1>, Items b2, b6 and b7 are applicable to this system.

c. This system is:

   1. Required to operate during normal plant operation.

2. Designed to maintain the computer rooms and the cable spreading areas at the temperature and relative humidity given in <Figure 3.11-17>.

3. Designed to remove heat generated by the computer rooms, adjacent cable spreading areas and control complex HVAC equipment room.

4. Continuously monitored to indicate system operating status, system malfunction and high computer room temperature.

9.4.1.2 System Description

9.4.1.2.1 MCC, Switchgear and Miscellaneous Electric Equipment Areas HVAC System

This system, shown on <Figure 9.4-1>, operates continuously to provide cooling or heating during normal plant operation, during plant shutdown and following loss of offsite power or a LOCA. The areas served by this system include MCC, switchgear, dc switchgear rooms, battery rooms, HPCS switchgear rooms, reactor protection system rooms, remote shutdown panel rooms, cable spreading areas, and HVAC equipment rooms. The HVAC system consists of two 100 percent capacity supply plenums (M23-B001A, B) that house roughing filters and chilled water cooling coils, two 100 percent capacity supply fans (M23-C001A, B), a supply duct system with electric reheat coils (M23-B002A,B,C,D and M23-B003A,B,C,D), and a return duct system. One-hundred percent capacity based on removing the heat resulting from simultaneous operation of the equipment in these areas for Unit 1 and Unit 2.

The plenums and fans are located in the control complex at Elevation 679'-6". The A equipment is in a separate room from the B equipment. The duct systems and controls are arranged so that a mixture of outside air and return air from the HVAC equipment room is directed through the cooling plenum and supplied to the various areas requiring cooling or heating. Room air, from all areas except the battery rooms, after satisfying the cooling or heating function, is directed to the return fan and delivered to the HVAC equipment room. The routing of return air from the battery rooms is discussed in <Section 9.4.1.2.2>. Operation of the system in a recirculation mode, with no outside air addition and no exhaust to the outside, is also discussed in <Section 9.4.1.2.2>. Specific areas noted in <Section 9.4.1.1.1> are also served by a manually started smoke removal system.

Regular ac offsite power sources have been provided for this system. If loss of offsite power or receipt of a LOCA signal occurs, redundant emergency power is available from the diesel generators.

Inactive supply or return components are isolated from the system by backdraft dampers and by automatically controlled duct dampers. Redundant supply and return components automatically start upon indication of low flow from the operating system.

9.4.1.2.2 Battery Room Exhaust System

This system, shown on <Figure 9.4-1>, operates continuously during normal plant operation, during plant shutdown and following loss of offsite power or a LOCA to exhaust the battery rooms to the outside. In the event of an emergency, the exhaust may be remote-manually redirected to a recirculation mode. In this mode, the exhaust air from the battery rooms is directed to the supply plenum described in <Section 9.4.1.2.1>; the outside air damper for the system described in <Section 9.4.1.2.1> is closed.

The exhaust system consists of two 100 percent capacity exhaust fans (M24-C001A, B), exhaust and recirculation duct systems. One-hundred percent capacity based on the exhaust flow required from simultaneous operation of the battery rooms in Unit 1 and Unit 2.

The exhaust fans are located in the control complex at Elevation 679’-6”. The A equipment is in a separate room from the B equipment.

Regular ac offsite power sources have been provided for this system. In the event of loss of offsite power or receipt of a LOCA signal, redundant emergency power is available from the diesel generators.

Inactive exhaust fans are isolated from the system by backdraft dampers and by automatically controlled dampers.

The redundant exhaust fan starts automatically upon indication of low flow from the operating system.

9.4.1.2.3 Controlled Access and Miscellaneous Equipment Areas HVAC System

This system, shown on <Figure 9.4-2>, operates continuously during normal plant operation and during plant shutdown to provide cooling and heating for various areas, and exhaust capabilities for various laboratory hoods and the CC-620 RRA Access Area Count Room. The areas served by this system include the controlled access rooms, miscellaneous areas such as the nuclear closed cooling pump and heat exchanger rooms, emergency closed cooling pump and heat exchanger area, hot laundry area, laboratory hoods, HVAC equipment rooms, and electric maintenance room. The system consists of:

a. Two 100 percent capacity supply plenums (M21-B001A, B) housing roughing filters and chilled water cooling coils.

b. Two 100 percent capacity supply fans (M21-C002A, B).

c. Two 100 percent capacity return fans (M21-C003A, B).

d. Two 100 percent capacity exhaust plenums (M21-D001A, B), housing roughing, HEPA, and charcoal filters.

e. Two 100 percent capacity exhaust fans (M21-C001A, B).

f. A supply duct system with electric reheat coils.

g. A return duct system.

h. An exhaust duct system.

i. A recirculation duct system.

One-hundred percent capacity is based on removing the heat resulting from simultaneous operation of the equipment in these areas for Unit 1 and Unit 2.

The plenums and fans are located in the control complex at Elevation 679’-6”. The A equipment is in a separate room from the B equipment. The duct systems and controls are arranged so that a mixture of outside air and return air from the HVAC equipment room is directed through the cooling plenum and is supplied to the various areas requiring cooling or heating. After satisfying the cooling or heating functions, room air from non-contaminated areas is ducted to the return air fan and from there is discharged to the HVAC equipment room. Room air from contaminated or potentially contaminated areas is ducted to the filter system and is then discharged to the unit plant vent.

In the event of an emergency, the filter plenum discharge may be remote-manually redirected to a recirculation mode. In this mode, the exhaust from the filter plenum is directed to the supply plenum discussed above, with the outside air damper to the supply plenum closed.

During normal plant operation and during plant shutdown, power will be provided to this system from the preferred ac source. During periods of emergency, this system is not required to operate to safely shut down the plant.

In the event of loss of offsite power or a LOCA, specific areas supplied by this system are cooled by the emergency closed cooling pump area cooling system <Section 9.4.5>. These specific areas are the emergency closed cooling pump and heat exchanger area, and areas housing the chillers and service air compressors.

Inactive supply or return components are isolated from the system by backdraft dampers and by automatically controlled duct dampers. Redundant supply, return and exhaust components automatically start upon indication of low air flow from the operating system.

The supply, exhaust and return fans maintain constant air flow through the automatic control of fan inlet vanes.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-18> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

9.4.1.2.4 Computer Room HVAC System

This system, shown on <Figure 9.4-3>, operates continuously during normal plant operation to provide cooling and to maintain humidification in the computer room, to cool adjacent cable spreading areas and to supplement cooling of the control complex HVAC equipment room. The HVAC system consists of two 100 percent capacity supply air handling units (M27-B001A, B), each including roughing filters, chilled water cooling coils and supply duct systems with steam humidifiers.

One-hundred percent capacity is based on removing the heat resulting from simultaneous operation of equipment in these areas for Unit 1 and Unit 2.

The air handling units are located in the control complex at Elevation 679’-6”. The A equipment is in a separate room from the B equipment. The duct systems are arranged so that cooled air from the air handling unit is ducted directly to the computer room. After absorbing heat from the computer room equipment, this air passes through the adjacent cable spreading area and returns to the heating and ventilating equipment room where the cooling cycle is repeated. During normal plant operation, power will be provided to this system from the preferred ac source. During periods of emergency, this system is not required to operate to safely shut down the plant. A pneumatically operated damper in the discharge duct of each air handling unit opens when the fan motor is energized and closes when the fan motor is de-energized. When in the standby mode, the redundant air handling unit automatically starts upon indication of low air flow in the operating system.

9.4.1.3 Safety Evaluation

The MCC, switchgear and miscellaneous electrical equipment areas HVAC system, the battery room exhaust system, and the controlled access and miscellaneous equipment areas HVAC system have been provided with smoke detectors. These detectors are in the supply, return and relief ductwork, and will alarm in the control room on the indication of smoke. The charcoal filter plenums in the controlled access and miscellaneous equipment areas HVAC system have been provided with continuous monitoring of the charcoal bed temperatures, and with high and high-high control room alarms. A smoke purge system has been provided to exhaust smoke from the MCC and switchgear rooms, the cable spreading areas and the control complex chase.

The computer room HVAC system has been provided with high temperature detectors and high-low humidity detectors that alarm in the control room on indication of high or low levels.

Outside air and relief air ducts, supply, return and exhaust fans, air handling units, and filter plenums for the systems discussed in <Section 9.4.1> have been provided with dampers for automatic isolation of the equipment components, and for isolation of the outside air and relief air ducts from the areas served. This isolation minimizes the possibility of spreading contamination from a defective component or area.

Areas with potential for radioactive contamination in the controlled access area have been provided with charcoal filter systems which include redundant filter plenums and redundant exhaust fans.

Areas with potential for radioactive contamination in the controlled access area are continuously purged, with the air discharged through charcoal filters to the outside. Battery rooms are also continuously purged with the air discharged directly to the outside. The systems effecting this purge are redundant. Where potential for radioactivity exists, air flow is in the direction of lesser to greater levels of radioactivity; in laboratories, exhaust is directed through laboratory hoods.

All of the systems described in <Section 9.4.1> are continuously monitored from the control room for operating status of components and for system air flow. Low air flow caused by equipment malfunction or equipment degradation causes automatic change over to the redundant equipment component. Additionally, the rooms served by the MCC, switchgear and miscellaneous electrical equipment areas HVAC systems, and the computer rooms systems are continuously monitored for ambient air temperature with high alarm and main control room readout. The computer rooms are also continuously monitored for ambient relative humidity with high and low alarm in the main control room.

9.4.1.4 Inspection and Testing Requirements

The various components of the cooling, heating and ventilation systems described in <Section 9.4.1> are accessible for inspection and testing during normal plant operation. The ability to isolate an idle redundant component for each system enables inspection, maintenance and testing to be performed while the system is in normal operation.

Periodic tests will be performed on the controlled access area charcoal exhaust filter systems. These tests will include measurement of differential pressure across the filter units, field determination of efficiency of HEPA filters and laboratory determination of charcoal filter efficiency to demonstrate that aging, weathering or poisoning of the filters have not significantly affected the HEPA filters or degraded the adsorptive material in the charcoal filters.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other safety devices to ensure that these operational components perform their function reliably and accurately during normal operation, and under conditions of operating interruptions.

9.4.1.5 Instruments, Controls, Alarms, and Protective Devices

9.4.1.5.1 MCC, Switchgear and Miscellaneous Electrical Equipment Areas HVAC Systems

Instrumentation, controls, alarms, and protective devices for the MCC, switchgear and miscellaneous electrical equipment areas HVAC system are as follows:

a. Operation of this system is initiated manually from a local panel. During normal operation, one of the two sets of redundant components operates continuously.

b. Operation of system fans and dampers is controlled by a fan train setup switch A or B (stop-standby-on), a two-position selector switch (recirculating and normal) to position dampers, and a manual control switch for each fan as indicated on <Figure 9.4-1>.

c. Details of the instrumentation and controls for this system are discussed in <Section 7.3.1>.

9.4.1.5.2 Battery Room Exhaust System

Operation of the battery room exhaust system is manually initiated from the local panel. During operation, one of the two sets of redundant components operates continuously. Details of the instrumentation and controls for this system are discussed in <Section 7.3.1>.

9.4.1.5.3 Controlled Access and Miscellaneous Equipment Area HVAC System

Instrumentation, controls, alarms, and protective devices for the controlled access and miscellaneous equipment areas HVAC systems are as follows:

a. Operation of this system is initiated from a local panel. During normal operation, one of the two sets of redundant components operates continuously.

b. Instrumentation is provided for indication on the local panel of the following:

   1. Indication of fans in operation (status lights).

   2. Low air flow alarm for each fan (local annunciator point with corresponding system trouble alarm in the control room).

   3. Smoke in each supply, return and exhaust duct (high smoke alarm in the control room with corresponding indicating light on the local panel).

   4. High temperature in the carbon beds (computer alarm point in the control room with corresponding indicating light on the local panel).

   5. High-high temperature in the carbon beds (annunciator alarm point in the control room with corresponding indicating light on the local panel).

   6. Continuous carbon bed temperature indication in the control room.

7. Indication is provided in the control room for which fan train is operating.

c. The major items of instrumentation and controls are as follows:

1. Differential pressure indicator across each supply and exhaust filter plenum with local indication.

2. Pneumatically driven dampers with solenoid valves in each outside air intake duct and in each return duct. The outside air intake dampers will fail open and the return air dampers will fail open on loss of control air.

3. Pneumatically driven dampers with solenoid valves in each HVAC equipment room supply branch duct. The damper will fail open on loss of control air.

4. Pneumatically driven dampers with solenoid valve in the exhaust duct and recirculation duct of each exhaust fan. The exhaust damper (normally open) and the recirculation damper (normally closed) will fail open and fail closed, respectively, on loss of control air.

5. Pneumatically driven fan vortex damper operators to modulate the variable inlet vanes of each supply and exhaust fan. The supply fan damper will fail open on loss of control air. The exhaust fan damper will fail close on loss of control air.

6. Two-position damper selector switch to position the dampers as indicated on the schedule on <Figure 9.4-2>.

7. Air monitoring device in each supply and exhaust fan discharge duct to provide a signal to modulate the variable inlet vanes and to alarm on the local panel and in the control room (SYSTEM TROUBLE) on low air flow. An air monitoring device is

also provided in each return fan discharge duct to alarm on the local panel and in the control room (SYSTEM TROUBLE) on low air flow. An air monitoring device is also provided to furnish a signal for the fan train automatic switchover network. On loss of any operating fan (low flow), the air monitoring device will trip the remaining operating fans in the train and will automatically switch over to the standby fan train.

8. Smoke detector in each supply and exhaust fan discharge duct to give alarm indication on the local panel and to alarm in the control room upon detection of smoke.

9. Smoke detector in the main return branch to give alarm indication on the local panel and to alarm in the control room upon detection of smoke in the return air. This high smoke signal will also trip the return fans and close dampers to preclude discharging smoke into the HVAC equipment room. In addition, solenoid valves are energized to reduce the supply fan air flow rate to avoid pressurizing potentially contaminated rooms in the radiologically restricted areas.

10. Pneumatic temperature transmitter in the fan discharge duct to modulate the three-way valve in the chilled water coil, depending on the discharge air temperature.

11. Electronic room thermostats to control the electric duct reheat coils.

12. Temperature sensors (thermistors) for the charcoal filters providing an electrical signal to a local temperature monitor unit. The temperature monitor unit provides the following output signal:

    (a) Analog output signal to a temperature indicator located in the control room to provide continuous temperature indication.

    (b) High temperature alarm (225°F) contacts to provide alarm indication on the local control panel and the main computer.

    (c) High-high temperature alarm (250°F) contacts to provide alarm indication on the local control panel and the common HVAC panel in the control room.

13. A fan train setup switch and individual remote-manual fan control switches are provided on the local panel for fan train control.

14. A pneumatic actuated ball valve with solenoid valve to drain spray water from the charcoal beds during fire protection spray deluge valve activation. Solenoid valve is energized when the push button is depressed with the collar of spray deluge valve switch in the armed position which allows the control air to operate the piston operator, thus opening the ball valve. The drain valve will remain open until manually closed by the manual override lever.

9.4.1.5.4 Computer Room HVAC Systems

Instruments, controls, alarms, and protective devices for the computer room HVAC systems are as follows:

a. Operation of this system is initiated manually from a local panel, so that either the A or the B set of components is operating with the redundant set of components as backup.

b. Instrumentation is provided for indication on the local control panel (with corresponding system trouble alarm in the control room) of the following:

   1. Indication of which air handling unit is operating (status light).

   2. Low air flow alarm for each air handling unit fan with the fan running (annunciator point).

   3. High or low relative humidity in the computer rooms (annunciator point).

c. The major instruments and controls are as follows:

   1. Differential pressure switch across each air handling unit fan to alarm on low air flow and to automatically start the backup air handling unit.

   2. Pneumatically driven discharge damper in the main supply duct of each air handling unit that automatically opens (closes) when the corresponding air handling unit fan motor is energized (de-energized).

3. Three-way solenoid valves to automatically close (open) the control air supply port to the pneumatic driven dampers when the corresponding air handling unit is stopped (started).

4. Temperature transmitters, temperature indicators and pneumatic temperature controllers in the computer rooms to modulate the three-way valve controlling chilled water flow through the air handling unit cooling coils.

5. Humidity controllers in the computer rooms to modulate the humidifier control valve controlling the amount of steam discharge to the supply air stream.

6. High and low limit moisture switches that provide a signal to alarm the control room of high or low relative humidity condition in the computer rooms. High limit moisture switches also automatically close steam supply motor-operated valves at the same high setpoint and automatically open the valves when the relative humidity is low.

7. Temperature element in each computer room to alarm in the control room if the room temperature rises above the high temperature setpoint.

9.4.2 FUEL HANDLING AREA VENTILATION SYSTEM

The fuel handling area ventilation system (FHAVS) is comprised of the fuel handling area supply subsystem (FHASS) and the fuel handling area exhaust subsystem (FHAES). These systems provide ventilation for the general fuel handling area, fuel pool area, control rod drive pump areas, and the fuel pool cooling equipment room.

9.4.2.1 Design Bases

Design bases for the FHASS and the FHAES are as follows:

a. The FHASS and FHAES are classified as Safety Class 3, Seismic Category I. System design complies with the requirements of General Design Criteria (GDC) 1, 2, 4, 5, 60, and 61 of <10 CFR 50, Appendix A>. The guidance provided by <Regulatory Guide 1.3>, <Regulatory Guide 1.13>, <Regulatory Guide 1.26>, <Regulatory Guide 1.29>, <Regulatory Guide 1.47>, <Regulatory Guide 1.52>, and <Regulatory Guide 1.183> has been considered in the system design.

b. The FHASS and FHAES are not required for safe shutdown of the plant in the event of a LOCA. Also, the FHAES is no longer credited to operate to mitigate the consequences of a fuel handling accident. Redundant components are provided to satisfy the single failure criterion even though dose calculations show that after 24 hours of radiological decay time, credit for FHAES filtration is no longer required to meet the licensing basis acceptance criteria for a fuel handling accident <Section 15.7.4> and <Section 15.7.6>. Fuel handling is prohibited prior to 24 hours of radiological decay, because no dose calculations exist to address a fuel handling accident within the first 24 hours of an outage.

c. The FHASS and FHAES are initially started and subsequently operated remote-manually from the control room.

d. The FHASS and FHAES are designed to maintain the temperature of the fuel handling areas, and any other areas they serve, between the temperatures given in <Figure 3.11-32>, <Figure 3.11-33>, and <Figure 3.11-34>. This temperature range is suitable for operating personnel and equipment.

e. Although not credited in the fuel handling accident analysis, the FHASS and FHAES are designed so that air flow is directed from areas of low probable airborne contamination to areas of high probable airborne contamination.

f. The FHAES passes exhaust air from the fuel handling area through charcoal filter trains to ensure that release of radioactivity to the environment is kept below permissible discharge limits.

g. The FHASS outside air intake is provided with a structural missile barrier to prevent external missiles from entering the fuel handling area. The air intake duct is provided with two barometric pressure relief dampers. The system discharges the exhaust air to the atmosphere through a concrete vent which provides a structural barrier against external missiles.

h. The major components of the FHAVS are physically separated and located so that they are not affected by internally generated missiles, pipe whip and jet impingement forces associated with breaks in high and moderate energy piping.

i. Design features of the FHAES are also contained in <Section 6.5.1>.

9.4.2.2 System Description

Ventilation of the fuel handling area and other associated areas is accomplished by the FHAVS. This system is shown schematically on <Figure 9.4-4>.

The FHAVS is designed to provide heating and ventilation for the various operating areas of the fuel handling area and ventilating equipment areas, and to provide effective protection for personnel against airborne radioactive contaminants.

The FHASS continuously draws outside air through roughing filters and heating coils. One of the two 100 percent capacity supply fans (M40-C001 A, B) normally operates to draw air through the supply plenum and discharge it to the supply ductwork for distribution. The areas provided with supply air are the control rod drive pump areas, the FHAVS equipment area, the railway and overhead crane area, and the periphery of the fuel pool area on all sides. The general air flow pattern in the fuel handling area is from areas of low probable airborne contamination to areas of high probable airborne contamination.

The ventilation pattern in the fuel pool areas is from the supply around the periphery of the pools toward the exhaust located directly above the pools.

The FHAES continuously draws air from the CRD pump areas, the control rod drive maintenance area, the area above the fuel pools, and from the fuel pool cooling, cleaning and postaccident sampling system (PASS) equipment rooms located in the intermediate building. Two of the three 50 percent charcoal exhaust units are operating normally to draw air through the exhaust ductwork and discharge it to the atmosphere through the unit vent.

In the event that the radiation monitors located upstream of the charcoal exhaust units senses high radiation, the high radiation signal alarms in the control room and automatically trips the supply fan. The exhaust system remains operational to continue exhausting contaminated air from the fuel handling area through charcoal filters, thus precluding any uncontrolled release of radioactivity to the outside. Two barometric pressure relief dampers (F575 and F576) in the supply duct would relieve any excessive negative building pressure. This filtration is not credited in the fuel handling accident analysis.

During normal plant operation and plant shutdown, power will be provided by the preferred ac source. In case of a LOCA, this system is not required to operate to safely shut down the plant. However, during loss of offsite power (without LOCA), this system is automatically connected to the diesel generator and may be started manually at the operator's option.

To comply with the single failure criterion, the power for exhaust fan M40-C002C and filter train M40-D001C is provided from Division 1 or Division 2, preferred ac sources. The division transfer at the motor control center is done by a manual key interlock system. An effective means to maintain cable and wiring separation between Division 1 and Division 2 is achieved by the installation of totally enclosed raceways. The raceways and wiring are installed as Division 2, except for the Division 1 main feed to the motor control center.

The supply and exhaust fans are provided with variable inlet vanes to maintain a constant air flow in each of the systems as filters get dirty. Isolation dampers are also provided for isolation of idle units.

The major components of the fuel handling area supply system are located in the fuel handling area at Elevation 599'-0" and consist of two 100 percent capacity supply fans (M40-C001A & B) and one 100 percent capacity supply plenum (M40-B001). The supply plenum includes roughing filters and hot water heating coils.

The major components of the fuel handling area exhaust system are located in the intermediate building at Elevation 682'-6" and consist of three 50 percent capacity exhaust fans (M40-C002A, B and C) and three 50 percent filter trains (M40-D001A, B and C). These filter trains include demisters, roughing filters, electric heating coils, HEPA prefilters, charcoal filters, and HEPA after-filters.

The components of the supply and exhaust systems are of standard industrial design manufactured to meet the Quality Assurance requirements of Safety Class 3, Seismic Category I items. Filter racks, frames and plenums are specially designed to satisfy the system space requirements, and meet the QA and seismic requirements.

For additional filtered exhaust system details refer to <Section 6.5> and <Section 12.3>. <Figure 12.3-16> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.52> as presented in <Table 6.5-2>.

9.4.2.3 Safety Evaluation

Provision for redundant supply and exhaust components ensures that adequate ventilation will be provided in the event of any single component failure. Air flow control maintaining the flow direction and flow rates and providing an effective filtration system, provides an effective means of controlling radioactive release to the atmosphere.

On loss of control air, the air monitor flow control vortex damper for the supply and exhaust fans will fail in the open position and the system will continue to operate (provided there is no loss of offsite power).

In case of fire, the ventilation system will continue to operate to supply and exhaust from the building and handle the products of combustion through appropriate ventilation duct. This will continue until the temperature transmitters located in specific areas of the supply and exhaust ducts sense high temperature; indication of high temperature automatically stops the operating fan. System fans can be shut off by a manual switch in the control room at the operator's option.

Radiation monitoring is also provided to alarm in the control room if the radioactivity level in the exhaust air exceeds a preselected set point. The radiation monitor is located in the ventilation exhaust duct at the main exhaust header, and draws representative samples of the air from the area. Details of the radiation monitoring system and set points are discussed in <Section 12.2>. Evaluation and analysis of radiological considerations during normal operation and a fuel drop accident are discussed in <Section 12.2> and <Chapter 15.0>, respectively. Comparison of the fuel handling building exhaust air filtration system with the positions in <Regulatory Guide 1.52> is given in <Section 6.5.1>.

9.4.2.4 Inspection and Testing Requirements

The components of the fuel handling building ventilation supply and exhaust subsystems are accessible during normal plant operation, shutdown and refueling operations. The ability to isolate an idle redundant component enables inspection, maintenance and testing to be performed while the system is in normal operation. When maintenance and testing are required on the common supply plenum, the supply system will be shut down.

Periodic tests will be performed on the fuel handling building exhaust filter system. These tests will include measurement of differential pressure across the filter units and determination of filter efficiency to demonstrate that aging, weathering or poisoning of the filters has not significantly degraded the adsorptive material in the charcoal and HEPA filters. <Section 6.5.1> gives additional testing requirements for the charcoal filter trains.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other safety devices to ensure that these operational components perform their function reliably and accurately during normal operation, and under conditions of operating interruptions.

9.4.2.5 Instruments, Controls, Alarms, and Protective Devices

Operation of the fuel handling area ventilation supply and exhaust subsystems is manually initiated from the control room. During operation, one of the two supply fans and two of the three exhaust fans operate continuously. The supply fans are interlocked to operate only when the exhaust fans are operating, and are interlocked to trip when either of the temperature transmitters in the supply duct senses high temperature. The exhaust fans are interlocked to trip when the charcoal filter deluge valves are armed or actuated, and when either of the temperature transmitters in the exhaust duct senses high temperature. Details of the instrumentation and controls for this system are discussed in <Section 7.3.1>.

9.4.3 AUXILIARY AND RADWASTE AREA VENTILATION SYSTEMS

The auxiliary and radwaste building ventilation systems consist of separate systems for the auxiliary building, steam tunnel and radwaste building.

9.4.3.1 Design Bases

9.4.3.1.1 Auxiliary Building Ventilation System

Design basis for the auxiliary building ventilation system (ABVS) is as follows:

a. The ABVS is classified as nonsafety-related and non-seismic category, except for the exhaust system charcoal filter plenum and for ductwork in close proximity to safety class equipment. These exceptions are classified as Seismic Category I. The design of the systems complies with the requirements of General Design Criteria (GDC) 60 and 61 of <10 CFR 50, Appendix A> and <10 CFR 50, Appendix B>. The requirements of <Regulatory Guide 1.29>, <Regulatory Guide 1.140>, National Fire Protection Association (NFPA) 90A, and Branch Technical Position APCSB 9.5-1 have also been considered in the system designs and equipment procurement.

b. The ABVS is:

1. Not required to operate to safely shut down the plant in the event of a LOCA.

2. Started and stopped from panels local to the supply and exhaust fans.

3. Designed to maintain areas served by this system between the temperatures given in <Figure 3.11-11>, <Figure 3.11-12>, <Figure 3.11-13>, <Figure 3.11-14>, and <Figure 3.11-16>.

4. Designed so that air flow is directed from areas of potentially low radioactivity to areas of higher radioactivity.

5. Designed to maintain flow rates of 3 to 6 air changes per hour for areas of low probable airborne contamination and 6 to 10 air changes per hour for areas of high probable airborne contamination.

6. Designed to maintain constant supply and exhaust air flow despite filter pressure drop increase due to dirt accumulation.

7. Designed to direct the exhaust air of this system through a charcoal filter plenum to ensure that the release of radioactivity to the environment is below permissible discharge limits.

8. Continuously monitored to indicate system status, system malfunction, fire or smoke hazard, and excess radiation in the discharge of this exhaust system.

c. The ABVS outside air intake is provided with a structural missile barrier to prevent external missiles from entering the auxiliary building.

d. The ABVS discharge is directed to the concrete unit vent.

e. The ABVS supply and exhaust fans are physically separated from each other, and are located in equipment areas that would not be affected by internally generated missiles, pipe whip or jet impingement resulting from breaks in high energy piping.

9.4.3.1.2 Steam Tunnel Cooling System

Design bases for the steam tunnel cooling system (STCS) are as follows:

a. The STCS is classified as nonsafety-related and non-seismic category. The requirements of NFPA 90A and Branch Technical Position APCSB 9.5-1 have also been considered in the system design and equipment procurement.

b. The STCS is:

   1. Not required to operate to safely shut down the plant in the event of a LOCA.

   2. Started and stopped from panels local to the supply fans.

   3. Designed to maintain areas served by this system between the temperatures given in <Figure 3.11-15>.

   4. Designed to relieve the cooling ventilation air to the auxiliary building exhaust system charcoal filter system and turbine building.

5. Continuously monitored to indicate system status and system malfunction.

c. The STCS supply fans are mounted above the inlet plenum in an equipment area that would not be affected by internally generated missiles, pipe whip or jet impingement resulting from breaks in high and moderate energy piping.

9.4.3.1.3 Radwaste Building Supply and Exhaust Systems

Design bases for the radwaste building supply system (RBSS) and radwaste building exhaust system (RBES) are as follows:

a. Bases listed in <Section 9.4.3.1.1>, excluding Item b2, are also applicable to the RBSS and RBES.

b. The RBVS is started from the Radwaste Control Room.

9.4.3.2 System Description

9.4.3.2.1 Auxiliary Building Ventilation System

The auxiliary building ventilation system (ABVS) is shown on <Figure 9.4-5>. The ABVS operates continuously to provide filtered (the supply roughing filters may be removed to preclude snow buildup on the filters) and tempered outside air to various areas of the auxiliary building. The ABVS operates continuously to exhaust these areas and to direct this exhaust through a charcoal filter plenum to the unit vent. The supply system consists of one 100 percent capacity supply plenum (M38-B001) housing roughing filters (the supply roughing filters may be removed to preclude snow buildup on the filters) and hot water heating coils, two 100 percent capacity supply fans (M38-C001A, B) and supply distribution ducts. The exhaust system consists of one 100 percent capacity filter plenum (M38-D001) which houses roughing, HEPA, charcoal and a second bank of HEPA filters, two 100 percent capacity exhaust fans (M38-C002A, B), and exhaust distribution ducts.

The supply and exhaust fans are provided with automatically controlled variable inlet vanes to maintain constant supply and exhaust air flow. Inactive supply or exhaust fans are isolated by automatically controlled dampers.

The filter plenums and the supply and exhaust fans for these systems are located in the auxiliary building at Elevation 620′-6″.

The supply and exhaust ductwork is arranged to satisfy the design bases listed <Section 9.4.3.1> and to serve the following areas:

a. Turbine building chiller hallway area.

b. LPCS pump room.

c. RHR "B" pump and heat exchanger room.

d. RHR "C" pump room.

e. RCIC pump room.

f. RHR "A" pump room and heat exchanger room.

g. HPCS pump room.

h. RWCU pump room.

i. Steam tunnel area.

j. Auxiliary building hallway.

k. ADHR heat exchanger room.

During normal plant operation and during plant shutdown, power will be provided to this system from the preferred ac source. During periods of emergency, this system is not required to operate to safely shut down the plant. See <Section 9.4.5.2.3> for a description of the ECCS pump room cooling system.

A high differential temperature signal causing inadvertent isolation of the RHR and RCIC systems is precluded since dual element thermocouples installed in the RCIC equipment room for sensing high differential temperature are insensitive to sharp variations in outside air temperature.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-20> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

9.4.3.2.2 Steam Tunnel Cooling System

The steam tunnel cooling system (STCS) is shown on <Figure 9.4-6>. It operates continuously to provide filtered and cooled air to the steam tunnel. Cooling air is directed from the auxiliary building general area through the cooling plenum, to the steam tunnel, and is then relieved to the turbine building and to the auxiliary building exhaust system. The STCS consists of one 100 percent capacity supply plenum (M47-B001) which houses roughing filters and chilled water cooling coils, two 100 percent capacity supply fans (M47-C001A, B), supply and relief distribution ducts. Inactive supply fans are isolated by automatically controlled dampers. The filter plenum and the supply fans for this system are located at Elevation 620’-6”. The supply and relief duct is arranged to satisfy the design bases specified above for this system.

During normal plant operation, power will be provided to this system from the preferred ac source. System operation is not required to safely shut down the plant.

9.4.3.2.3 Radwaste Building Ventilation System

The radwaste building ventilation system (RBVS) is shown on <Figure 9.4-7>.

The supply system operates continuously to provide filtered (the supply roughing filters may be removed to preclude snow buildup on the filters) air to various areas of the radwaste building. The exhaust system operates continuously to exhaust these areas and to direct this exhaust through a charcoal filter plenum to the unit vent.

The supply system consists of one 100 percent capacity supply plenum (M31-B001) which houses roughing filters (the supply roughing filters may be removed to preclude snow buildup on the filters) and hot water heating coils, two 100 percent capacity supply fans (M31-C001A, B) and supply distribution ducts.

The exhaust system consists of two 100 percent capacity filter plenums (M31-D001A, B), housing roughing, HEPA, charcoal and a second bank of HEPA filters, two 100 percent capacity exhaust fans (M31-C002A, B) and exhaust distribution ducts. The supply and exhaust fans are provided with automatically controlled variable inlet vanes to maintain constant supply and exhaust air flow. Inactive supply or exhaust fans are isolated by automatically controlled dampers.

The filter plenums and the supply and exhaust fans for these systems are located in the radwaste building at Elevation 623’-6”.

The supply and exhaust ductwork is arranged to satisfy the design bases listed above and to serve all areas of the radwaste building as shown on <Figure 9.4-7>.

During normal plant operation and during plant shutdown, power will be provided to this system from the preferred ac source. During periods of emergency, system operation is not required to safely shut down the plant.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-19> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

9.4.3.3 Safety Evaluation

Providing redundant supply and exhaust fans for the auxiliary building, steam tunnel and radwaste building ensures that adequate ventilation will be provided in case a single failure of an active component occurs. Maintenance of air flow patterns in the direction of progressively greater probability of airborne contamination is ensured by automatically controlling the supply and exhaust air flow rates and by alarming if the design air flow has not been maintained. Provision of charcoal filter systems for all the air exhausted from these areas assures an effective means for controlling the release of radioactivity to the atmosphere. If control air is lost, all outside air dampers and fan isolation dampers close, preventing reverse flow from the unit vent from entering the inactive system.

The duct systems (except STCS) are monitored for high temperature and smoke. Indication of smoke automatically stops the supply fans. A high temperature signal automatically stops the exhaust fans which are interlocked to stop the supply fans.

The charcoal filter plenums are monitored for excessive air temperatures leaving the charcoal beds, which are provided with a fire spray water system.

Radiation monitoring is provided to alarm the control room if the activity in the exhaust air exceeds a preselected set point. Details of the radiation monitoring system are discussed in <Section 12.3.4>.

9.4.3.4 Inspection and Testing Requirements

The components of the cooling, heating and ventilation systems of the auxiliary building steam tunnel and radwaste building are accessible for inspection and testing during normal plant operation except the auxiliary building exhaust plenum. The ability to isolate an idle redundant component enables inspection, maintenance and testing to be performed while the system is in normal operation. When maintenance and testing is required on nonredundant plenums, the system will be shut down. Periodic tests will be performed on the auxiliary building and radwaste building charcoal exhaust filter systems. These tests will include measurement of differential pressure across the filter units and determination of filter efficiency to demonstrate that aging, weathering or poisoning of the filters have not significantly degraded the absorptive material in the charcoal and HEPA filters.

During testing and inspection, provisions will be made to verify the function and performance of the fans, dampers, valves, controls, and other safety devices. This will ensure that these operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.3.5 Instruments, Controls, Alarms, and Protective Devices

9.4.3.5.1 Auxiliary Building Ventilation System

Instruments, controls, alarms, and protective devices for the auxiliary building ventilation system (ABVS) are as follows:

a. Operation of the supply and exhaust fans are manually initiated from the local panel. During operation, one of the two supply fans and one of the two exhaust fans operate continuously. The supply fans are interlocked to be operable only when at least one exhaust fan is operating. The exhaust fans are interlocked to stop when the charcoal deluge switch is armed or actuated, and upon indication of high temperature in the exhaust duct. The exhaust fans are also interlocked to prevent simultaneous operation of both fans on startup and restart following loss of power.

b. Instrumentation is required for indication in a local panel of the following:

   1. Indication of which fan is energized (status light).

   2. Low air flow with fan in operation (alarm locally with corresponding trouble alarm in control room).

   3. Smoke in common fan discharge duct (local indicating light with alarm in the control room).

   4. High temperature in supply fan discharge duct (alarm locally with corresponding trouble alarm in the control room).

   5. High radiation in the exhaust air (indicating light with alarm in the control room).

6. High temperature in the carbon beds (alarm and readout in the control room).

7. Low air temperature alarm downstream of heating coil (alarm locally with corresponding system trouble alarm in the control room).

c. The major items of instrumentation and controls are as follows:

1. Differential pressure indicator, with local indication, across each filter bank.

2. Pneumatically driven damper with solenoid air valve in the outside air intake duct of the supply system. This damper is open during system operation and will fail closed on loss of control air.

3. Pneumatically driven dampers with solenoid air valves in the discharge duct of each supply fan. The dampers will open when the corresponding fan is energized and close when the fan stops. Dampers will fail closed on loss of control air.

4. Pneumatically driven damper with solenoid air valve in the discharge duct of each exhaust fan. The damper will open when the corresponding fan is energized and close when the fan stops. Dampers will fail closed on loss of control air.

5. Air monitoring device switch in each fan discharge duct to provide a signal to modulate the variable inlet vanes and to alarm in the control room on loss of air flow.

6. Smoke detectors in the supply and exhaust fan common discharge ducts to alarm in the control room if smoke is detected. The

operating supply fan will also be de-energized upon detection of smoke in the supply fan common discharge duct.

7. Temperature sensor with a low temperature sensing element mounted downstream of the heating coil to alarm in the control room when the preset low temperature is exceeded. The low temperature signal automatically stops the operating supply fan.

8. Differential pressure switch across each exhaust fan to initiate automatic start signal for the standby fan on low air flow condition of the operating fan. The standby fan will only start once the operating fan has tripped.

9. Discharge air thermostat in the common supply fan discharge duct to control the three-way valve of the heating coil.

10. Temperature sensors (thermistors) for the charcoal filter beds to provide an electrical signal to a local temperature monitor unit. The temperature monitor unit provides the following output signals:

    (a) Analog output signal to a temperature indicator located in the control room to provide continuous temperature indication.

    (b) High temperature alarm (225°F) contacts to provide alarm indication on the main computer (teletype and alarm display).

    (c) High-high temperature alarm (250°F) contacts to provide alarm (annunciator point) on panel H13-P904.

11. A pneumatic actuated ball valve (M38-F100) with solenoid valve (M38-F101) to drain spray water from the charcoal beds during

fire protection spray deluge valve activation. The solenoid valve is energized when the push button is depressed with the collar of spray deluge valve switch in the armed position. This allows the control air to operate the piston operator and open the ball valve. Deactivating the spray deluge valve switch will de-energize the solenoid valve (M38-F101); the drain valve (M38-F100) will remain open until manually closed by the manual override lever.

12. Radiation monitor in the exhaust plenum common inlet duct to provide indication (panel light on local panel) when gaseous activity of the exhaust air exceeds a preselected set point. High radiation automatically stops the operating supply fan.

13. High temperature switches in the exhaust fan common discharge duct. The high temperature signal automatically stops the operating exhaust fan.

9.4.3.5.2 Steam Tunnel Cooling System

Instruments, controls, alarms, and protective devices for the steam tunnel cooling system (STCS) are as follows:

a. Operation of this system is initiated from the local panel. This system operates continuously during normal plant operation.

b. Instrumentation is provided for indication on the local panel (with corresponding system trouble alarm in the control room) of the following:

    1. Low air flow alarm for each fan (with fan energized).

    2. High ambient temperature in the steam tunnel (alarm and readout in control room only).

c. The major items of instrumentation and controls are as follows:

   1. Differential pressure switch across the fan to alarm in the local panel (with a corresponding "trouble alarm" in the control room) on low air flow with fan energized, and to furnish a signal to automatically start the standby fan.

   2. Temperature element in the steam tunnel transmitting to a temperature monitoring module to alarm and provide readout in the control room when a preset high temperature is exceeded.

   3. Temperature controller in fan common discharge duct to modulate three-way valve of cooling coil.

   4. Pneumatically driven isolation dampers with solenoid air valves in each fan discharge duct. The dampers will open when the corresponding fan is energized and will close when the energized fan stops. The dampers will fail open on loss of control air.

9.4.3.5.3 Radwaste Building Ventilation System

Instruments, controls, alarms, and protective devices for the radwaste building ventilation system (RBVS) are as follows:

a. Operation of this system is manually initiated from the radwaste control room. During operation, one of the two supply fans and one of the two exhaust fans operates continuously. The one operative supply fan is interlocked to run only if at least one exhaust fan is energized. The exhaust fans are interlocked to trip when the charcoal filter deluge valves are armed or actuated, and upon indication of high temperature in the exhaust duct.

b. The following instrumentation is provided for indication in the radwaste control room:

1. Indication of which fan is energized (status light).

2. Low air flow with fan in operation (alarm locally).

3. Smoke in supply fans common discharge duct and in each exhaust fan discharge duct (alarm).

4. High temperature in common supply duct (alarm locally).

5. High radiation in the exhaust duct (alarm).

6. High temperature in the carbon beds (alarm locally and readout in the control room).

7. High-high temperature in the carbon beds (alarm locally and in the control room).

8. Heating coil low temperature (alarm).

c. The major items of instrumentation and controls are as follows:

1. Differential pressure indicator, with local indication, across each filter bank.

2. Pneumatically driven damper with solenoid air valve in the outside air intake duct of the supply system. This damper is open during system operation. Damper will fail closed on loss of control air.

3. Pneumatically driven dampers with solenoid air valves in the discharge duct of each supply fan. The dampers will open when

the corresponding fan is energized and close when the fan stops. Dampers will fail closed on loss of control air.

4. Pneumatically driven damper with solenoid air valve in the discharge duct of each exhaust fan. The damper will open when the corresponding fan is energized and close when the fan stops. Dampers will fail closed on loss of control air.

5. Air monitoring device in each supply and exhaust fan discharge duct to provide a signal to modulate the variable inlet vanes and to alarm locally (radwaste control room) on loss of air flow.

6. Differential pressure switch across each exhaust fan to provide start signal for the standby exhaust fan upon low flow condition of the operating fan.

7. Smoke detectors in the supply fan common discharge duct and in each exhaust fan discharge duct to alarm and provide indication on the local panel (red lamp), and to alarm in the radwaste control room if smoke is detected. High smoke signal in the supply duct will also stop the supply fan.

8. High temperature switch in the common supply fan duct to alarm in the radwaste control room upon receipt of high temperature. The supply air low temperature alarm signal automatically stops the operating supply fan.

9. Pneumatically operated three-way valve for the hot water heating coil.

10. Temperature controller in the common supply fan discharge duct to control the three-way valve of the heating coil in response to discharge air temperature.

11. Temperature sensors (thermistors) for the charcoal filter beds to provide an electrical signal to a local temperature monitor unit. The temperature monitor unit provides the following output signals:

    (a) Analog output signal to a temperature indicator located in the main control room to provide continuous temperature indication.

    (b) High temperature alarm (225°F) contacts to provide alarm indication on the main computer (teletype and alarm display).

    (c) High-high temperature alarm (250°F) contacts to provide alarm (annunciator point) on panel H13-P904 and in the radwaste building control room.

12. A pneumatic actuated ball valve (M31-F160A or B) with solenoid valve (M31-F161A or B) to drain spray water from the charcoal beds during fire protection spray deluge valve activation. Solenoid valve is energized when the pushbutton is depressed with the collar of spray deluge valve switch in the armed position, allowing the control air to operate the piston operator and open the ball valve. Deactivating the spray deluge valve switch will de-energize the solenoid valve (M31-F161A or B); the drain valve (M31-F160A or B) will remain open until manually closed by the manual override lever.

13. Radiation monitor to alarm in the main control room and the radwaste control room when the gaseous activity in the exhaust air exceeds a preselected set point. The high radiation alarm also stops the supply fan in operation.

14. High temperature switches in each of the exhaust fan discharge ducts and the common discharge duct. The high temperature signal automatically stops the operating exhaust fan.

9.4.4 TURBINE BUILDING AREA VENTILATION SYSTEM

9.4.4.1 Design Bases

The cooling, heating and ventilation systems for the turbine building, heater bay and offgas building (including the turbine building chilled water system) are designed to:

a. Maintain the ambient temperature as described in <Figure 3.11-37> and <Figure 3.11-38> to provide suitable environment for operating personnel and equipment.

b. Direct the air flow from areas of low potential radioactivity level to areas of high potential radioactivity level.

c. Pass the exhaust air from the offgas building and from the steam jet air ejectors and catalytic recombiner areas, through a charcoal filter train before discharge to the atmosphere.

d. Provide chilled water to the cooling coils to sufficiently cool the air before supplying it to the various areas requiring cooling.

e. Provide sufficient redundancy in components to meet the single failure criterion.

The design bases for the location of fire dampers is discussed in <Section 9.5.1>.

9.4.4.2 System Description

The cooling, heating and ventilating systems for the turbine building area, shown schematically on <Figure 9.4-8>, <Figure 9.4-9>, and <Figure 9.4-10>, consist of the following:

a. Turbine building ventilation system

b. Heater bay ventilation system

c. Offgas building exhaust system

d. Turbine building chilled water system <Section 9.4.9>

These systems are discussed in the sections that follow.

9.4.4.2.1 Turbine Building Ventilation System

The supply units provide clean, filtered (perforated plates may be installed in lieu of supply roughing filters during the months when snow is anticipated) and cooled or heated air to the condenser bay area, condensate pump area, steam piping and valve area, turbine operating floor, condensate polishing area, and to the offgas building for the purpose of maintaining an ambient temperature suitable for operating plant equipment.

Ducted exhaust air is provided at the roof of the turbine building. The supply air is drawn through the turbine operating floor, exhausted at the roof and discharged to the atmosphere by centrifugal fans through an elevated release point (heater bay vent duct).

The supply system draws outside air, passes it through filters (perforated plates may be installed in lieu of supply roughing filters during the months when snow is anticipated), heating coils and cooling coils (as required) and distributes the air to the condenser bay area, condensate pump area, steam piping and valve area, condensate polishing area, and to the offgas building. The quantity of air supplied to the various areas is based on the heat load that must be removed to maintain the required ambient temperatures.

The air supply to the different areas in the turbine building is partly exhausted by the offgas building exhaust system, and the rest is drawn through the turbine operating floor by the turbine building/heater bay exhaust fans and discharged to the atmosphere through elevated release points. During winter operating, two turbine building supply fans (M35-C001A, -C001B or -C001C) and one heater bay supply fan (M41-C001A, or -C001B) operate to provide ventilation air. Exhaust air is provided by the operation of one offgas building exhaust fan (M36-C001A or -C001B) and one turbine building/heater bay exhaust fan (M41-C002A or -C002B). Winter heating will be supplied by thermostatically controlled unit heaters. During summer operation, supply air is provided by two of three turbine building supply fans and both heater bay supply fans. Exhaust air is provided by the operation of both turbine building/heater bay exhaust fans and one of two offgas building exhaust fans. Additional ventilation air is provided during the summer by manually operated windows. The exhaust rate being greater than the supply rate at all times creates a slight negative pressure throughout the plant, minimizing transfer of possible contamination from one area to another.

A radiation monitoring device is provided in the heater bay exhaust system vent duct to monitor the air exhausted to the atmosphere.

The turbine building ventilation system is not required to operate during a LOCA or loss of offsite power. Components of this system are classified as nonsafety and non-seismic.

The main components of this system are located in the offgas building at Elevation 635’-0” and consist of three 50 percent capacity supply plenums and three 50 percent capacity centrifugal fans. Each supply plenum includes roughing filters (perforated plates may be installed in lieu of supply roughing filters during the months when snow is anticipated), heating coils and chilled water coils. Pneumatically driven isolation dampers with solenoid air valves are provided in each supply plenum inlet and in each fan discharge duct for idle unit isolation.

Components for the turbine building ventilation system are of standard industrial design. However, the filter racks, frames and plenums are designed to satisfy system space requirements.

9.4.4.2.2 Heater Bay Ventilation System

The heater bay ventilation system is divided into the supply system and the exhaust system. The supply system includes two axial flow fans (M41-C001A, B) with isolation dampers and distribution ductwork. The exhaust system includes two centrifugal exhaust fans (M41-C002A, B); these fans are also designated as the turbine building/heater bay exhaust fans.

During summer operation, two supply fans (M41-C001A & B) and both turbine building/heater bay exhaust fans (M41-C002A, B) are operating. The supply system draws outside air through two intake openings (one with operating louvers and one with hooded heating coils) and supplies it to the lower heater bay areas through a ventilation chase to cool equipment and maintain a suitable operating environment. The quantity of air supplied to the various areas is based on the heat load to be dissipated to maintain the required ambient temperature. The air supplied to the lower areas is drawn through floor and wall openings by the turbine building/heater bay exhaust fans and then discharged to the atmosphere through an elevated release point (heater bay vent duct). Ventilating air for the upper areas is provided by drawing outside air through operating louvers in the wall above floor Elevation 620’-6” and internal wall and floor openings, and is then discharged to the atmosphere through the heater bay vent duct.

During winter operation, one supply fan (M41-C001A or B) and one turbine building/heater bay exhaust fan (M41-C002A or B) are operating and all operating louvers are closed. The supply fan draws outside air through heating coils in the intake housing and supplies it to the lower heater bay areas through a ventilation chase to maintain a suitable operating condition. The air is then further used for the same heating function in the upper heater bay areas. This is accomplished by the exhaust fan (M41-C002A or B) drawing the air through wall and floor openings before it is discharged to the atmosphere through an elevated release point. The heating coils heat the supply air depending upon the outside air temperature. The hot water to the coils has a modulating valve controlled by a thermostat downstream of the heating coils. Temperature switches protect the heating coils from freeze up by interlocking to shut down the supply fan and alarm on low temperature. Additional space heating will be provided by recirculating ambient air through hot water unit heaters.

Wall and floor openings are arranged to maintain air flow pattern from areas of less radioactivity to more radioactive areas.

The heater bay exhaust system vent duct is provided with a radiation monitor to measure radioactivity of the exhaust air before it is discharged to the atmosphere. For details of the radiation monitoring system see <Section 12.3.4>.

The heater bay ventilation system is not required to operate during a LOCA or loss of offsite power.

Components of the heater bay ventilation system are classified as nonsafety and non-seismic.

The supply fans for this system are located in the heater bay at Elevation 620’-6”, and includes two 80,000 cfm capacity axial flow fans with isolation dampers and heater coils mounted on the wall louvers. Fans, coils, louvers, and dampers are of standard industrial design.

The main components of the exhaust system are located on the roof of the heater bay at Elevation 667’-6” and consist of two centrifugal exhaust fans. The components of this system are of standard industrial design.

9.4.4.2.3 Offgas Building Exhaust System

The function of this system is to exhaust air from the offgas building and from potentially contaminated areas like the steam jet air ejector area, catalytic recombiner area, and various rooms and equipment cells in the condensate polishing area. This exhaust air passes through a charcoal filter train before it is discharged to the atmosphere through an elevated release point (offgas vent duct). The offgas exhaust system is operated continuously during normal operation. The main components of this system are located in the offgas building at Elevation 635’-0”, and consist of two 100 percent capacity charcoal filter trains and two 100 percent capacity centrifugal fans with isolation dampers for idle unit isolation. The charcoal filter trains include roughing filters, HEPA prefilters, charcoal filters, and HEPA after-filters.

Components of the Off-Gas Building Exhaust System located in the Turbine Building, Turbine Power Complex, and located above elevation 660’ of the Off-Gas Building are non-safety class and are of standard industrial design. Components located below elevation 660’ of the Off-Gas Building are designed to satisfy system space requirements and to satisfy the requirements for Safety Class 3 and Seismic Category I items.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-15> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

9.4.4.3 Safety Evaluation

Provision for redundant and separate components in the various cooling and ventilation systems serving the turbine building, offgas building and heater bay ensure that adequate cooling and ventilation will be provided in the event of a single component failure.

Effective means of controlling radioactive discharges to the atmosphere are provided by maintaining exhaust flow patterns and exhaust air flow rates in the various areas of the offgas building and condensate polishing area, maintaining a slight negative pressure in the steam jet air ejector and recombiner areas, having adequate charcoal filtration for offgas building exhaust, and monitoring all exhaust air. The various isolation dampers will open and the systems will continue to operate (provided there is no loss of offsite power) if control air is lost.

The offgas building exhaust system is designed to operate continuously even during plant shutdown, and is provided with redundant exhaust filter trains and fans to allow continuous operation of the system if a single component failure occurs. For this reason, the exhaust flow patterns in the various offgas building areas, and the slight negative pressure in the steam jet air ejector and recombiner areas, are always maintained. This will preclude the probability of air from these areas being exhausted.

Evaluations of radiological considerations during normal plant operation are discussed in <Section 12.2>.

9.4.4.4 Inspection and Testing Requirements

The components of the turbine building, offgas building and heater bay cooling, heating and ventilation systems (including the chilled water system) are accessible for inspection and testing during normal plant operation, plant shutdown and refueling operations. Redundancy in the components and the ability to isolate idle components enables inspection, maintenance and testing to be performed while the system is in normal operation.

Periodic tests will be performed on the offgas building charcoal filter system in accordance with <Regulatory Guide 1.140>. These tests will include measurement of differential pressure across the filter units, and determination of filter efficiency to demonstrate that aging, weathering or poisoning of the filter has not significantly degraded the absorptive materials in the charcoal and HEPA filters.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, chillers, pumps, controls, and other safety devices. These provisions ensure that these operational components function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.4.5 Instruments, Controls, Alarms, and Protective Devices

9.4.4.5.1 Turbine Building Ventilation System

Instruments, controls, alarms, and protective devices for the turbine building ventilation system are discussed as follows:

a. Operation of the supply system is initiated manually from the local panel located at Elevation 635’-0” in the offgas building. During normal operation in winter or summer, two of the three supply units operate continuously.

b. Operation of the exhaust system is initiated manually from the offgas building. In normal operation in winter, one of the two turbine building/heater bay exhaust fans operate continuously. The other exhaust fan may be manually started and the operating windows manually opened as required to provide additional cooling in the turbine operating area during summer operation.

c. Instrumentation is required for indication on the local panel of the following:

   1. Indication of which fans are operating (status light).

   2. Low air flow alarm for each fan with a corresponding system trouble alarm in the control room.

   3. Smoke in supply fan common discharge duct (indicating light with corresponding high smoke alarm in the control room).

   4. High air temperature alarm and low air temperature alarm downstream of each heating coil with a corresponding system trouble alarm in the control room.

   5. Motor trip alarm (computer).

d. The major items of instrumentation and controls are as follows:

   1. Differential pressure indicator across each filter bank with local indication.

   2. Pneumatically driven isolation dampers with solenoid air valves in each supply fan discharge duct and each supply plenum inlet duct. Dampers will open when the corresponding fan is energized and will close when the fan stops. Dampers will fail closed on loss of control air.

   3. Differential pressure switch across each supply fan to give local alarm and to alarm in the control room on low air flow.

4. Temperature controller in each supply fan discharge duct to modulate the three-way valve in the chilled water coil or hot water coil to maintain 60°F fan inlet temperature.

5. Smoke detector in the supply fan common discharge duct to indicate an alarm condition locally and to alarm in the control room upon detection of smoke.

6. Radiation monitor in the discharge of the heater bay vent duct to alarm in the control room upon detection of high radioactivity in the exhaust air.

7. Temperature sensor with a low temperature sensing element mounted downstream of the heating coil to alarm locally and in the control room when the low or high temperature set point is reached. The low temperature alarm will automatically stop the supply fans.

8. A trouble alarm will be in the control room.

9.4.4.5.2 Heater Bay Ventilation System

Instruments, controls, alarms, and protective devices for the heater bay ventilation system are discussed as follows:

a. Operation of this system is initiated manually from a local panel with a system trouble alarm in the control room. During summer operation, the two supply fans and the two turbine building/heater bay exhaust fans operate continuously. During winter operation, one supply fan and one turbine building/heater bay exhaust fan are required to operate to provide the necessary equipment ventilation with all operating louvers closed.

b. Instrumentation is required for indication on the local panel (with a corresponding system trouble alarm in the control room) of the following:

   1. Indication of which fans are operating (status light).

   2. Low air flow alarm (indicating light and audible alarm) for each fan with a corresponding trouble alarm in the Control Room.

   3. Indication of position for the operating louvers.

c. An audible alarm and an alarm acknowledge pushbutton is provided at the local panel. The acknowledge pushbutton silences the local audible alarm and clears the control room system trouble alarm.

d. The major items of instrumentation and controls are as follows:

   1. Pneumatically driven dampers with solenoid air valves in each fan discharge duct. The dampers will open when the corresponding fan is energized and will close when the fan stops. Dampers will fail closed on loss of control air.

   2. Differential pressure switch (1M41-N030A, B) across the supply fans (1M41-C001A, B) to give indication on the local panel on low air flow. Differential pressure switches (1M41-N050A, B) across the exhaust fans (1M41-C002A, B) to give indication on the local panel on low air flow.

   3. Temperature controller (1M41-R042) downstream of the heating coil to modulate the three-way valve of the heating coil depending on the entering air temperature.

4. Temperature switches (M41-N280, 281, 282, 283; 1M41-N284) downstream of the heating coil to alarm and shut down the supply fans (1M41-C001A, B) on low temperature.

   The addition of a bypass switch around each temperature switch permits isolation when its associated coil is out-of-service.

   An audible alarm and an alarm acknowledge pushbutton is provided at the local panel. The acknowledge pushbutton silences the local audible alarm and clears the control room system trouble alarm.

5. Radiation monitor in the heater bay vent stack to alarm in the control room on detection of high radioactivity level in the exhaust air.

9.4.4.5.3 Offgas Building Exhaust System

a. Operation of this system is initiated manually from the control room. During normal operation, one of the two fans operate continuously. Details of the instrumentation and controls for this system are discussed in <Section 7.6.1>.

b. The operation of the offgas holdup pipe room fan is initiated manually from wall panel 1H51-P5236 next to the offgas holdup pipe room entrance. During normal operation of the offgas system this fan would operate continuously.

9.4.5 ENGINEERED SAFETY FEATURES VENTILATION SYSTEM

The engineered safety features (ESF) ventilation systems discussed in this section are the emergency service water pumphouse ventilation system, emergency closed cooling pump area cooling system, ECCS pump room cooling systems, and the diesel generator building ventilation system. Additional ESF ventilation systems are discussed in the sections noted:

a. Annulus exhaust gas treatment system <Section 6.5.3>

b. Control room HVAC and control room emergency recirculation system <Section 6.4>

c. MCC, switchgear and miscellaneous electric equipment areas HVAC/battery room exhaust system <Section 9.4.1>

d. Fuel handling area exhaust subsystem <Section 6.5.1> <Section 9.4.2>

e. Control complex chilled water system <Section 9.4.9>

9.4.5.1 Design Bases

9.4.5.1.1 Emergency Service Water Pumphouse Ventilation System

Design bases for the Emergency Service Water Pumphouse Ventilation System (ESWVS) are as follows:

a. The ESWVS is classified as Safety Class 3, Seismic Category I. The design of this system complies with the requirements of General Design Criteria (GDC) 1, 2, 3, 4, and 5 of <10 CFR 50, Appendix A>, and <10 CFR 50, Appendix B>. The requirements of <Regulatory Guide 1.26>, <Regulatory Guide 1.29>, <Regulatory Guide 1.47>, <Regulatory Guide 1.53>, National Fire Protection Association (NFPA) 90A, and Branch Technical Position APCSB 9.5-1 have also been considered in the system designs and equipment procurement.

b. The ESWVS is:

1. Required to operate to safely shut down the plant during normal conditions, and emergency or LOCA conditions.

2. Started automatically when the emergency service water pumps operate. The ESWVS is remote-manually stopped from the control room.

3. Designed to maintain areas served by this system between the temperatures given in <Figure 3.11-31>.

4. Designed to remove the heat generated by the emergency service water pumps and auxiliary pump room equipment.

5. Continuously monitored to indicate system operating status, system malfunction, high and low space temperatures.

c. The ESWVS air inlet and relief openings are provided with structural missile barriers to prevent external missiles from entering the pump room. These openings are also designed to be unaffected by snow, freezing rain or sleet.

d. The ESWVS fans are physically separated by a minimum of 20 feet-9 inches between fan center lines. They are located in an area not affected by internally generated missiles, pipe whip or jet impingement resulting from breaks in high energy piping.

e. The ESWVS is provided with multiple ventilation fans and multiple operating exhaust louvers so that failure of a single active component will not prevent satisfactory system operation.

9.4.5.1.2 Emergency Closed Cooling Pump Area Cooling System

Design bases for the emergency closed cooling pump area cooling system (ECPCS) are as follows:

a. All requirements discussed in <Section 9.4.5.1.1.a> are applicable to the ECPCS.

b. The ECPCS is:

   1. Required to operate to safely shut down the plant during normal conditions and emergency or LOCA conditions, and may be used to provide additional cooling during normal shutdown conditions.

   2. Started automatically when the emergency closed cooling pumps operate. The ECPCS can also be manually started or stopped from a locally mounted panel.

   3. Designed to maintain areas served by this system between the temperatures given in <Figure 3.11-19>.

   4. Designed to remove the heat generated by the emergency closed cooling pumps, instrument air compressors, service air compressors, control complex chillers and pumps, piping, and auxiliary equipment.

   5. Continuously monitored to indicate system operating status, system malfunction and high space temperature.

c. The ECPCS has no outside air or relief air openings through the pump area walls.

d. The ECPCS air handling units are physically separated by 28 feet between unit center lines. They are located in an area not affected by internally generated missiles, pipe whip or jet impingement resulting from breaks in high energy piping.

e. The ECPCS is provided with multiple cooling air handling units so that failure of a single active component will not prevent satisfactory system operation.

9.4.5.1.3 ECCS Pump Room Cooling Systems

Design bases for the ECCS pump room cooling systems (ECCSCS) are as follows:

a. All requirements discussed in <Section 9.4.5.1.1.a> are applicable to the ECCSCS.

b. The cooling units associated with the RHR pumps are required to operate to safely shut down the plant during normal conditions and emergency or LOCA conditions.

c. The cooling units associated with the HPCS and LPCS pumps are required to operate to safely shut down the plant in the event of a LOCA.

d. The cooling units associated with the RCIC pumps are operated only when the steam turbine driven RCIC pump is operating.

e. The ECCSCS air handling units are:

    1. Started automatically when the associated pump starts except for the RCIC pump room cooling unit which is initiated when the RCIC turbine steam admission valve is open. They can also be manually started or stopped from local stations.

2. Designed to maintain pump areas between the temperatures given in <Figure 3.11-11>, <Figure 3.11-12>, and <Figure 3.11-13>.

3. Designed to remove heat generated by the RHR pumps, HPCS pumps, LPCS pumps, RCIC pumps, piping, and auxiliary equipment.

4. Continuously monitored to indicate system operating status, system malfunction and high space temperature.

f. The ECCSCS air handling units have no outside air or relief air openings through the pump area walls.

g. The ECCSCS air handling units are housed in separate rooms, each common to its associated pump. Any single air handling unit could be affected by pipe whip, jet impingement or flooding resulting from breaks in high or moderate energy piping in a pump room. However, multiple air handling units would not be affected by an incident in a single pump room.

9.4.5.1.4 Diesel Generator Building Ventilation System

Design bases for the diesel generator building ventilation system (DGBVS) are as follows:

a. All requirements discussed in <Section 9.4.5.1.1.a> are applicable to the DGBVS.

b. The DGBVS is:

1. Required to operate whenever the diesel generators operate.

2. Started automatically whenever the diesel generators operate. The DGBVS can be remote-manually started or stopped from the

control room. The only automatic shutoff of the supply fans is when the CO_2 system is activated. Additionally, the diesel generator rooms are each equipped with a nonsafety-related auxiliary exhaust fan which cycles on and off automatically to promote further cooling during diesel generator standby conditions, and shuts off upon a diesel generator start or CO_2 activation signal.

3. Designed to maintain the diesel generator rooms between the temperatures given in <Figure 3.11-27>.

4. Designed to remove heat generated by the diesel generator and auxiliary equipment.

5. Continuously monitored to indicate system operating status, system malfunction and high and low diesel room air temperature.

c. The DGBVS outside air inlet opening is shielded from external missiles by the control complex wall and the relief air opening is shielded by a structural missile barrier. These openings are also designed to be unaffected by snow, freezing rain or sleet.

d. The DGBVS supply fans are physically separated by 17 feet-7 inches (center-to-center) or by a concrete wall. They are located in an area not affected by internally generated missiles, pipe whip or jet impingement resulting from breaks in high or moderate energy piping. The nonsafety-related auxiliary exhaust fan is installed outside the diesel room exhaust louvers between the diesel generator room outside wall and a structural missile shield.

e. The DGBVS is provided with multiple supply fans and multiple operating exhaust louvers so that failure of a single active component will not prevent satisfactory system operation.

9.4.5.2 System Description

9.4.5.2.1 Emergency Service Water Pumphouse Ventilating System

The ESWVS is shown on <Figure 9.4-11>. This system operates whenever the ESW pumps operate (normal shutdown and emergency shutdown) or during testing of the ESWVS.

The ESWVS consists of two 100 percent capacity supply fans (M32C001A, B), two operating relief louvers and supply ductwork with return dampers for cooling the ESW pumps and auxiliary equipment. One hundred percent capacity includes removing the heat resulting from simultaneous operation of both ESW pumps. Inactive supply fans are isolated by automatically controlled dampers. Electric unit heaters are also provided to maintain the minimum room temperature when the ESW pumps are not operating. The supply fans and intake louvers are located at the south end of the ESW pump building at Elevations 619’-6” and 630’-0”, respectively. Relief louvers are located at the north end of the building at Elevation 638’-4-3/4”.

The supply fans and duct systems satisfy the design bases discussed in <Section 9.4.5.1.1>. They are arranged so that cooling air is admitted to the south end of the building and after absorbing heat is relieved to the outside at the north end of the building. The amounts of outside air and recirculated return air used for cooling are automatically controlled by outside air and return air dampers. Regular ac offsite and onsite power sources have been provided for this system. If offsite power is lost or a LOCA signal received, redundant emergency power will be provided from the diesel generators.

9.4.5.2.2 Emergency Closed Cooling Pump Area Cooling System

The ECPCS is shown on <Figure 9.4-12>. This system operates whenever the ECC pumps operate (normal shutdown and emergency shutdown) or during testing of the ECPCS. The ECPCS consists of two 100 percent capacity air handling units and supply distribution ducts for recirculating air and for cooling the ECC pumps and related equipment. One hundred percent capacity is based on removing the heat resulting from simultaneous operation of all the ECC pumps for Unit 1 and Unit 2, and also includes the heat losses from piping, instrument air compressors, service air compressors, control complex chillers, and chilled water pumps. The dissipated heat is removed by cooling water from the safety-related chilled water system.

The air handling units are located in the south end of the control complex at Elevation 587’-0”. Each air handling unit includes roughing filters, cooling coils and a fan section. Supply ducts from each air handling unit are extended to the ECC pump areas. The cooling air returns unducted to the operating air handling unit.

Normal ac offsite power sources have been provided for this system. If offsite power is lost or a LOCA signal is received, redundant emergency power will be provided from the diesel generators.

9.4.5.2.3 ECCS Pump Room Cooling System

The ECCS pump room cooling system (ECCSCS) is shown on <Figure 9.4-13>. Each ECCS air handling unit operates whenever the associated pump operates. These operating periods occur during normal shutdown, during emergency or LOCA shutdown or during hot standby conditions. The ECCSCS includes one air handling unit for each room to recirculate air and provide cooling for the RHR A pump and heat exchanger room, RHR B pump and heat exchanger room, RHR C pump room, HPCS pump room, LPCS pump room, and RCIC pump room. Each air handling unit is capable of removing 100 percent of the cooling requirements of the ECCS pump and related equipment. The dissipated heat for all air handling units except the HPCS is removed by the emergency closed cooling water system. The HPCS air handling unit is served by the emergency service water system. The air handling units are located in the auxiliary building, north of the reactor building at Elevation 574’-10”. Each air handling unit includes roughing filters, cooling coils, a fan section and is located so that air is discharged directly toward the ECCS pumps and returns unducted to the operating air handling unit.

Normal ac offsite and onsite power sources have been provided to this system. If offsite power is lost or a LOCA signal is received, redundant emergency power will be provided from the diesel generators.

9.4.5.2.4 Diesel Generator Building Ventilation System

The DGBVS is shown on <Figure 9.4-14>. This system operates whenever the diesel generators operate (following loss of offsite power signal and following a LOCA signal) or during testing of the DGBVS, except for the auxiliary exhaust fan, which operates only when the diesel generator is not running. The DGBVS for each diesel generator room consists of two 100 percent capacity supply air fans, two sets of exhaust louvers, outside air and return air dampers, ductwork arranged for cooling the diesel generators and related equipment, and a nonsafety-related auxiliary exhaust fan. Inactive supply fans are isolated by automatically controlled outside air dampers. However, when neither fan operates, the outside air and recirculation dampers automatically modulate to promote natural ventilation. The exhaust louver closest to the auxiliary exhaust fan is maintained open during exhaust fan operation. The exhaust fan withdraws air from the diesel room to further promote cooling during diesel standby conditions.

When the CO_2 system is activated, outside air and exhaust air dampers close, the return air dampers open and the ventilation fans stop.

Electric unit heaters are also provided to maintain the minimum room temperature when the diesel generators are not operating.

The supply fans and intake louvers are located at the east end of the diesel generator building and the exhaust louvers are located at the west end of the diesel generator building. They are arranged so that cooling air is admitted to the east end of the diesel generator building and after absorbing heat, the air is relieved to the outside at the west end of the building. The amounts of outside air and recirculated return air used for cooling are automatically controlled by outside air and return air dampers.

Normal ac offsite and onsite power sources have been provided for this system. If offsite power is lost or a LOCA signal is received, redundant emergency power will be provided from the diesel generators.

The auxiliary exhaust fans are not safety-related and are not backed with emergency power, nor are they relied upon for operation during accident conditions.

9.4.5.3 Safety Evaluation

Redundant ventilation cooling or recirculation cooling components have been provided for the emergency service water pumphouse ventilation system (ESWVS), emergency closed cooling pump area cooling system (ECPCS) and diesel generator building ventilation system (DGBVS). Providing redundant equipment components, normal and emergency power supplies and automatic starting of equipment components for these systems ensures that adequate cooling will be available if a single failure of an active component occurs.

Redundant air handling units have not been provided for each ECCS pump room, but the heat removal function of the multiple and varied type ECCS rooms provides redundancy. Thus, loss of function of a single air handling unit would not prevent the aggregate ECCS from achieving safe plant shutdown. None of the systems noted above require control air for operation or isolation. The ESWVS and the DGBVS include electrically operated outside air and exhaust dampers that fail closed, and recirculation dampers that fail open on loss of power. However, multiple dampers powered from separated and different power sources are provided so that a single loss of power would not prevent system operation.

The systems have been provided with an offsite and an onsite ac power source. If offsite power is lost, redundant emergency power sources provided by diesel generators automatically supply power.

Indication of system operating status, open or closed damper position for those system cooling with outside air, low air flow and high space temperature will be provided in the control room. This ensures that equipment anomalies, including fire, will be detected and eliminated so that the cooling function of these systems will continue.

9.4.5.4 Inspection and Testing Requirements

The components of the ventilation cooling and recirculating cooling systems for the emergency service water pumphouse, emergency closed cooling pump areas, ECCS pump rooms, and diesel generator rooms are accessible for inspection and testing during normal plant operation. The ability to isolate an idle, redundant component enables inspection, maintenance and testing to be performed while the system is in normal operation. Periodic tests will be performed to verify the functional performance of fans, dampers, controls, and other safety devices. This will ensure that these components perform their function reliably and accurately during normal operation and under conditions of operation interruptions.

9.4.5.5 Instruments, Controls, Alarms, and Protective Devices

9.4.5.5.1 Emergency Service Water Pumphouse Ventilation System

The two axial flow fans are individually interlocked with the two emergency service water pump motors. The fans automatically start when the corresponding pump motors are energized. However, the fans will not stop automatically when the corresponding pump motors are de-energized, but are stopped remote-manually from the control room panel. Details of the instrumentation and controls for the emergency service water pumphouse ventilations system are discussed in <Section 7.3.1>.

9.4.5.5.2 Emergency Closed Cooling Pump Area Cooling System

Operation of this system is initiated automatically upon receipt of a start signal from associated pump circuitry. Details of the instrumentation and controls for this system are discussed in <Section 7.3.1>.

9.4.5.5.3 ECCS Pump Rooms Cooling Systems

Operation of each pump room cooling unit is initiated automatically when the corresponding pump is energized, except for the RCIC pump room cooling unit which is initiated when the RCIC turbine steam admission valve is open. The details of the instrumentation and controls for these systems are discussed in <Section 7.3.1>.

9.4.5.5.4 Diesel Generator Building Ventilation System

Operation of both axial flow supply fans and electric motor-operated exhaust louvers is initiated automatically when the respective diesel generator is started. When neither fan is operating, the outside air and recirculation dampers automatically modulate to promote natural ventilation. Each diesel generator room is also equipped with a nonsafety-related auxiliary exhaust fan to withdraw hot air from the diesel room to further promote cooling during diesel standby conditions. The supply fans do not stop automatically (except when the CO_2 system is activated) when the corresponding diesel generator is stopped, but must be stopped remote-manually from the control room. Fans can also be started and stopped manually from the control room when the diesel generator is not operating. The auxiliary exhaust fans operate automatically when the diesel generator is not operating to promote further cooling in the associated diesel room, and can be started and stopped manually from their local control panels. Details of the instrumentation and controls for the diesel generator building ventilation system are discussed in <Section 7.3.1>.

9.4.6 REACTOR BUILDING VENTILATION SYSTEMS

The areas served by the various reactor building cooling and ventilation systems are the drywell, containment vessel and the reactor building annulus.

Under normal operating conditions, cooling systems of the drywell and containment vessel are required to maintain the ambient air temperature at a suitable level for continuous operation of the plant equipment.

Access to the containment is considered a routine operation; therefore, the containment vessel is purged intermittently by operating the containment purge system at the reduced flow rate to reduce the radioactivity level. The occupancy during normal operation is derived from General Electric experience with previous plants with consideration of the equipment found in the Mark III containment (e.g., sample station, CRD, ECCS, and process equipment). For refueling, either purging of the containment and drywell is required at the full flow rate or compensatory actions are taken.

Under normal and postaccident conditions, potential release of radioactivity to the environment from the containment vessel leakage is minimized by the annulus negative pressure created by operation of the annulus exhaust gas treatment system. This system provides charcoal filtration and releases the exhaust air at an elevated point through the unit vent.

9.4.6.1 Design Bases

Design bases for the containment vessel, drywell and annulus ventilation, air purification, and cooling systems that address the general requirements discussed in <Section 9.4.6> are as follows:

a. Maintain the ambient air temperatures in the drywell and containment vessel, under normal operating conditions, between the temperatures given in <Figure 3.11-20>, <Figure 3.11-21>, <Figure 3.11-22>, <Figure 3.11-23>, <Figure 3.11-24>, <Figure 3.11-25>, <Figure 3.11-26>, <Figure 3.11-28>, <Figure 3.11-29>, and <Figure 3.11-30>.

b. Maintain a minimum of 60°F ambient air temperature in the containment vessel and drywell under normal shutdown conditions.

c. Provide cooling in areas of high heat release to limit the air temperature to a maximum of 145°F. These areas include reactor vessel support skirt flange, refueling bellows support skirt and the annular space between the reactor vessel and the biological shield wall.

d. Maintain adequate ambient temperature for equipment in areas in the containment vessel such as the RWCU heat exchangers, the standby liquid control area, the CRDM area, RWCU filter demineralizer area, and holding pumps area.

e. Provide intermittent purging in the containment vessel areas to minimize radioactivity buildup.

f. Maintain a minimum (negative) pressure differential in the annulus relative to the outside to minimize ground level release of airborne radioactivity due to containment vessel exfiltration during normal and postaccident conditions. This system will filter the annulus exhaust through a filter train consisting of roughing filters, demisters, HEPA prefilters, charcoal filters, and HEPA after-filters, to remove radioactive particles and halogens prior to discharge to the atmosphere through the unit vent. Part of the air extracted is recirculated to ensure adequate mixing with annulus volume.

g. Provide the required instrumentation for monitoring and control of the ventilation cooling, and exhaust systems, and for maintaining the minimum (negative) pressure differential in the annulus relative to the outside.

h. Determine the flow rates of the purge exhaust system; their design bases are discussed in <Section 12.2>.

i. Design the drywell and containment isolation valves and connecting piping for the containment vessel purge supply and exhaust system to Quality Group B requirements.

j. Provide the isolation valve systems for the containment vessel and drywell purge system with redundant instrumentation and control systems; these valves will be actuated by the diverse input parameters of high drywell pressure, low reactor water level and high purge exhaust radiation.

k. Minimize containment vessel purge and exhaust flow rates consistent with the requirements to maintain continuous occupancy airborne activity levels inside the majority of the containment spaces.

l. Demonstrate performance and reliability of the purge supply and exhaust containment isolation valves by a comprehensive testing program consisting of closure and leak tightness tests on prototype and actual isolation valves. In addition, these valves will meet the requirements of <Regulatory Guide 1.48>.

9.4.6.2 System Description

The ventilation, cooling, heating and purge systems for the drywell, containment vessel and reactor building annulus are shown schematically on <Figure 9.4-15>, <Figure 9.4-16>, <Figure 9.4-17>, and <Figure 6.5-1>. These systems consist of:

a. Drywell cooling system.

b. Containment vessel cooling system.

c. Containment vessel and drywell purge system.

d. Annulus exhaust gas treatment system; a detailed discussion of this system is presented in <Section 6.5.3>.

9.4.6.2.1 Drywell Cooling System

The drywell cooling system is designed to operate continuously during normal plant operation. It will provide the necessary cooling to maintain temperatures suitable for equipment operation in the various drywell areas. These regions include the reactor vessel skirt and pedestal area. The drywell cooling system uses three fan cooler units. One unit is located in the lower drywell area to dissipate heat from the reactor vessel support skirt flange and the pedestal area. The other two units are located in the upper part of the drywell to dissipate the heat from the steam piping, feedwater piping, recirculating pumps, and related piping. These units also cool the space above the reactor vessel head and the refueling bellows support skirt to keep these areas within the required temperature limits.

Under normal and abnormal operating conditions, the fan-cooler units operate with cooling water from the nuclear closed cooling system.

Redundancy in the system is provided since each fan-cooler unit has two 100 percent capacity axial fans and two 100 percent capacity independently piped banks of cooling coils.

The fan cooler units supply recirculated cooled air to the various drywell areas through ducts as required for proper air distribution.

The drywell cooling system is nonsafety-related, non-seismic category and is not required to operate during a LOCA. Components of this system are of standard industrial design.

During abnormal conditions or loss of offsite power, the drywell coolers can be powered from the emergency power source if cooler operation is required. Each fan cooler unit consists of roughing filters (filters may be removed during normal operation and shall be installed in outage situations when work is being performed in the drywell area), two banks of cooling coils, two axial fans, and check dampers for idle fan isolation. One fan and one coil bank in each of the three units are required to operate to achieve the design air flow and cooling during normal operation.

9.4.6.2.2 Containment Vessel Cooling System

The containment vessel cooling system operates normally to provide cooled recirculated air in the containment vessel and various equipment rooms.

Under normal operating conditions, the fan cooler units operate with chilled water supplied by the containment vessel chilled water system. A discussion of the containment vessel chilled water system is presented in <Section 9.4.9>.

This system is located in the containment vessel and consists of six air handling units, three on the east side of the containment vessel and three on the west side. Each unit consists of cooling coils, centrifugal fan, and isolation damper for idle unit isolation, and manual balancing dampers for system balancing. Two of the units in the east containment area and two units in the west containment area are required to operate to achieve the design air flow and cooling during normal plant operation.

Redundancy in the fan cooler units is provided since any two of three units servicing the east containment area and equipment rooms, and any two of three units servicing the west containment area and equipment rooms, can provide all of the cooling capacity required under normal operating conditions.

The containment vessel cooling system is nonsafety-related, non-seismic category and is not required to operate during a LOCA. Components of this system are of standard industrial design.

9.4.6.2.3 Containment Vessel and Drywell Purge System

Operation of this system will reduce the activity level in the containment vessel and drywell to a safe level for entry of personnel, maintain a safe atmosphere during refueling operations and provide a means of controlled release of activity to the environment.

Where physically possible the debris screens are located a minimum of one pipe diameter away from the inner side of each inboard isolation valve. Both piping and ductwork between the debris screen and isolation valve are Seismic Category I design. The debris screen is Seismic Category I and designed to withstand the LOCA differential pressure. The debris screen opening is designed as 1/2 inch by 1/2 inch.

The containment vessel and drywell purge system is divided into the containment vessel purge supply subsystem, drywell purge supply subsystem and the purge exhaust subsystem.

The containment vessel purge supply subsystem is located in the intermediate building at Elevation 682’-6” and provides filtered (the supply roughing filters may be removed to preclude snow buildup on the filters) and heated outside air to the containment vessel at a constant rate. This subsystem consists of two supply fans and two supply plenums, each with roughing filters (the supply roughing filters may be removed to preclude snow buildup on the filters), heating coils and with inlet and outlet dampers for idle unit isolation. The supply air is discharged into the containment vessel and circulated by the containment vessel fan cooler units. Each supply fan has a rated capacity of 15,000 cfm; operation of both units is required to obtain the full purge rate. However, with the use of the variable inlet vanes, the flow rate is adjusted to 5,000 cfm during normal plant operation. Redundant butterfly valves are also provided for containment isolation. Components of these subsystems (except the isolation valves) are of standard industrial design.

During the drywell purge mode of system operation (used during refueling and cold shutdown only) the drywell purge supply subsystem directs air from the containment vessel ambient into the drywell area where it is circulated by the drywell fan cooler units.

This subsystem is located inside the containment vessel at Elevation 639'-0" and is operated only prior to personnel entry into the drywell and during refueling operations. It consists of two 10,000 cfm capacity axial fans and redundant butterfly isolation valves for drywell isolation. Both these units are required to obtain the full purge rate in the drywell.

Components of the drywell purge supply subsystem (except the butterfly isolation valves) are of standard industrial design.

The purge exhaust subsystem is located in the intermediate building at Elevation 654'-6". It draws air from the containment vessel and drywell and exhausts it through two trains (rated at 15,000 cfm each) of roughing filters, HEPA prefilters, charcoal filters, and HEPA after-filters. The exhaust air is then discharged to the atmosphere through the unit vent. Two filter plenums and two exhaust fans are provided, each with inlet and outlet dampers for idle unit isolation. Redundant butterfly isolation valves are provided for drywell and containment vessel isolation. Drywell purge exhaust and supply subsystem isolation valves are passive isolation valves which remain closed during Modes 1, 2 and 3.

Redundant radiation monitoring devices are also provided to alarm in the control room and isolate the containment if a preset radiation level is exceeded. Details of the radiation monitoring system are discussed in <Section 7.6.1>.

During normal operation, one purge exhaust plenum and fan operates intermittently at a reduced flow rate of 5,000 cfm to draw air from the containment vessel area. This exhaust air is passed through the exhaust filter train and is then discharged to the atmosphere by the unit vent. One purge supply fan simultaneously operates to replenish the air exhausted from the containment vessel area.

Purging at the full rate provides approximately 1.6 volume air changes per hour in the containment vessel (30,000 cfm air flow rate) and approximately 4.5 volume air changes per hour in the drywell (20,000 cfm air flow rate). During this mode of operation, the two containment vessel supply fans, two drywell supply fans and the two purge exhaust fans operate together at rated capacity. In addition, during refueling operation, the isolation damper in the branch duct that exhausts 5,000 cfm directly from the containment atmosphere is remote-manually opened by a selector switch located in the control room.

Components of this subsystem (except the isolation valves) are of standard industrial design. However, the charcoal filter racks, frames and housing are specially designed to satisfy the system space requirements, and to satisfy the requirements of Seismic Category I items.

A separate inline HEPA filter is installed between the RWCU, backwash receiving tank and the containment vessel and drywell purge exhaust system.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-17> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

The containment vessel and drywell purge system is also provided with redundant pneumatically operated butterfly type valves which are automatically shut off if a design basis accident occurs. Although these valves receive an isolation signal, not all are active valves (proven capable of operating during design bases accidents). Those valves which have not been declared active remain closed during Modes 1, 2 and 3.

The isolation valve arrangement consists of two 42-inch valves: one located inside the containment vessel (sealed closed during Modes 1, 2 and 3) and one located in the annulus (open during purge operation). Two 18-inch valves in series (open only during purge operation) located inside the containment vessel are provided in parallel with the sealed closed 42-inch valve <Figure 9.4-17>, ensuring that the net effective opening during purging operation is only 18 inches. The active redundant valves ensure isolation of the containment vessel from the atmosphere in the event that one valve fails to close. In addition, the use of in-series 18-inch valves eliminates concern over leakage potential of the 42-inch valve after a single failure of one 18-inch valve during Modes 1, 2 and 3. Each active isolation valve includes a three-way solenoid valve sized for emergency rapid closing (4 seconds maximum) against the LOCA design pressure of 15 psig for the containment vessel and 30 psig for the drywell. The air cylinder operators are air-open spring closed mechanisms. The active valves are also suitable to operate under LOCA conditions. Passive isolation valves operate in the same manner as the active valves however, credit is not taken for their capability to operate during a design bases accident. Therefore they are maintained closed during Modes 1, 2 and 3.

Components of the containment vessel and drywell purge system, except for the purge isolation valves and the charcoal exhaust plenums, are nonsafety-related and non-seismic classified.

The purge isolation valves and accessories are classified as Safety Class 2, Seismic Category I.

The charcoal exhaust plenums are classified as nonsafety-related, Seismic Category I.

The containment vessel and drywell purge isolation valves are pneumatically operated butterfly type valves which are bubble tight at rated pressure and temperature and capable of satisfactory operation even after long periods of inactivity and/or infrequent operation. Redundant valves are provided for the containment vessel purge supply (M14-F040, F045) and purge exhaust (M14-F085, F090) subsystems and are located inside containment and in the annulus. Also, two sets of 18-inch bypass valves (M14-F190, F195, F200, and F205) are provided in parallel with the 42-inch valves located inside the containment vessel. Redundant valves are also provided for each drywell purge supply line (M14-F055A, F055B, F060A, F060B) and exhaust line (M14-F065, F070) and are located in the containment and in the drywell. When the subsystem is not in operation, the corresponding purge valves are held closed by spring action.

If a LOCA occurs while the active valves are open, the solenoid valves are automatically de-energized allowing the spring to shut the valve. The active isolation valves have emergency fast closure against the LOCA design pressure.

9.4.6.3 Design Evaluation

9.4.6.3.1 Drywell Cooling System

Operation of this nonsafety-related system is not required to safely shut down the plant during a design basis accident. However, redundancy is provided since each fan-cooler unit has two 100 percent capacity axial fans and two 100 percent capacity independently piped banks of cooling coils. One fan and one coil bank in each of the three fan-cooler units are required to operate to achieve the design air flow and cooling during system operation. If an operating fan fails, the resulting low differential pressure across that fan alarms in the control room and automatically starts the standby fan. If the cooling coil in operation fails, the resulting high discharge air temperature from the fan-cooler unit alarms in the control room and signals the operator to divert the cooling water flow to the standby coil through a three-way diverting valve.

Although the components of this system are not safety-related, they are seismically anchored to preclude the possibility of these components becoming a missile during an earthquake. The air distribution ductwork is also seismically designed and supported.

9.4.6.3.2 Containment Vessel Cooling

Operation of this nonsafety-related system is not required to safely shut down the plant during a design basis accident. However, redundancy is provided since any two of the three fan-cooler units servicing the east area of the containment vessel, and any two of the three fan-cooler units servicing the west area and equipment rooms, can provide all the cooling capacity required when the system is in operation. Cooling water flows through the coils of all six units at all times. If an operating fan fails, the resulting low pressure differential across that fan will alarm in the control room and the operator can manually start the standby unit.

Although the components of this system are not safety-related, they are seismically anchored to preclude the possibility of these components becoming a missile during an earthquake. The air distribution ductwork is also seismically designed and supported.

9.4.6.3.3 Containment Vessel and Drywell Purge System

Two containment vessel purge supply plenums and fans, two drywell purge supply fans and two exhaust filter trains and fans are provided for the purge system. Monitoring the purge exhaust by the instrumentation provided ensures controlled release of radioactivity to the environment. Details of radiation monitoring instrumentation and controls are discussed in <Section 7.6.1>.

The containment vessel and drywell purge isolation valves are pneumatically operated butterfly type valves which are bubble tight (4 cc per hr per inch valve diameter leakage rate) at rated pressure and temperature and capable of satisfactory operation even after long periods of inactivity and/or infrequent operation. Redundant valves are provided for the purge supply, and the purge exhaust systems are located inside containment and in the annulus. When the containment vessel and drywell purge system is not in operation, the purge valves are held closed by spring action. If a loss-of-coolant accident occurs while the active valves are open, the solenoid valves are automatically de-energized allowing the spring to shut the valve. The active isolation valves have emergency fast closure control (four seconds). Passive isolation valves operate in the same manner as the active valves however, credit is not taken for their capability to operate during a design bases accident. Therefore they are maintained closed during Modes 1, 2 and 3.

Operation of the purge system is not required to safely shut down the plant in the event of a LOCA. However, the isolation valves and the corresponding penetration piping are classified as Safety Class 2, Seismic Category I. In addition, the guidelines of Branch Technical Position CSB 6-4 were considered in the design of the purge system. The complete evaluation of compliance with Branch Technical Position CSB 6-4 can be found in <Section 6.2.4>.

The containment purge system operates intermittently during reactor operation to reduce the containment airborne activity. Containment isolation provisions for the containment purge system are effectively 18 inches in diameter as shown in <Figure 9.4-17>. The main isolation valves for purge supply and exhaust during refueling are 42 inches in diameter. A bypass line with two 18-inch, butterfly isolation valves open during purge operation are parallel to the normally closed 42-inch valve located inside the containment vessel. The outboard 42-inch butterfly isolation valve is open during containment purge operation. This design provides for the smallest size effective operation while allowing for the optimum air flow of 5,000 cfm required for normal plant purge. The effective 18-inch penetration offers a much smaller opening between the containment atmosphere and the outside environs, reducing potential leakage of the containment atmosphere following all containment ventilation isolation.

During refueling, the inboard 42-inch isolation valve will be opened to allow a purge rate of approximately 25,000 cfm through the containment.

The interconnecting piping for the penetration and the valves are classified Safety Class 2, Seismic Category I. The 18-inch and the 42-inch active isolation valves are leak tight (4 cc/hr per in. of diameter leakage rate), quick closure types capable of full closure in 4 seconds at peak temperature against the full pressure of the containment during a LOCA. These active isolation valves also have fail-safe provisions (spring-close) which enable them to close on loss of actuating air pressure.

An intermittent containment vessel purge rate of 5,000 cfm is the design flow rate used to maintain continuous occupancy radiation levels inside the containment vessel. Since a design purge rate of 5,000 cfm does not create any potential safety or health hazard, and does provide the important advantages stated above, the design of this system is considered acceptable.

The active purge supply and exhaust containment isolation valves are fast acting valves (4 seconds) which close on a containment isolation signal (high drywell pressure and/or low reactor vessel water level). These valves also close on a high radiation signal in the exhaust line. The amount of containment air that will be released from the purge exhaust and supply lines immediately after a LOCA has been determined for the main steam line break in the drywell, and for the RWCU line break in containment. Details are provided in <Section 6.2.4>.

For the RWCU line break outside the drywell, a high radiation signal closes the purge valves.

9.4.6.4 Inspection and Testing Requirements

The drywell fan-cooler, containment vessel fan-cooler and the annulus exhaust units are all operating during normal plant operation. The purge system is operated intermittently at partial flow during normal plant operation; it is either operated at full purge rate prior to personnel entry into the drywell and during refueling operation or compensatory actions are taken. Sufficient redundancy is provided for all these systems. None of these systems, except the annulus exhaust gas treatment system, is required to operate during a design basis accident.

The main components of these systems (including the purge isolation valves), with the exception of the cooling units and isolation valves in the drywell, are normally accessible for inspection or testing while the plant is in operation. However, the drywell cooling redundant units can be periodically tested by operation from the control room. Components of the containment vessel and drywell purge system, and the annulus exhaust gas treatment system are located outside the reactor building and can be inspected and tested during normal plant operation.

Periodic tests will be performed on the purge exhaust system <Regulatory Guide 1.140> and annulus gas treatment system <Regulatory Guide 1.52> to demonstrate that aging, weathering or poisoning of the filters has not significantly degraded the absorption material.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other safety devices. These provisions will ensure that these operational components will perform their function reliably and accurately during normal operation and under conditions of operation interruptions.

9.4.6.5 Instrumentation, Controls, Alarms, and Protective Devices

9.4.6.5.1 Drywell Cooling System

Instruments, controls, alarms, and protective devices for the drywell cooling system are discussed as follows:

a. Operation of the system is manually initiated from the control room. One fan from each fan-cooler unit normally operates continuously.

b. Instrumentation is provided in the control room for indication of the following:

   1. Which fan is energized (status lights).

   2. Low air flow with fan in operation (alarm).

   3. High temperature (and low temperature for M13-N050) in areas indicated in Item c4 (alarm and readout).

   4. Excessive fan vibration (alarm).

c. The major items of instrumentation and controls are as follows:

   1. Differential pressure switch across each fan to automatically start the standby fan if the operating fan is lost.

   2. Differential pressure switch across each fan to alarm in the control room on low air flow with fan in operation.

   3. One vibration detector on each fan to alarm in the control room on excessive vibration.

4. Temperature recorder to monitor and alarm the temperature in the following areas:

   (a) Inlet and outlet cooling water temperatures (monitor only).

   (b) Supply air temperature from each cooling unit.

   (c) Return air temperature to each cooling unit.

   (d) Bulkhead refueling bellows temperature (three points minimum circumferential at 120° spacing).

   (e) Zone temperatures.

   Instrument readout and recording are located on the HVAC panel in the control room.

5. Temperature controller located in control room to modulate three-way motor-operated valve on cooling coil bank in unit 1M13-B001 only.

9.4.6.5.2 Containment Vessel Cooling System

Instruments, controls, alarms, and protective devices for the containment vessel cooling system are discussed as follows:

a. Operation of the system is manually initiated from the control room. Four of the six air handling units normally operate continuously.

b. Instrumentation is provided for indication in the control room of the following:

   1. Indication of which fan is energized (status lights).

   2. Low air flow with fan in operation (alarm).

   3. High temperature in fan discharge duct with fan in operation (alarm).

c. The major items of instrumentation and controls are as follows:

   1. Pneumatically driven isolation damper with solenoid valve (1M11-F010A, F010B, F010C, F010D, F010E and F010F) in the discharge duct of each fan. The damper will open when the fan is started and will close when the fan stops. Dampers will fail closed on loss of control air.

   2. Differential pressure across each fan to alarm in the control room on low air flow with fan in operation.

   3. Temperature switches in each fan discharge duct to alarm in the control room when a preset high temperature is exceeded.

   4. Temperature controller with local temperature indicator to pneumatically modulate three-way valve in chilled water coil.

9.4.6.5.3 Containment and Drywell Purge System

Instruments, controls, alarms, and protective devices for the containment vessel purge supply subsystem are discussed as follows:

a. Operation of this subsystem is manually initiated from the control room. Normally, one of the two units operates intermittently at a reduced flow rate of 5,000 cfm. During refueling operations and prior to personnel access into the drywell area, either both supply units are operated to attain the full purge rate or compensatory actions are taken to ensure personnel safety.

b. The supply fans can be operated only when the following conditions are satisfied:

   1. Purge supply isolation valves are full open as follows:

      (a) For intermittent operation (single supply fan operation), valves M14-F040, M14-F190 and M14-F195 must be open.

      (b) For refueling operations or prior to drywell purging, valves M14-F040, M14-F190, M14-F195, and M14-F045 must be open.

   2. Either of the purge exhaust fans are operating; both exhaust fans must be operating to permit operation of both supply fans.

   3. Smoke detector has not stopped fan.

   4. High or low temperature indication has not stopped fan.

c. Details of the instrumentation and controls of this subsystem are discussed in <Section 7.3.1>.

Instruments, controls, alarms, and protective devices for the drywell purge supply subsystem are discussed as follows:

a. Operation of this subsystem is manually initiated from the control room.

b. The drywell purge supply fans can be operated when the following conditions are satisfied:

   1. Containment vessel purge supply fans are both operating.

   2. Purge exhaust fans are both operating.

   3. Drywell Purge supply and exhaust isolation valves are full open.

c. Details of the instrumentation and controls for this subsystem are discussed in <Section 7.3.1>.

Instruments, controls, alarms, and protective devices for the containment vessel and drywell purge exhaust subsystem are discussed as follows:

a. Operation of this system is manually initiated from the control room. One of the two exhaust fans normally operates intermittently. During refueling operations and prior to personnel entry into the drywell area, both fans are operated to attain the full purge rate, or compensatory actions are taken to ensure personnel safety.

b. Electrical permissives only allow operation of the purge exhaust units under the following conditions:

   1. For single exhaust unit intermittent operation (intermittent purge):

      (a) Purge exhaust isolation butterfly valves M14-F200, M14-F205 and M14-F090 are full open.

(b) The charcoal water spray system switch collar is not in the armed position.

2. For simultaneous exhaust unit operation (refueling and personnel access):

   (a) Purge exhaust isolation butterfly valves M14-F200, M14-F205, M14-F090, and F085 are full open.

   (b) The charcoal water spray system switch collar is not in the armed position.

c. Details of the instrumentation and controls for this subsystem are discussed in <Section 7.3.1>.

Control of the purge isolation valves is discussed as follows:

a. Normal operation of the purge isolation valve is manually initiated from the control room. Normally, when the containment vessel purge supply subsystem and the purge exhaust subsystem are operating, the purge isolation valves are open (except for the drywell purge supply and exhaust valves, and the 42-inch isolation valves located inside the containment vessel).

b. The section of the drywell purge supply lines between the isolation valves can be filled with water to provide shielding. The water provides shielding to minimize radiation streaming in the area of the containment adjacent to the drywell purge supply lines. Manual control is used for filling and draining operations.

   The level of water in the line between the drywell purge supply isolation valves is monitored, indicated and alarmed locally in the containment. This provides information to permit filling and maintaining the water shield as well as warning if the level falls below the top of the 24-inch drywell purge supply lines.

In addition to LOCA or high radiation signals the drywell purge supply isolation valves (M14-F055 A & B and M14-F060 A & B) are prevented from being opened until the water level indicates the water shield has been manually drained below the bottom of the 24-inch supply line. Closure of these valves prior to refilling the water shield is a manual operation and administratively controlled; no interlocks are provided.

c. Instrumentation is provided for indication in the control room (status lights) of the close or open position of the valves.

d. The major items of instrumentation and controls are pneumatically driven purge isolation valves, as indicated on <Figure 9.4-17>. Each valve includes limit switches and a three-way solenoid valve sized for emergency rapid closing (four seconds maximum). The air cylinder operators are air-open spring-closed mechanisms.

9.4.7 INTERMEDIATE BUILDING VENTILATION SYSTEM

9.4.7.1 Design Bases

Design Basis for the Intermediate Building Ventilation System (IBVS) is as follows:

a. The IBVS is classified as nonsafety-related and non-seismic category, except for the sub-exhaust unit charcoal filter plenum which is classified as Seismic Category I.

b. The IBVS is:

1. Designed to maintain the ambient temperatures in various operating areas of the intermediate building at the conditions presented in <Figure 3.11-32>, <Figure 3.11-33>, and <Figure 3.11-34> during normal plant operation and plant shutdown in order to provide suitable environment for operating personnel and equipment.

2. Designed so that air flow is directed from areas of low probable airborne contamination to areas of high probable airborne contamination.

3. Continuously monitored to indicate system status, system malfunction, fire or smoke hazard, and radiation in the discharge of this exhaust system.

4. Designed to maintain flow rates of 3 to 6 air changes per hour for non-contaminated areas and 6 to 10 air changes per hour for potentially contaminated areas.

5. Designed to direct the exhaust air from potentially contaminated areas served by this system through an exhaust filter plenum to ensure that the release of radioactivity to the environment is below permissible discharge limits.

6. Designed to maintain constant air flow through the potentially contaminated areas served by this system despite filter pressure drop increase due to dirt accumulation.

9.4.7.2 System Description

The heating and ventilation system for the intermediate building is shown schematically on <Figure 9.4-18>.

The function of this system is to continuously supply clean, filtered and heated outside air to various areas in the intermediate building, and to continuously exhaust air from various operating areas and equipment rooms for the purpose of providing adequate ventilation in the building.

The supply unit continuously draws outside air through roughing filters (the supply roughing filters may be removed to preclude snow buildup on the filters) and heating coils and supplies it to the general areas of the building. This supply air is drawn through the various ventilation equipment rooms and is then discharged to the atmosphere by the unit vent. The supply air drawn through the fuel pool cooling and cleanup system equipment rooms and the postaccident sampling room is directed through the charcoal filter train of the fuel handling area exhaust system before being discharged to the atmosphere by the unit vent. The supply air drawn through the Intermediate Building Tool Storage/Tool Decon Areas is directed through the sub-exhaust unit, which contains a filter train consisting of roughing filters, HEPA pre-filters, charcoal filters and HEPA after-filters. After passing through the filter train, the exhaust air from these areas is carried through the system exhaust ductwork and is exhausted to the atmosphere through the unit vent. During system operation, power will be provided by the preferred ac source. During periods of emergency, as may result from a LOCA or loss of offsite power, this system is not required to operate.

The major components of this ventilation system are located in the Intermediate Building at elevation 682'-6" and include a supply unit and exhaust unit. The sub-exhaust unit is located in the Intermediate Building at elevation 574'-10".

The supply unit includes a 100 percent capacity fan (M33-C001) and a 100 percent capacity supply plenum (M33-B001). The supply plenum contains a roughing filter (the supply roughing filters may be removed to preclude snow buildup on the filters) bank and hot water heating coil bank.

The exhaust unit includes one 100 percent capacity centrifugal fan.

The sub-exhaust unit consist of one centrifugal fan and one charcoal filter train. The filter train includes roughing filters, HEPA pre-filters, charcoal filters and HEPA after-filters.

The supply, exhaust and sub-exhaust fans are also provided with isolation dampers for unit isolation.

The fans, coils, dampers, and filter elements are of standard industrial design. However, the plenums, frames and filter racks are specially designed to satisfy the system space requirements. This system is nonsafety-related and non-seismic classified, except for the sub-exhaust charcoal filter plenum which is designed to satisfy the requirements of Seismic Category I items.

For additional filtered exhaust system details refer to <Section 12.3>. <Figure 12.3-22> represents the general arrangement of the filtered exhaust plenum. Filtered exhaust component characteristics to ensure control of radiological releases is ensured by compliance to <Regulatory Guide 1.140> as presented in <Table 12.3-3>.

9.4.7.3 Safety Evaluation

Provision for adequate distribution ductwork ensures proper ventilation of the various rooms and areas of the building during normal plant operation and plant shutdown.

If control air is lost, the outside air intake damper and the exhaust fan and sub-exhaust fan isolation dampers will close.

In case of fire, the ventilation system will continue to operate to exhaust from the building and handle the products of combustion through appropriate ventilation ductwork. However, the system fans can be shut off by a manual switch at the local panel H51-P040 at the operator’s option.

With the exception of the sub-exhaust plenum, which can be shut off at local panel H51-P5246. The charcoal filter plenums are monitored for excessive air temperatures leaving the charcoal trays and are provided with a water spray fire suppression system.

Radiation monitoring is also provided to alarm in the control room if activity is detected in the exhaust air. Details of the radiation monitoring system are discussed in <Section 12.2>.

9.4.7.4 Inspection and Testing Requirements

The various components of the intermediate building ventilation system are accessible during normal plant operation and plant shutdown for testing and inspection. However, when maintenance is required on the exhaust plenum, the sub-exhaust system will be shut down.

Periodic tests will be performed on the upstream HEPA filter within the exhaust filter system. These tests will include measurement of differential pressure across the filter units and determination of filter efficiency to demonstrate that aging or weathering has not significantly degraded the HEPA filters.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other devices; this will ensure that these operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.7.5 Instrumentation, Controls, Alarms, and Protective Devices

Instruments, controls, alarms, and protective devices for the intermediate building ventilation system are discussed as follows:

a. Operation of the supply fan and exhaust fan is manually initiated from the local control panel H51-P040 located at elevation 682'-6" of the Intermediate Building. Operation of the sub-exhaust fan is manually initiated from the local control panel H51-P5246 located at elevation 574'-10" of the Intermediate Building. During operation of this system, the supply fan, the exhaust fan and the sub-exhaust fan operate continuously. An interlock is provided which prevents operation of the supply fan (M33-C001) unless the exhaust fan (M33-C002) is energized. An interlock is provided which prevents starting or continued operation of the sub-exhaust fan (M33-C003) unless the exhaust fan (M33-C002) is energized. The sub-exhaust fan (M33-C003) is also interlocked to stop when the charcoal filter deluge is initiated.

b. Instrumentation is provided for local indication at panel H51-P040 with corresponding trouble alarm in the control room of the following:

    1. If the fans are energized (status lights).

    2. Low air flow with the fan in operation (red indicating light).

    3. Smoke in supply fan discharge and exhaust fan discharge duct (red indicating light).

    4. High and low temperature of supply air (red indicating light).

    5. High radiation in exhaust air for any of the above conditions (red indicating light).

Instrumentation is provided for local indication at panel H51-P5246 of the following:

1. Indication if each fan is energized (status light).

2. Loss of air flow with sub-exhaust fan in operation (alarm locally with corresponding trouble alarm in control room at panel H51-P040).

3. High temperature in the carbon beds (alarm and read out locally and alarm in the control room).

4. High-High temperature in the carbon beds (alarm locally and corresponding trouble alarm in the control room).

5. Smoke in discharge duct of sub-exhaust fan (red indicating light).

c. Major items of instrumentation and controls are:

1. Differential pressure indicator with local indication across each filter bank.

2. Pneumatically driven isolation damper (M33-F010) with solenoid air valve in the outside air intake duct of the supply system, and pneumatically driven isolation dampers (M33-F080 and M33-F619) with solenoid air valves in the discharge duct of the exhaust fan and sub-exhaust fan respectively. The dampers will open when the corresponding fan is energized and will close when the fans stop.

3. Differential pressure switches across the supply fan (PS-N110) and across the exhaust fan (PS-N120) to indicate in the local

panel H51-P040 (with corresponding system trouble alarm in the control room) if low air flow or loss of fan operation occurs.

4. Smoke detectors in the discharge duct of the supply fan (XE-N060) and in the discharge duct of the exhaust fan (XE-N100) and sub-exhaust fan (XE-N040) to indicate on the local panels H51-P040 and H5246 and alarm on the fire protection panel in the control room if smoke is detected. High smoke alarm in the supply and sub-exhaust discharge ducts will automatically trip the supply fan and sub-exhaust fan.

5. Capillary tube type freeze-up protection temperature switches (TS-N050, TS-N130 and TS-N140) located in the supply plenum downstream of the heating coil to indicate locally on panel H51-P040 (with corresponding system trouble alarm in the control room) if low temperature occurs. This low temperature signal will also trip the supply fan to prevent coil freeze-up.

6. Temperature switch (TS-N030) located in the supply fan discharge duct to indicate locally on panel H51-P040 (with corresponding system trouble alarm in the control room) upon receipt of high temperature.

7. Temperature controller (TC-R042) in the supply fan discharge duct to modulate the three-way valve of the heating coil in response to the discharge air temperature.

8. Radiation monitor to alarm in the control room (with corresponding local panel indication on H51-P040) and trip the supply fan when the gaseous activity in the exhaust air exceeds a preselected set point.

9. High temperature switch in the supply duct to automatically stop the supply fan upon the receipt of high temperature.

10. Differential pressure transmitter across the charcoal filter to provide a signal to modulate the variable inlet vanes and to alarm locally on panels H51-P040 and H51-P5246 and in the control room on loss of air flow.

11. Temperature sensors (thermisters) for the charcoal filter beds to provide an electrical signal to a local temperature monitor unit. The temperature monitor unit provides the following output signals:

    (a) Analog output signal to a temperature indicator located on local panel H51-P5246 to provide continuous temperature indication.

    (b) High temperature alarm (225°F) contacts to provide alarm indication on the computer (Teletype and alarm display), and on local panel H51-P5246.

    (c) High-High temperature alarm (250°F) contacts to provide a local indication on panel H51-P5246 and an alarm (annunciator point) on panel H13-P680.

12. A pneumatic actuated ball valve M33-F615 with solenoid valve M33-F616 to drain spray water from the charcoal beds during fire protection spray deluge valve actuation. When the manual deluge valve is opened a magnetic position switch energizes the solenoid valve to provide control air to operate the piston operator thus opening the ball valve. Resetting the magnetic position switch will de-energize the solenoid valve M33-F616; however, the drain valve M33-F615 will remain open until manually closed via the normal override lever.

9.4.8 TURBINE POWER COMPLEX VENTILATION SYSTEM

9.4.8.1 Design Bases

The ventilation system for the turbine power complex is designed to provide a suitable environment for operating personnel and equipment by maintaining the ambient temperatures between 75°F and 80°F in the battery rooms, and between 60°F and 104°F in other electrical areas during normal plant operation and plant shutdown.

9.4.8.2 System Description

The turbine power complex ventilation system is shown schematically in <Figure 9.4-19>.

This system operates continuously during normal operation to cool the electrical equipment areas in the turbine power complex.

Temperature controllers (M42-R062 and M42-R052) are provided to control the cooling coil three-way valve and the heating coil three-way valve, respectively. The temperature controller modulates the three-way valve controlling chilled/hot water flow through the coil to cool/heat the air as required to satisfy the temperature controller setpoint.

The supply unit is also provided with modulating outside air intake (M42-F060) and return (M42-F050) dampers which are controlled by a temperature controller M42-R042, with temperature indicator M42-R041 and temperature transmitter M42-N040 located in the mixing box of the supply unit. When the outside temperature is 50°F or higher, 100 percent outside air is supplied to the turbine power complex. When the outside air temperature is below 50°F, the dampers are modulated to attain a mixture air temperature of 50°F in the mixing box. Outside air is relieved back to the atmosphere through relief louvers at Elevation 647’-6” and through the relief duct in the battery room.

The battery room is normally maintained at 77°F. A constant quantity of cooled (heated) air is supplied to the room to maintain the temperature. To preclude hydrogen buildup in the battery room to dangerous levels, air supplied to the room is directly exhausted to the atmosphere through the relief duct. An electric reheat coil, located in the battery room supply duct and controlled by a room thermostat (M42-R065), is also provided to heat the supply air as required to maintain the battery room design temperature.

In the case of an emergency, which could result from a LOCA or loss of offsite power, the turbine power complex ventilation system is not required to operate.

The main components of this system consist of a 100 percent capacity supply plenum, two 100 percent centrifugal fans with isolation dampers, and modulating outside air intake and return dampers. The supply plenum includes roughing filters (the supply roughing filters may be removed to preclude snow buildup on the filters), hot water heating coils and chilled water cooling coils. These components are located at Elevation 647’-6” of the turbine power complex. The components of this system are classified as nonsafety and non-seismic and are of standard industrial design.

9.4.8.3 Safety Evaluation

Provision for adequate distribution ductwork ensures proper ventilation of the various rooms and areas of the building during normal plant operation and plant shutdown. Redundant supply fans are also provided.

If control air is lost, the outside air intake damper will close, the return air damper will open and the system will continue to operate (provided there is no loss of offsite power).

Operation of this system is not required to safely shut down the plant if an emergency occurs.

9.4.8.4 Inspection and Testing Requirements

The various components of the turbine power complex ventilation system are accessible during normal plant operation and plant shutdown for testing and inspection.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other devices. This will ensure that these operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.8.5 Instrumentation, Controls, Alarms, and Protective Devices

Instrumentation, controls, alarms, and protective devices for the turbine power complex ventilation system are discussed as follows:

a. Operation of this system is initiated manually from the local panel. One of the two fans is operated continuously during normal plant operation.

b. Instrumentation is provided for indication on the local panel (with a corresponding system trouble alarm in the control room) of the following:

    1. Which fan is operating (status light).

2. Low air flow alarm (indicating light) for each fan with a corresponding system trouble alarm in the control room.

c. The major items of instrumentation and controls are as follows:

1. Differential pressure indicator (M42-R030) across the roughing filter bank for local indication.

2. Pneumatically driven isolation dampers with solenoid air valves in each fan discharge duct. The damper will open when the corresponding fan is energized and will close when the fan stops. Dampers will fail open if control air is lost.

3. Differential pressure switch (1M42-N010A, B) across each fan to give local indication and to alarm in the control room on low air flow. This switch will also provide a signal to automatically start the standby fan upon low flow condition of the operating fan.

4. Temperature controller (1M42-R062, 2M42-R062) located above floor Elevation 647'-6" to modulate the three-way valve controlling chilled water flow through supply unit cooling coils.

5. Temperature controller (1M42-R052, 2M42-R052) located above floor Elevation 647'-6" to modulate the three-way valve controlling hot water flow through supply unit heating coils.

6. Modulating outside air intake (1M42-F060, 2M42-F060) and return (1M42-F050, 2M42-F050) dampers for the supply unit controlled by a temperature controller (1M42-R042, 2M42-R042). The outside air intake damper fails closed while the return damper fails open if control air is lost.

7. Indicating temperature controller (1M42-R065, 2M42-R065) located in the battery room that controls the supply duct electric reheat coil.

9.4.9 CHILLED WATER SYSTEMS

9.4.9.1 Design Bases

The chilled water systems are designed to provide mechanically chilled water to the cooling coils of the air handling units serving the following areas:

a. Control complex.

b. Turbine building.

c. Turbine power complex.

d. Containment vessel.

e. Inservice inspection room.

f. Steam tunnel.

9.4.9.2 System Description

The chilled water systems serving the plant areas listed above consist of the control complex chilled water system, turbine building chilled water system and the containment vessel chilled water system.

These systems are shown schematically on <Figure 9.4-20>, <Figure 9.4-21>, and <Figure 9.4-22>.

9.4.9.2.1 Control Complex Chilled Water System

The function of this system is to provide mechanically chilled water to the chilled water coils of the following control complex air handling units:

a. Control room.

b. Motor control center, switchgear and miscellaneous areas.

c. Controlled access and miscellaneous equipment areas.

d. Emergency closed cooling pump area.

e. Computer room (to cool the air supplied to the control complex area).

The control complex chilled water system is shown in <Figure 9.4-20>.

Three 100 percent capacity water chilling machines and three 100 percent capacity water recirculating pumps are provided. These are connected to two redundant chilled water piping systems, one of which is normally operating while the other is on manual standby. Loop A can be connected to chiller A or C, and loop B can be connected to chiller B or C. One set of isolation valves on the main header is normally closed. The other set of isolation valves is normally open to valve chiller C into either pipe loop A or B.

One chiller and one circulating pump are connected to the standby diesel generator, Division 1 of Unit 1. Another chiller and circulating pump are connected to the standby diesel generator, Division 2 of Unit 1. The third chiller and pump are connected to Division 1 of Unit 2.

During all modes of operation, condenser water for the “A” and “B” chillers is provided by the emergency closed cooling system and condenser water for the “C” chiller is provided by the nuclear closed cooling system.

Initial fill and makeup water to the system is supplied by the two bed water distribution system.

Electric motor-operated isolation valves (P47-F290 A and B; P47-F295 A and B) are also provided to isolate the chilled water coils of the nonsafety-related and non-seismic air handling units (M21-B001 A, B; M27-B001 A, B). This will prevent draining the chilled water from the system if a coil failure occurs. A rupture will not occur in the cooling coils and related piping of air handling units M21 or M27 due to a safe shutdown earthquake or an operating basis earthquake. The signal from the low level switch in the expansion tank will activate the corresponding isolation valves. In addition, the isolation valves may be activated remote-manually from control switches located in the control room.

Each chiller is provided with a complete system of operating and safety controls.

Components of this system are classified as Safety Class 3, Seismic Category I. The portion of the system after the isolation valves (F290A, B and F295A, B) is nonsafety-related and non-seismically qualified, however, it will not rupture during a safe shutdown earthquake or an operating basis earthquake. All materials for cooler, condenser, economizer, chilled water piping to oil cooler, bolts, and supports shall reflect the use of Code Case N-242, Paragraphs 1 through 4.

Description and performance requirements for the major components of the control complex chilled water system are as follows:

a. Water Chillers (P47-B001A, B and C)

The water chillers for the control complex chilled water system are located in the control complex at Elevation 574’-10”. The chillers are of the packaged, centrifugal type with hermetically sealed motors. They are of standard industrial design modified to meet the Quality Assurance and seismic requirements of Safety Class 3, Seismic Category I.

Design information for the water chillers is listed in <Table 9.4-23>.

b. Chilled Water Pumps (P47-C001A, B and C)

These pumps are located in the control complex at Elevation 574’-10”. The pumps are centrifugal, double suction and horizontally split casing with drip-proof drive motors. Both the pump and drive motor are mounted on a common steel base.

The pumps and motors are of standard industrial design modified to meet the Quality Assurance and seismic requirements of Safety Class 3, Seismic Category I.

Design information for the chilled water pumps is listed in <Table 9.4-23>.

c. Expansion Tanks (P47-A002A, and B)

Each redundant chilled water piping circuit is provided with an open expansion tank located in the control complex at Elevation 698’-1”. The expansion tank has a capacity of 70 gallons (flooded) and is of standard industrial design, modified to meet the Quality Assurance and seismic requirements of Safety Class 3 and Seismic Category I.

9.4.9.2.2 Turbine Building Chilled Water System

The function of this system is to provide mechanically chilled water to the chilled water coils of the turbine building air handling units, turbine power complex air handling unit, turbine plant sample panel, and the steam tunnel air handling unit. The turbine building chilled water system is shown schematically on <Figure 9.4-21>.

This chilled water system operates continuously, as required, during normal operation to provide chilled water to the chilled water coils of various air handling units for the purpose of cooling the air supplied to the areas served by these air handling units.

Two 100 percent capacity water chilling machines and two 100 percent capacity chilled water recirculating pumps are provided. One set of chiller and pump are normally operated with the other set as backup. During operation, condenser water is provided by the nuclear closed cooling system. This system is not required to operate during a LOCA or loss of offsite power, and is normally not required to operate during the winter season.

Initial fill and makeup water for this system is supplied by the two bed water distribution system. An open type expansion tank (130 gallons flooded) and a chemical addition tank are provided.

The main components of the turbine building chilled water system are located in the auxiliary building at Elevation 599’-0”, and consist of two 100 percent capacity chillers and two 100 percent capacity recirculating pumps. The chillers are of the packaged centrifugal type with hermetically sealed motors. The pumps are of the centrifugal, split casing, double suction type.

Water quality is maintained by chemical addition through a chemical addition tank.

The pumps, chillers and tanks are of standard industrial design, and are classified as nonsafety-related and non-seismic.

Design information for the turbine building chilled water system components is listed in <Table 9.4-24>.

9.4.9.2.3 Containment Vessel Chilled Water System

The function of this system is to provide mechanically chilled water to the chilled water coils of the containment vessel air handling units and the inservice inspection room air handling units. The containment vessel chilled water system is shown schematically on <Figure 9.4-22>.

This chilled water system operates continuously during normal operation to provide chilled water to the chilled water coils of the various containment vessel cooling system air handling units and the inservice inspection room air handling units for the purpose of cooling the air supplied to the areas served by these air handling units.

Three 100 percent capacity water chilling machines and three 100 percent capacity chilled water recirculating pumps are provided. Normally, one set of chiller and pump provides service with the second and third sets as backup. Condenser water is provided by the nuclear closed cooling system during operation. This system is not required to operate during LOCA or loss of offsite power.

Initial fill and makeup water for this system is supplied by the two bed water distribution system. Capacity for expansion and a bypass chemical feeder are also provided.

Each chiller is provided with a complete system of operating and safety controls.

The pumps, chillers, valves, piping, and tanks are of standard industrial design and are classified as nonsafety-related and non-seismic. However, isolation valves in the containment vessel penetration line are Safety Class 2 and Seismic Category I.

Design information for the containment vessel chilled water system components is listed in <Table 9.4-25>.

9.4.9.3 Safety Evaluation

The control complex chilled water system is classified as Safety Class 3, Seismic Category I. This system is provided with three (A, B and C) 100 percent capacity chiller and pump combinations and two separate, redundant chilled water loops. Either one is capable of providing adequate chilled water for normal and emergency conditions. Each of the chiller/pump combinations is supplied with electric power from a separate Class 1E load source. If offsite power is lost, the Class 1E diesel generators are used to supply power to the A and B chiller/pump combinations. The C chiller/pump is supplied only with offsite power. Electric motor-operated isolation valves are also provided to isolate the chilled water coils of the nonsafety-related air handling units to prevent draining the chilled water from the system if a coil failure occurs. The signal from the low level switch in the expansion tank will activate the corresponding isolation valves.

The turbine building chilled water system and the containment vessel chilled water system are not required to operate to safely shut down the plant following a design basis accident. However, sufficient redundancy is provided for these systems to enhance system reliability and ensure chilled water availability if a single chiller or pump failure occurs.

9.4.9.4 Inspection and Testing Requirements

Components of these systems are subjected to tests during the preoperational test phase to verify proper function of system components and control devices under normal and emergency conditions, and to establish system air and water balance in accordance with design requirements.

Redundancy in the components, and the ability to isolate idle components, enables inspection, maintenance and testing to be performed while the systems are in normal operation.

During testing and inspection, provisions will be made to verify the function and performance of the valves, chillers, pumps, controls, and other safety devices. The provisions will ensure that operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.9.5 Instruments, Controls, Alarms, and Protective Devices

9.4.9.5.1 Control Complex Chilled Water System

a. Operation of the system is initiated locally as well as remotely from the control room. During normal operation, chiller C and its pump are connected to loop A or loop B and are operating. Chillers A and B are in standby. In the event of either a loss of offsite power (LOOP) or a LOCA, chiller C and its pump will trip, and chillers A and B and their respective pumps will start automatically. The Control Complex Chilled Water system can also be operated with chiller C and its pump isolated from loop A and loop B and not operating. In this configuration one chiller A (or B) will operate with only one chiller in standby B (or A). A LOOP will result in the operating chiller tripping and automatically restarting. Also, the standby chiller and pump will start automatically. When two chillers are operating, they each serve a separate piping loop. During a LOOP, power will be provided by the diesel generators. During a LOCA without LOOP, offsite power will be provided, however, the diesel generators will be running and automatically available for backup power.

b. Electrical permissives only allow operation of the chillers under the following conditions:

   1. The chilled water flow switch has verified the flow of chilled water.

   2. The condenser water flow switch has verified the flow of condenser water.

   3. The corresponding chilled water pump is operating.

c. A detailed description of the instrumentation and controls for this system is presented in <Section 7.3.1>.

9.4.9.5.2 Turbine Building Chilled Water System

Instruments, controls, alarms, and protective devices for the turbine building chilled water system are discussed as follows:

a. Operation of this system may be initiated by starting the chiller manually from the control room or local panel and starting the pump from the local panel. One chiller and one pump operate continuously during operation.

b. Electrical permissives only allow operation of the chillers under the following conditions:

    1. The chilled water flow switch has verified the flow of chilled water.

    2. The condenser water flow switch has verified the flow of condenser water.

    3. The corresponding chilled water pump is operating.

c. Instrumentation is provided for indication in the control room of the following:

    1. Which chiller is in operation (status light).

    2. Loss of chiller operation (alarm).

    3. Low chilled water flow (alarm).

    4. Low condenser water flow (alarm).

    5. Chiller amp meter.

6. Low expansion tank water level (alarm).

7. High expansion tank water level (alarm).

d. The major items of instrumentation and controls are as follows:

1. Temperature and pressure indicators with local indication and capped pressure tap points installed as indicated on <Figure 9.4-21>.

2. Chilled water flow switch in each chiller discharge line to alarm in the control room on loss of chiller water flow and to de-energize the corresponding water chiller. Indicating lights are provided on the local panel.

3. Condenser water flow switch to alarm in the control room on loss of condenser water flow and to de-energize the corresponding water chiller. This is shown on <Figure 10.1-7>. Indicating lights are provided on the local panel.

4. Pneumatically driven three-way valve in the main chilled water line from each chilled water coil bank which is controlled by a thermostat in the air downstream of the coil.

5. Level switch to alarm in the control room when either the low level or the high level set points are exceeded in the expansion tank.

6. Level switch to de-energize the solenoid valve and close the makeup valve, to energize the solenoid valve and open the makeup valve when the corresponding set points are exceeded.

7. Pneumatically driven valve, with solenoid valve, in the makeup line for automatic water makeup upon receipt of the low level signal.

8. Miscellaneous trouble alarm from the integral control panel on the chillers to alarm in control room on low oil pressure, high refrigerant pressure, etc.

9. Chiller ammeters in the control room to indicate the amount of current drawn by the operating chillers.

9.4.9.5.3 Containment Vessel Chilled Water System

Instruments, controls, alarms, and protective devices for the containment vessel chilled water system are discussed as follows:

a. Operation of this system is initiated by starting the chiller manually from the control room and starting the pump from the local panel. One chiller and one pump operate continuously during operation.

b. It becomes electrically permissive to operate the chillers under the following conditions.

   1. The chilled water flow switch has verified the flow of chilled water.

   2. The condenser water flow switch has verified the flow of condenser water.

   3. The corresponding chilled water pump is operating.

c. Instrumentation is provided for indication in the control room of the following:

   1. Which chiller is in operation (status light).

   2. Loss of chiller operation (alarm).

   3. Loss of chilled water flow (alarm).

   4. Loss of condenser water flow (alarm).

   5. Chiller ammeter.

   6. Containment isolation valves (status lights).

   7. Low expansion tank water level (alarm).

   8. High expansion tank water level (alarm).

d. The major items of instrumentation and controls are as follows:

   1. Temperature and pressure indicators with local indication and capped pressure tap points installed as indicated on <Figure 9.4-22>.

   2. Chilled water flow switch in each chiller discharge line to alarm in the control room on loss of chilled water flow, and to de-energize the corresponding water chiller. Indicating lights are provided on the local panel.

   3. Condenser water flow switch to alarm in the control room on loss of condenser water flow, and to de-energize the

corresponding water chiller. This is shown on <Figure 10.1-7>. Indicating lights are provided on the local panel.

4. Pneumatically driven three-way valve in the main chilled water line from each chilled water coil bank which is controlled by a thermostat in the air downstream of the coil.

5. Level switch to alarm in the control room when either the low level or the high level set points are exceeded in the expansion tank.

6. Level switch to de-energize the solenoid valve and close the makeup valve, or to energize the solenoid valve and open the makeup valve when the corresponding set points are exceeded.

7. Pneumatically driven valve, with solenoid valve, in the makeup line for automatic water makeup upon receipt of the low level signal.

8. Chiller amp meter in the control room to indicate the amount of current drawn by the operating chillers.

9. Control switches for the containment isolation valves. The containment isolation valves can be isolated by an automatic LOCA signal or remote-manually by use of the control switches.

9.4.10 BUILDING HEATING SYSTEM

9.4.10.1 Design Bases

The building heating system is designed to maintain the design minimum temperature in various areas and buildings of the plant. This function is accomplished by the hot water heating system and by electric unit heaters.

Hot water heating coils, hot water unit heaters and electric unit heaters are used in the heating system as discussed in <Section 9.4.10.2>.

The hot water heating system is designed to provide sufficient hot water to the hot water heating coils and to the hot water unit heaters located in areas throughout the plant for the purpose of maintaining a minimum ambient temperature of 60°F in the specified areas. This system also provides steam heated water to the following systems for freeze protection:

a. Condensate transfer and storage system.

b. Two bed demineralizer and distribution system.

c. Mixed bed demineralizer and distribution system.

9.4.10.2 System Description

The heating system for each reactor unit consists of two 100 percent shell and tube type heat exchangers (steam-water), two 100 percent circulation pumps, an expansion tank, a chemical mixing tank, hot water and electric unit heaters located at various buildings and elevations, valves, and distribution piping. The hot water heating system is shown schematically on <Figure 9.4-23>.

The two steam sources for the hot water heating system are the extraction steam system (normal) and the auxiliary steam system (shutdown and startup). Two 100 percent heat exchangers are provided so that one heat exchanger will only use steam from the extraction steam system and the other heat exchanger will only use steam from the auxiliary steam system. This design precludes direct contamination of the auxiliary steam system by the extraction steam system.

During normal plant winter operation, the P55-B001A heat exchanger and one of the two circulation pumps (P55-C001A or B) are in operation. Extraction steam is supplied to the shell of the heat exchanger to heat the water in the tube to 190°F. The steam heated water is then supplied to the hot water heating coils and hot water unit heaters located at various buildings and elevations. Hot water is also supplied to the mixed bed demineralizer system, two bed demineralizer system and condensate transfer and storage system heat exchangers for freeze protection.

Hot water heating coils are used in conjunction with the building ventilation systems. They add heat to the supply air prior to distribution if the air temperature drops below the air temperature controller preset value. Hot water heating coils are used in the supply plenum of the following ventilation systems:

a. Auxiliary building ventilation system.

b. Fuel handling building ventilation system.

c. Heater bay ventilation system.

d. Intermediate building ventilation system.

e. Containment vessel purge supply system.

f. Radwaste building ventilation system.

g. Turbine power complex ventilation system.

h. Turbine building ventilation system.

Hot water and electric unit heaters are used to provide heat to the space they serve. When the space temperature drops below the preset value, the space thermostat provided with each heater will automatically operate the unit heater and will automatically stop the unit heater when the space temperature satisfies the thermostat set point. The following buildings are provided with hot water unit heaters:

a. Auxiliary building.

b. Auxiliary boiler building.

c. Heater bay.

d. Intermediate building.

e. Offgas building.

f. Radwaste building.

g. Turbine building.

h. Turbine power complex.

i. Water treating building.

The following buildings are provided with electric unit heaters:

a. Fuel oil pumphouse.

b. Circulating water pumphouse.

c. Diesel generator building.

d. Discharge tunnel dechlorination equipment building.

e. Decant control structure.

f. Emergency service water pumphouse.

g. (Deleted)

h. Reactor building annulus.

i. Service water pumphouse.

j. Control complex stairway at Elevation 707'-2".

k. (Deleted)

If heating is required during plant startup and shutdown, the P55-B001B heat exchanger and one of the two circulation pumps (P55-C001A or B) will operate. Operation is the same as described above except that steam is supplied to the heat exchanger by the auxiliary steam system.

An expansion tank is also provided to allow water to expand as the water temperature rises. This tank is also pressurized with compressed nitrogen to help maintain the water pressure above the extraction steam pressure (60 psig minimum water pressure vs. 50 psig extraction steam pressure). This will prevent contamination of the hot water distribution system by the extraction steam. Pressure in the expansion tank is maintained at 70 psig by the addition of compressed nitrogen utilizing a nitrogen generator or N_2 bottled gas. A pressure relief valve on the expansion tank relieves excessive tank pressure.

Two bed demineralized water (80-120 psig) is supplied for makeup water and water required to initially fill the system. This water is supplied through a valve controlled from level switches on the expansion tank. The valve closes when the water level in the expansion tank returns to high level. The valve is controlled between high and low level.

A description of the components of the hot water heating system is as follows:

a. Heat exchangers (1P55-B001A, 1P55-B001B)

   The heat exchangers are located in the heater bay at Elevation 580’-6”. They are of the shell and tube type, with U-bend removable tube bundle, steam in shell and water in tubes.

   The heat exchangers are classified nonsafety and non-seismic. Design information for the heat exchangers is listed in <Table 9.4-26>.

b. Circulation pumps (1P55-C001A, 1P55-C001B)

   These pumps are located in the heater bay at Elevation 580’-6”. The pumps are centrifugal, double suction and horizontally split casing, with drip-proof drive motors. Both the pump and drive motor are mounted on a common steel base.

   The pumps and motors are of standard industrial design and are classified as nonsafety and non-seismic. Design information for the circulation pumps is listed in <Table 9.4-26>.

c. Expansion tanks (1P55-A002)

   The expansion tanks are located in the heater bay at Elevation 620’-6”. The tank has a capacity of approximately

1,355 gallons and is of standard industrial design with a relief valve and a sight glass. Level switches and alarms are provided to annunciate on a local panel when the water level either reaches a low level or high level. A separate high/low level switch opens the water makeup valve if low water level is sensed and will automatically close the water makeup valve when the normal level is attained. The same switch activates a computer to provide print out and monitor indication when the makeup valve is opened. A pressure switch is also provided to activate an alarm when the pressure in the tank drops below 60 psig.

The expansion tanks are classified as nonsafety and non-seismic.

d. Chemical mixing tanks (1P55-A001, 2P55-A001)

A five gallon capacity chemical mixing tank is connected across the circulation pumps for adding chemical treatment to the water. The tank is located in the heater bay at Elevation 580’-6” and is of the standard industrial design, classified as nonsafety and non-seismic.

e. Piping and valves

The hot water heating system water piping circuits and valves are shown on <Figure 9.4-23>.

Piping is carbon steel ASTM A-106 Gr. B. Water quality is maintained by chemical addition to the system through a chemical addition tank.

f. Hot water and electric unit heaters

The hot water and electric unit heaters are of the recirculating type and are individually controlled by a remotely mounted thermostat. If the space temperature drops below the preset value, the thermostat will automatically operate the unit heater and will automatically stop the unit heater when the space temperature satisfies the thermostat set point.

The hot water and electric unit heaters are of standard industrial design and are classified nonsafety and non-seismic.

9.4.10.3 Safety Evaluation

Redundant heat exchangers and pumps are provided so that failure of one component will not affect the continuous operation of the system. Assuming the system fails with the outside temperature at design winter temperature (-5°F), it would take approximately 3-4 days for the ambient temperature around emergency cooling water lines to decrease to freezing temperatures. This is sufficient time to establish supplemental heating measures if required. In addition, flow in emergency cooling water lines is sufficiently high (greater than 4 ft/sec) to prevent freezing due to low ambient temperatures.

Since the hot water heating system is non-seismically designed, piping and components are located so that they have no adverse effects on safety-related structures, systems or components if a system failure occurs during an SSE. Because this is a moderate energy system, flooding, spraying and environmental effects are the only events that are considered.

Since the system piping and components are separated from safety-related components, there is no possibility of adverse effects due to flooding, spraying or environmental conditions as a result of system failure.

The two steam sources for the hot water heating system are the extraction steam system (normal) and the auxiliary steam system (shutdown and startup). Two 100 percent heat exchangers are provided so that one heat exchanger will only use steam from the extraction steam system and the other heat exchanger will only use steam from the auxiliary steam system. In this way, direct contamination of the auxiliary steam system by the extraction steam system is precluded.

An expansion tank is also provided to allow water to expand as the water temperature rises. Nitrogen is used to help pressurize and maintain the water pressure above the extraction steam pressure (60 psig minimum water pressure vs. 50 psig extraction steam pressure) to prevent contamination of the hot water distribution system by the extraction steam.

9.4.10.4 Inspection and Testing Requirements

The main components of the hot water heating system are readily accessible for inspection, testing and maintenance during normal plant operation or shutdown. Redundancy in the system and the capability to isolate idle components enables inspection, maintenance and testing to be performed without interrupting the normal operation of the system.

During testing and inspection, provisions will be made to verify the function and performance of the pumps, heat exchangers, valves, heating coils, unit heaters, compression tank, and other safety devices. These provisions will ensure that operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.10.5 Instruments, Controls, Alarms, and Protective Devices

Instruments, controls, alarms, and protective devices for the building heating system are discussed as follows:

a. Operation of the system is initiated manually from the local control panel located in the heater bay. During normal winter operation, the P55-B001A heat exchanger and one circulation pump are in operation. Extraction steam is used to heat the water. During plant shutdown (or when extraction steam is not available) if heating is required, the P55-B001B heat exchanger and one circulation pump are operating. Steam is supplied by the auxiliary steam system to heat the water. An expansion tank (P55-A002) is provided to allow water to expand and to pressurize the water above the extraction steam pressure.

The expansion tank is provided with level gauge and level switches to alarm in the control room if the water level in the tank falls below, or rises above, the critical level. A separate high/low level switch opens the water makeup valve if the expansion tank water level drops below the low level setpoint, and will automatically close the water makeup valve when the normal level is attained. A computer print out and monitor indication in the control room are initiated when the makeup valve is opened. A relief valve is provided to relieve excess pressure in the expansion tank. A pressure switch is also provided to alarm at the local control panel, 1H51-P333, when the tank pressure drops below 60 psig.

b. Instrumentation is provided to indicate on the local control panel (with corresponding trouble alarm in the control room) of the following:

1. Which circulation pump is in operation (status light).

2. Low water flow (alarm).

3. Low water level in the expansion tank (alarm).

4. High water level in the expansion tank (alarm).

5. Low pressure in the expansion tank (alarm).

c. Instrumentation is provided to indicate in the control room of the following:

   1. Common trouble (alarm).

   2. Computer printout and monitor indication when the water makeup valve opens.

d. The major items of instrumentation and controls are as follows:

   1. Temperature and pressure indicators with local indication and capped pressure tap points installed as indicated on <Figure 9.4-23>.

   2. Pressure switch in the common heat exchanger discharge line to alarm in the control room on loss of hot water flow.

   3. Level gauge on the expansion tank.

   4. Level switches on the expansion tank to alarm in the control room when the water level either reaches a low level or high level. A separate high/low level switch opens the water makeup valve on low water level and closes the water makeup valve at normal water level. The same switch activates a computer to provide computer printout and monitor indication when the makeup valve is opened.

   5. Pneumatically driven three-way valve in the main hot water line to each heating coil bank which is controlled by a temperature controller in the discharge duct of the air handling (or supply plenum) unit.

   6. Pressure relief valve on the expansion tank to relieve excess tank pressure.

7. Pressure regulator control valve in the compressed nitrogen supply line to the expansion tank to automatically maintain system pressure.

8. Pressure switch to alarm on a local panel on low expansion tank pressure.

9. Oxygen deficiency monitor/alarm at the expansion tank to detect absence of oxygen due to a relief valve discharge (personnel safety).

9.4.11 OFFGAS CHARCOAL VAULT REFRIGERATION SYSTEM

9.4.11.1 Design Bases

The offgas charcoal vault refrigeration system is designed to perform the following functions:

a. Maintain the vaults at a preselected temperature within the range of 0°F to 40°F during normal plant operation to enhance the filtration efficiency of the offgas charcoal adsorbers.

b. Cool nominal 30 scfm process gas from 90°F to -3°F or lower during normal operation only.

c. Cool 250 scfm process gas from 90°F to +3°F or lower during startup operation only.

d. Cool the charcoal vaults and equipment within the vault from 150°F to 0°F in 36 hours or less during startup operation only.

9.4.11.2 System Description

The offgas charcoal vault refrigeration system consists of four 50 percent capacity air handling units, three 50 percent series connected brine cooling packages, two 100 percent capacity brine recirculation pumps, brine expansion tanks, brine filter drier, air distribution ductwork, and brine distribution piping. The system is shown schematically on <Figure 9.4-24>.

The offgas vault is divided into two pairs of rooms. Each pair is served by two air handling units, each unit capable of handling the total load per pair of rooms. During normal operation one air handling unit per pair is operating and the other is a backup unit. It supplies recirculated cooled air to the vault to dissipate the heat load and maintain the vault temperature in the operating band provided in <Section 11.3.2.1.1>. The air handling unit also provides cool air to the process gas cooler to cool the nominal 30 scfm (250 scfm during startup) process gas to near vault temperature during normal operation before it enters the first charcoal adsorber. The vault temperature is maintained by the air temperature controller, which can be set anywhere from -40°F to +40°F and is located in the air handling unit common return duct. It controls the three-way valve of the operating air handling unit cooling coil, which may be required to bypass a certain percentage of the cooled brine full flow rate around the unit to satisfy the controller set point.

The three series connected 50 percent capacity brine cooling packages supply cooled brine to the cooling coils of the air handling units. Each brine cooling package consists of a shell and tube heat exchanger (brine in shell, R-502 in tube), with each heat exchanger having two independent R-502 refrigeration systems. The condensing water for each R-502 refrigeration system is supplied by the turbine building closed cooling system. A brine temperature controller is located in the common brine pipe downstream of the brine cooling packages and maintains the temperature of the brine supplied to the air handling units. The set point of this controller is set below the air temperature controller set point. The brine temperature controller controls the three-way valve upstream of the brine cooling packages which bypasses brine, if required, to satisfy the controller set point.

An expansion tank is connected to the brine piping circuit to allow the brine to expand when the system is adjusted to a higher temperature set point, or when the system is shut down and the brine approaches room temperature. The expansion tank is also used to maintain the brine pump suction at a minimum pressure of 15 psig. This is accomplished by pressurizing the expansion tank to a minimum pressure of 15 psig using compressed air from the instrument air supply system.

A cycle timer is provided for the two air handling units serving the same rooms; each air handling unit is provided with electric heaters and a defrost timer for defrosting purposes. The cycle timer is manually preset as field experience dictates and stops the operating air handling unit, automatically putting the backup unit into operation. The electric heaters of the deactivated air handling unit are then energized for a period of time to defrost the air handling unit cooling coils, drain pan and dampers. This period can be adjusted by changing defroster set point. In addition, the electric heaters are thermostatically controlled to operate as required during defrosting cycle to maintain the preselected temperature internal to plenum. The air handling unit remains on standby after the defrost operation.

To minimize the system cooling load, insulated wall and ceiling panels are used to form refrigerated spaces for the charcoal adsorbers and related equipment. These panels are connected to one another by mechanical cam type devices. To provide access to the refrigerated spaces, cold storage type doors are used. These doors are equipped with peripheral electric heaters to prevent door icing. The floor in the refrigerated spaces consists of a 10.5-inch thick wearing slab, vapor barrier membranes and two layers of 4-inch thick rigid polyurethane boards placed between the wearing slab and the vault concrete floor. Vapor barrier membranes are also used between the vault concrete walls and insulated walls.

The nonrefrigerated spaces between ceilings and floor, concrete walls and insulated walls are kept at a negative pressure to ensure that air will flow from areas of low probable airborne contamination to areas of high probable airborne contamination. This is accomplished by the offgas exhaust system exhausting air continuously from these spaces. The offgas exhaust system is discussed in <Section 9.4.4>.

Detailed descriptions and performance requirements for the major components of the offgas charcoal vault refrigeration system are as follows:

a. Air handling units (1N64-B112A, B112B, B112C, B112D)

   Four 50 percent air handling units are provided for this system. The units are located in the offgas building adjacent to the offgas vault. Units N64-B112A and N64-B112C are hung underneath the floor slab at Elevation 620’-6”. Units N64-B112B and N64-B112D are mounted on a platform at Elevation 608’-6”.

   Units N64-B112A & B constitute a set and are physically arranged one over the other. These units have a common supply and a common return duct. Units N64-B112C & D are similarly arranged and constitute the other set. One set serves two rooms of the vault and the other set serves the other two rooms of the vault. The units also supply the gas cooler with air to cool the process gas. During normal operation, one unit per set is operating and the other unit is a backup. Electric motor-operated dampers are provided to isolate an idle unit. These dampers automatically open when the corresponding air handling unit is energized and automatically close when the corresponding unit is de-energized.

Each air handling unit is provided with electric heaters, a defrost timer and thermostats to control heaters during defrosting cycle.

The air handling units are of the standard industrial design and are classified as nonsafety-related and non-seismic.

Design information for the air handling units is listed in <Table 9.4-27>.

b. Brine cooling packages (1N64-B113A, B113B, B113C)

Three 50 percent brine cooling packages are provided for this system. They are located in the offgas building at floor Elevation 620’-6”. The three packages are arranged for a series brine flow. Each brine cooling package has a shell and tube heat exchanger with brine in shell and R-502 in tubes. The brine flowing in shell is baffled for cross flow. The shell is factory insulated with 4-1/2 inch thick polyurethane covered with an outer steel jacket. Each heat exchanger has two independent R-502 refrigeration systems with each system consisting of the following equipment:

1. A two stage open type compressor unit with:

   (a) A compressor motor (460 volt, 3 phase, 60 Hertz) with a maximum power input of 32 kW.

(b) Nine cylinders (6 low stage and 3 high stage) with 2-5/8 inch bore and 2-1/4 inch stroke.

(c) An interstage liquid cooler with strainer, solenoid valves, thermal expansion valve suitable for liquid cooling, and low stage discharge gas desuperheating.

(d) An enclosed control center (120 volt, 1 phase, 60 Hertz) with the following factory wired and piped controls:

(1) High pressure cutout (manual reset) with corresponding red alarm lights.

(2) Automatic reset low pressure cutout for pump down control.

(3) Oil pressure failure switch (manual reset) with corresponding red alarm light.

(4) High discharge temperature cutout with corresponding red alarm light.

(5) Crankcase heater control.

(6) Compressor on-off switch.

(7) Pressure control to energize liquid line solenoid at 15 psig or lower.

(8) Suction and discharge pressure gauges.

(9) Oil pressure gauge.

(10) Inherent motor protection with corresponding red alarm light (high winding temperature).

2. One oil receiver with a 2kW (480 volt, 1 phase, 60 Hertz) and a built-in thermostat.

3. One discharge line oil separator with float drainer.

4. One water cooled condenser with tubes seven feet in length.

5. One liquid vapor heat exchanger.

6. One thermal expansion valve with a capillary tube 10 feet in length and arranged for external equalization.

7. One high pressure R-502 liquid receiver, six inches in diameter and eight feet long. This receiver is designed for a 350 psig design working pressure, and equipped with a relief valve of capacity adequate for the receiver and the condenser together.

8. One strainer-dryer with replaceable high capacity core.

9. One water regulating valve.

10. One level switch and one level gauge mounted on the high pressure receiver used as local level indicator and an alarm for low liquid level to show loss of refrigerant from the system.

11. One moisture/liquid indicator.

All of the above equipment is mounted on a single steel base suitable for shipment and for installation on concrete pad. All refrigerant interconnection lines are of copper tubing.

The two packages in series have a combined cooling capacity in excess of that required to cool the brine to -30°F. Condensing water is supplied by the turbine building closed cooling system at 95°F.

The components of the brine cooling package are of the standard industrial design and are classified as nonsafety and non-seismic.

c. Brine recirculation pumps (1N64-C101A, C101B)

Two 100 percent brine recirculation pumps are provided for this system. They are located in the offgas building at floor Elevation 620’-6”. The pump is used to recirculate brine through the brine cooling packages and the air handling units, returning it in a closed loop to the pump suction. Each pump is of the accessible hermetic type complete with enclosed cast iron impeller, hermetic motor, ductile iron casing for 300 psig working pressure, and 300 psi ANSI flanged connections.

The pumps are of the standard industrial design and are classified as nonsafety-related and non-seismic.

Design information for the brine recirculation pumps is listed in <Table 9.4-27>.

d. Expansion tank (1N64-A101)

One expansion tank, wall mounted in the offgas building above floor Elevation 620’-6”, is provided for this system. The expansion tank is made from a 6-foot long, 16-inch diameter Schedule 10 pipe with the ends capped. It is provided with a relief valve (50 psig setting) that is piped to the atmosphere, brine charging connection, vent, compressed air connection, and pump suction connection. A level switch and a level gauge are also provided to indicate locally the brine level and also to activate an alarm on loss of brine in the system.

Functionally, the expansion tank provides a means of venting air from the piping system during initial startup as well as a place for charging brine into the system. It allows volume changes due to temperature level changes in the brine system.

Components of the offgas charcoal vault refrigeration system that contain the brine and can be valved off are protected against excessive hydrostatic pressure by providing them with a relief system that is connected to expansion tank. Each relief connection is provided with a spring-loaded check valve and a bypass angle valve.

e. Filter-dryer (1N64-D601)

One filter-dryer is provided for the brine piping circuit of this system. It is located in the offgas building and is connected in the suction side of the brine recirculating pumps. It is of the standard industrial design and is nonsafety, non-seismically classified.

9.4.11.3 Safety Evaluation

The offgas charcoal vaults refrigeration system is not safety-related and is not required to safely shut down the plant during a design basis accident. However, sufficient redundancy is provided for system reliability and to ensure that adequate refrigeration is available if a single component failure occurs.

The components of the system that contain the brine, and can be isolated, are protected against excessive pressure by providing them with a relief system connected to the expansion tank. Each relief connection includes a spring-loaded check valve and a bypass angle valve.

Nonrefrigerated spaces between ceilings and floor, insulated walls and concrete walls are at a slightly negative pressure relative to the offgas vaults. This ensures proper air flow patterns are maintained and potentially contaminated air from the offgas vaults is passed through the charcoal exhaust system prior to discharge to the atmosphere.

9.4.11.4 Inspection and Testing Requirements

The various components of the offgas charcoal vault refrigeration system are readily accessible for inspection and routine maintenance during normal plant operation, plant shutdown or refueling operations. Redundancy in the components and the ability to isolate idle components, enables inspection, maintenance and testing to be performed while the system is in normal operation.

During acceptance testing, routine maintenance and inspection, provisions will be made to verify the function and performance of the fans, dampers, valves, controls, and other equipment safety devices. These provisions will ensure that operational components will perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

9.4.11.5 <u>Instruments, Controls, Alarms, and Protective Devices</u>

Instruments, controls, alarms, and protective devices for the offgas charcoal vault refrigeration system are discussed as follows:

a. Operation of this system is initiated manually from a local panel (1H51-P132).

b. An interlock is provided which prevents operation of any brine cooling package unless one brine recirculation pump is operating.

c. Instrumentation is provided for indication on the local control panel (1H51-P132), with corresponding system trouble alarm in the control room, of the following:

    1. Which brine cooling package compressors are in operation (status light).

    2. Which brine recirculating pump is in operation (status light).

    3. Which air handling units are in operation (status light).

    4. Which air handling units are on defrosting stage (timer light energized).

    5. Open or close position of air handling unit isolation dampers status light).

    6. Indication of failure of a R-502 refrigeration system operation by:

        (a) (Deleted)

(b) Alarm on high compressor motor winding temperature with corresponding red alarm light.

(c) Alarm on high compressor discharge temperature with corresponding red alarm light.

(d) Alarm on low compressor oil pressure with corresponding red alarm light.

(e) Alarm on high pressure cutout with corresponding red alarm light.

NOTE: Alarm light is a single annunciator point. Any failure as described above will annunciate this alarm.

7. Loss of refrigerant R-502 (alarm).

8. Loss of brine alarm.

9. Air handling unit low air flow (alarm).

10. High vault return air temperature (alarm).

11. Brine recirculation pump low flow (alarm).

12. Brine temperature alarm on deviation from set point (alarm).

13. (Deleted)

d. The major items of instrumentation and controls are as follows:

1. Local temperature and pressure indicators as shown on <Figure 9.4-24>.

2. Water flow regulating valve for each water cooled condenser of each R-502 refrigeration system return line to regulate condenser water flow upon signal from the head pressure controller.

3. Thermal expansion valve with 10 foot capillary tube, arranged for external equalization for each R-502 refrigeration system.

4. Level switch and level gauge for each high pressure receiver of each R-502 refrigeration system to locally indicate R-502 level in the receiver and to alarm on local panel on loss of refrigerant R-502.

5. Pressure relief valve on each R-502 high pressure receiver tank to relieve the receiver of excess pressure.

6. Brine pressure switch in each pump discharge line to alarm on local control panel and to automatically start the standby brine pump on low brine flow.

7. Pneumatically driven three-way valve in the main brine line upstream of the brine cooling packages. This valve is controlled by a temperature controller in the main brine line downstream of the brine cooling packages.

8. Temperature transmitter, temperature controller and electro-pneumatic converter in the main brine line downstream of the brine cooling packages to control the three-way valve in the main brine upstream of the brine cooling packages.

9. Temperature bistable to actuate an alarm when the brine temperature deviates from the brine temperature controller set point.

10. (Deleted)

11. Pneumatically driven modulating three-way valve in the cooling coil of each air handling unit. The three-way valve is controlled by the temperature controller in the air handling return duct.

12. Three-way solenoid valve for each cooling coil three-way valve to automatically close the air supply port when the corresponding air handling unit is stopped.

13. Motor-operated two position ball valve in each cooling coil bypass line to automatically close when the corresponding air handling unit is stopped.

14. Temperature transmitter, temperature controller and electro-pneumatic converter in each common return duct to control the cooling coil three-way valve.

15. Temperature bistable to actuate an alarm when the return air temperature from the vault deviates from the air temperature controller set point.

16. Temperature hand controller to provide a means of manually setting the air temperature controller set point.

17. Ratio controller to accept an electrical signal from the temperature hand controller and to provide a set point for the brine temperature controller.

18. Level switch and level gauge for the brine expansion tank to locally indicate brine level in the tank and to alarm on loss of brine in the system.

19. Air pressure regulator in the compressed air line to maintain the expansion tank pressure above 15 psig.

20. Pressure relief valve on the brine expansion tank to relieve excess tank pressure.

21. Adjustable relief and check valve connected to each cooling coil vent, brine pump discharge line, drier line, and brine cooling package line to open and relieve brine if the pressure exceeds the relief and check valve set point. The relief brine is piped to the expansion tank.

22. (Deleted)

23. Differential pressure switch across each fan to alarm on low air flow when the fan is operating.

24. Motor-operated damper in each air handling unit return and supply duct to automatically close or open when the corresponding air handling unit is stopped or started.

25. Cycle timer for each set of handling units to put an operating air handling unit on defrost mode at a preselected time interval and automatically startup the corresponding backup unit.

26. Defrost timer for each air handling unit to energize the electric heater at a preselected time interval when the corresponding air handling unit is in the defrost mode. This timer is interlocked with the cycle timer.

27. Thermostats for each air handling unit to thermostatically control the operation of electric heaters during defrosting cycle.

28. Air handling unit damper (suction and discharge) position switches to indicate open or close position.

29. (Deleted)

9.4.12 MISCELLANEOUS NONSAFETY HVAC SYSTEMS

9.4.12.1 Design Basis

The miscellaneous nonsafety-related HVAC systems throughout the plant are designed to ventilate and cool the areas they serve for the purpose of maintaining adequate ambient temperature suitable for equipment operation and personnel comfort.

9.4.12.2 System Description

The miscellaneous nonsafety-related HVAC systems are shown schematically on <Figure 9.4-5>, <Figure 9.4-25>, <Figure 9.4-27>, <Figure 9.4-28>, and <Figure 9.4-29> and consist of the following:

a. Water treatment building ventilation system.

b. Circulating water pumphouse ventilation system.

c. Service water pumphouse ventilation system.

d. Turbine lube oil storage area ventilation system.

e. Diesel driven fire pump area ventilation system.

f. Auxiliary boiler building ventilation system.

g. Radwaste control room HVAC system.

h. Smoke venting system.

i. Control and computer rooms humidification system.

j. Alternate Decay Heat Removal (ADHR) Room A/C Units.

9.4.12.2.1 Water Treatment Building Ventilation System

This system functions during normal operation. It provides ventilation in the water treatment building to maintain a suitable environment for operating personnel and equipment. During summer operation, ventilation of this building is accomplished by drawing outside air through operating windows into the building and then exhausting it through power roof exhausters. Two 50 percent capacity roof exhausters with motor-operated dampers are provided.

During winter operation, the roof exhausters are not operating and all windows are closed. Hot water unit heaters are provided to maintain a suitable ambient temperature condition inside the building.

A separate supply fan is provided for the water treatment laboratory to maintain a suitable environment for operating personnel. Supply air is from the water treatment building itself and is filtered prior to distribution to the laboratory.

The main components of this system consist of two 50 percent capacity power roof exhausters with electric motor-operated dampers and a supply fan. One roof exhauster is located on the water treatment building roof at Elevation 642’-0” and the other unit at Elevation 665’-0”.

Components of this system are of standard industrial design.

9.4.12.2.2 Circulating Water Pumphouse Ventilation System

This system functions during normal plant operation. It provides heating and ventilation in the circulating water pumphouse to maintain a suitable environment for equipment operation.

During summer operation, ventilation of the pumphouse is accomplished by drawing outside air through wall louvers and discharging it to the atmosphere through the roof exhausters. The HVAC is controlled from temperature switches and a programmable controller that will, by manipulation of various combinations of wall louvers and fan inlet dampers, utilize the effects of natural convection whenever possible and then use mechanically forced air when required.

During winter operation, the HVAC control system will operate the mechanical equipment on a demand basis. Electric unit heaters with remote thermostats are provided to maintain a suitable minimum ambient temperature.

The main components of this system consist of power roof exhausters, each with integral electric motor-operated inlet dampers located on the roof of the circulating water pumphouse at Elevation 684’-0”, and motor-operated wall louvers located on the north, west and south walls which are of standard industrial design.

9.4.12.2.3 Service Water Pumphouse Ventilation System

This system functions during normal plant operation. It provides heating and ventilation in the service water pumphouse to maintain a suitable environment for equipment operation.

During summer operation, ventilation of the pumphouse is accomplished by drawing outside air through supply fans and discharging it into the pump areas. This supply area is relieved to the atmosphere through wall louvers. Operation of the supply fans is initiated by a local control switch.

During winter operation, a portion of the pumphouse ambient air is recirculated depending upon the outdoor temperature. Also, electric unit heaters with remote thermostats are provided to maintain a suitable minimum ambient temperature.

The main components of this system consist of two axial flow fans, each with motor-operated intake and return dampers. The fans are located on Elevation 603’-0” and 620’-6”, and are of standard industrial design.

9.4.12.2.4 Turbine Lube Oil Storage Area Ventilation System

This system functions during normal plant operation. It provides heating and ventilation in the turbine lube oil storage areas.

During summer operation, ventilation of the lube oil areas is accomplished by drawing outside air through a supply fan and discharging the air to various storage areas. This supply air is relieved to the atmosphere through wall louvers. Operation of the supply fans is initiated from a local control switch.

During winter operation, a portion of the ambient air is recirculated depending upon the outdoor temperature. Also, hot water unit heaters with remote thermostats are provided to maintain suitable minimum ambient temperature.

The main components of this system consist of an axial flow fan with motor-operated intake and return dampers. The fan is of standard industrial design.

9.4.12.2.5 Auxiliary Boiler Building Ventilation System

This system functions during normal plant operation. It provides heating and ventilation in the auxiliary boiler building to maintain a suitable environment for equipment operation.

During summer operation, ventilation of the auxiliary boiler building is accomplished by drawing outside air through wall louvers and discharging it to the atmosphere through a roof exhauster. Operation of the roof exhauster is initiated by a temperature switch whenever a preselected set point is reached.

The roof exhauster may also be started manually from a local control switch. A motor-operated louver is provided and is interlocked to open when the roof exhauster starts and close when the unit stops.

During winter operation, the roof exhauster does not operate and the wall louver is closed. Hot water unit heaters with remote thermostats are provided to maintain a suitable minimum ambient temperature.

The main components of the system consist of a power roof exhauster (located on the roof of the auxiliary boiler building at Elevation 647’-6”) with integral electric motor-operated damper and motor-operated louvers. The roof exhauster is of standard industrial design.

9.4.12.2.6 Diesel Driven Fire Pump Area Ventilation System

This system provides ventilation in the diesel driven fire pump area to maintain suitable environment for equipment operation.

Ventilation of the diesel driven fire pump area is accomplished by supply fans that draw ambient air from the emergency service water pumphouse and discharge it to the fire pump area. This supply air is then relieved to the atmosphere through a ducted relief louver. Operation of the supply fans is initiated whenever the diesel driven fire pump starts. The fans may also be manually started from the local selector switches. High temperature switches in the supply fan discharge ducts and the exhaust duct automatically stop the supply fans on indication of high temperature.

The main components of this system consist of two axial flow fans and ducted relief louver. They are located above the diesel driven fire pump area at Elevation 601’-6”. The axial fans are of standard industrial design.

9.4.12.2.7 Radwaste Control Room HVAC System

This system consists of a rooftop air handling unit, and a split system air conditioning unit.

The rooftop air handling unit functions during normal plant operation. It provides heating, cooling and ventilation in the radwaste control room to maintain a suitable environment for equipment operation and for personnel comfort.

Cooling or heating and ventilation of the radwaste control room is accomplished by supplying cooled or heated air (mixture of outdoor and recirculated room air) to the radwaste control room, control panel, programmable controller area, and the motor control center (MCC) area. The air supply to the MCC area, and part of air from the radwaste control room, is relieved to the radwaste building hallway and exhausted by the radwaste building exhaust system; the balance of the supply air is recirculated. Operation of the system is initiated from a control panel located in the radwaste control room. The system is provided with a separate heating and cooling thermostat to control the supply air temperature. The control panel is provided with heating and cooling switches and has the capability of manual or automatic change over and continuous or automatic indoor fan operation. In addition, a ventilation control switch is also provided to remote-manually operate the outdoor air damper to admit 20 percent outdoor air for ventilation.

The rooftop air handling unit is a direct expansion single package air conditioning unit with electric heating coils. The unit is located on the radwaste building roof Elevation 646’-6” and is of standard commercial design.

The rooftop air handling unit is a single, packaged, unit with semihermetic compressors, direct expansion cooling coils and electric heating coils. The unit is located on the radwaste building roof at Elevation 646’-6”, and is of standard industrial design.

The split system air conditioning unit can supply cool air to the walkway area behind the H51-P031 control panel; the supply air is totally recirculated. Operation of the split system unit is initiated automatically upon reaching a preselected area high temperature setpoint. The unit will continue operation until a suitable ambient temperature is reached. The area is provided with a thermostat which will control the operation of the unit.

The main components of this backup system consist of a condensing unit mounted on the radwaste building roof at elevation 646’-6”, and a fan coil unit suspended from the roof of the radwaste building above the ceiling of the radwaste control room area. The condensing unit consists of a fan and motor, compressor, condenser coil, refrigerant piping, and auxiliary components. The fan coil unit consists of a 3-speed fan and motor, evaporator coil and filter.

9.4.12.2.8 Smoke Venting System

This system functions only when a high smoke condition occurs in the electrical areas such as the motor control center and switchgear rooms, cable spreading areas, duct and cable chases, and the cable tunnels. The smoke venting system will clear the smoke and enhance visibility to aid fire fighters in the affected areas.

Smoke venting is accomplished by exhausting air from the affected electrical areas through an axial flow fan and discharging the exhaust air to the atmosphere through the unit vent. Operation of the smoke venting fans is initiated manually from the intermediate building upon receipt of high smoke alarm from any of the electrical areas served. A total of two axial fans are provided and each electrical power division is served independently by a separate exhaust fan.

The main components of this system consist of two axial flow fans with isolation and check dampers to prevent backflow. The axial fans are located in the intermediate building at Elevation 639’-0”, and are of standard industrial design.

9.4.12.2.9 Control and Computer Rooms Humidification System

This system consists of one 100 percent capacity electric steam boiler, central type humidifiers, piping, and valves. The system is shown schematically on <Figure 9.4-29>.

During normal operation, the electric steam boiler supplies the central type humidifiers with steam. Humidifiers M29-B002A and B are located in control room return duct downstream of the return fans M25-C002A and B. Humidifiers M29-B003A and B are located in the branch supply ducts of the computer room HVAC system. Humidity controllers located in the computer room (one per room) and control room (one per unit) modulate the needle valve of the corresponding humidifier, thereby discharging the right quantity of steam to the air stream and satisfying humidity controller set point.

One motor-operated valve is provided for each humidifier steam supply line. Motor-operated valves M29-F030A and B are interlocked with the control room HVAC systems return fans M25-C002A and B, respectively. The motor-operated valve opens (closes) when the corresponding fan or air handling unit is energized (de-energized). This ensures that no steam is supplied to the idle humidifier, preventing steam discharge without air flowing in the duct. The computer room HVAC system is provided with high limit moisture switches M27-N030A and B, and low limit moisture switches M27-N040A and B. These switches activate an alarm in the control room if the relative humidity in the computer rooms reaches the high or low setpoints. In addition, the high limit moisture switches also automatically close the steam supply motor-operated valves M29-F035A and B, respectively, at the same high setpoint.
Motor-operated valves are automatically open when the relative humidity in the computer rooms is below the high limit setpoint alarm.

The main components of this system are located in the control complex HVAC equipment room at Elevation 679'-6" and consist of one 100 percent capacity electric steam boiler (M29-B001), central type humidifiers (M29-B002A and B, M29-B003A and B), motor-operated valves (M29-F030A and B, M29-F035A and B), manual valves, and piping.

The components of this system are of the standard industrial design and are classified as nonsafety and non-seismic.

The following is a brief description of the major components of this system:

a. Electric Steam Boiler

The boiler is an electric steam boiler generating steam by electric heating.

The boiler is equipped with the following:

1. Steam pressure gauge, water gauge, safety/relief valve, pressure controls, and blowout disc.

2. (Deleted)

3. Water level controls for water fill valve operation and to de-energize the boiler in the event of a low water condition.

4. Blowdown system with manual bypass to support reduction of mineral concentrations leading to scale formation.

b. Humidifiers

The humidifier is of the electric modulating control, steam separator type, providing full separation ahead of an integral steam jacketed control valve. The integral control valve is a parabolic plug capable of modulating flow of steam to provide full control over the entire stroke of the operator. The distribution manifold, located in the duct, provides uniform steam distribution (against air stream flow) over its entire length and is steam jacketed to ensure that the vapor discharged is free of water droplets. The humidifier is equipped with an interlocked temperature switch to prevent the humidifier from operating until the entire system is up to steam temperature, preventing the possibility of "spitting" on cold startup. The humidifier is also equipped with inlet strainer and external inverted bucket steam trap.

9.4.12.2.10 Alternate Decay Heat Removal System Packaged A/C Units

Two packaged air conditioning units ensure that the temperature and relative humidity in the areas surrounding the ADHR pump and heat exchanger are not adversely impacted during the operation of the ADHR system. These units have nominal capacities of 3 tons and 7.5 tons and are installed outside the ADHR heat exchanger room elevation 599’ and inside the LPCS pump room elevation 568’ respectively.

9.4.12.3 Safety Evaluation

Since the miscellaneous heating and ventilation systems are not safety-related, a safety evaluation discussion is not presented.

9.4.12.4 Inspection and Testing Requirements

The various components of the miscellaneous nonsafety ventilation systems are accessible during normal plant operation and plant shutdown for testing and inspection.

During testing and inspection, provision will be made to verify the function and performance of the fans, dampers, valves, controls, and other devices. These provisions ensure that operational components perform their function reliably and accurately during normal operation and under conditions of operating interruptions.

<Table 9.4-1>

<Table 9.4-2>

<Table 9.4-3>

<Table 9.4-4>

<Table 9.4-5>

<Table 9.4-6>

<Table 9.4-7>

<Table 9.4-8>

<Table 9.4-9>

<Table 9.4-10>

<Table 9.4-11>

<Table 9.4-12>

<Table 9.4-13>

<Table 9.4-14>

<Table 9.4-15>

<Table 9.4-16>

<Table 9.4-17>

<Table 9.4-18>

<Table 9.4-19>

<Table 9.4-20>

<Table 9.4-21>

<Table 9.4-22>

DELETED

TABLE 9.4-23

DESIGN DATA FOR CONTROL COMPLEX CHILLED WATER SYSTEM COMPONENTS

Water Chillers	
No. of chillers	3
Manufacturer	Carrier Corp.
Capacity of chillers, tons	607
Rating of each chiller, kW	580
Compressor motor electrical characteristics	4,000 volt, 3 phase, 60 Hertz
Chilled water flow rate per chiller, gpm	1,513
Entering chilled water temperature (max.), °F	54.6
Leaving chilled water temperature (max.), °F	45
Entering condenser water temperature (max.), °F	95
Leaving condenser water temperature (max.), °F	105.9
Condenser water flow rate, gpm	1,700
Condenser water pressure drop (max.), ft	19.7
Condenser fouling factor	0.0005
Evaporator water pressure drop (max.), ft	26
Evaporator fouling factor	0.0005
Chilled Water Pumps	
No. of pumps	3
Manufacturer	Ingersoll-Rand

TABLE 9.4-23 (Continued)

Type of pump	Centrifugal, double suction
Flow capacity per pump, gpm	1,513
Total pressure head per pump, ft	130
Pump motor horsepower, hp	100
Electrical characteristics	460 volt, 3 phase, 60 Hertz

TABLE 9.4-24

DESIGN DATA FOR TURBINE BUILDING CHILLED WATER SYSTEM COMPONENTS

Chillers (1P46-B001A & B)

No. of chillers	2
Manufacturer	Carrier Corp.
Capacity of chillers	800 tons
Type of chiller	Centrifugal, hermetic
Rating of chiller compressor, kW	766
Compressor motor electrical characteristics	4,000 volt, 3 phase, 60 Hertz
Chilled water flow rate per chiller, gpm	1,920
Entering chilled water temperature, °F	55
Leaving chilled water temperature, °F	45
Condenser water flow rate per chiller, gpm	2,400
Entering condenser water temperature, °F	95
Leaving condenser water temperature, °F	105.2
Condenser water pressure drop (max.), ft	19.0
Condenser fouling factor	0.0005
Evaporator pressure drop (max.), ft	15.9
Evaporator fouling factor	0.0005

TABLE 9.4-24 (Continued)

Pumps (1P46-C001A & B)

No. of pumps	2
Manufacturer	Ingersoll-Rand
Type of pump	Centrifugal, split casing, double suction
Pump flow rate, gpm	1,920
Pump total head, ft	150
Pump motor horsepower, hp	100
Pump motor electrical characteristics	460 volt, 3 phase, 60 Hertz

TABLE 9.4-25

DESIGN DATA FOR CONTAINMENT VESSEL CHILLED WATER SYSTEM COMPONENTS

Chillers (P50-B001A, B, & C)	
No. of chillers	3
Manufacturer	Carrier Corp.
Capacity of chillers, tons	200
Type of chiller	Centrifugal, hermetic
Rating of chiller, kW	255
Compressor motor electrical characteristics	4,000 volt, 3 phase, 60 Hertz
Chilled water flow rate per chiller, gpm	600
Entering chilled water temperature, °F	53
Leaving chilled water temperature, °F	45
Condenser water flow rate per chiller, gpm	600
Entering condenser water temperature, °F	95
Leaving condenser water temperature, °F	105.9
Condenser water pressure drop, ft	6.9
Condenser fouling factor	0.0005
Evaporator pressure drop, ft	12.9
Evaporator fouling factor	0.0005
Pumps (P50-C001A, B, & C)	
No. of pumps	3
Manufacturer	Ingersoll-Rand

TABLE 9.4-25 (Continued)

Type of pump	Centrifugal, split casing double suction
Pump flow rate, gpm	600
Pump total head, ft	125
Pump motor horsepower, hp	30
Pump motor electrical characteristics	460 volt, 3 phase, 60 Hertz

TABLE 9.4-26

DESIGN DATA FOR HOT WATER HEATING SYSTEM COMPONENTS

A. HEAT EXCHANGERS

Tube side	1P55-B001A	1P55-B001B
Design water flow rate, gpm	3,000	3,000
Inlet temp., °F	160	160
Outlet temp., °F	190	190
Minimum inlet pressure, psig	110	110
Water connection size, in.	10	10
Max. velocity through tubes, fps	7.8	8.2
Water pres. drop, ft	5.7	4.4
Design pressure, psig	200	200
Design temp., °F	340	390

Shell side	1P55-B001A	1P55-B001B
Steam inlet temp., °F	326	320
Steam inlet pres., psig	25	75
Steam inlet enthalpy, Btu/lbm	1,200	1,185
Drain cooling, °F	30	30
Drains outlet temp., °F	237	290
Design pressure, psig	100	200
Design temp., °F	340	390

B. CIRCULATION PUMPS

	1P55-C001A 1P55-C001B
Type of pump	Centrifugal, double suction
Design flow capacity per pump, gpm	3,000
Total pressure head per pump, ft	140
Pump motor rating, hp	125
Electrical characteristics	460 volt, 3 phase, 60 Hertz

TABLE 9.4-27

DESIGN DATA FOR OFFGAS CHARCOAL VAULT
REFRIGERATION SYSTEM COMPONENTS

Air Handling Units

No. of units	4
No. of fans per air handling unit	2 (with common shaft and motor drive)
Air Flow (total per air handling unit), cfm	5,000
External static pressure required per air handling units, in. w.g.	2.0 (at actual conditions)
Fan motor electrical characteristics	460 volt, 3 phase, 60 Hertz
Electric defrost heaters electrical characteristics	460 volt, 3 phase, 60 Hertz
Damper motor electrical characteristics	120 volt, 1 phase, 60 Hertz
Cooling capacity per air handling unit, Btu/hr	49,070
Max. coil face velocity, fpm	500
Brine flow rate per unit (max.), gpm	65

Brine Recirculation Pumps

No. of pumps	2

TABLE 9.4-27 (Continued)

Type of pump	Leak proof canned pump design, vertical discharge
Impeller size, in.	9-1/2
Flow capacity per pump, gpm	130
Brine Fluid	3M NOVEC HFE-7100
Total pressure head per pump, ft	80
Pump NPSH, ft	1.8
Pump motor type	Hermetic
Pump motor horsepower, hp	15
Motor speed, rpm	1,750
Electrical characteristics	460 volt, 3 phase, 60 Hertz

9.5 OTHER AUXILIARY SYSTEMS

9.5.1 FIRE PROTECTION SYSTEM

9.5.1.1 Design Bases

The design of the fire protection system is based on considerations discussed in the sections that follow.

9.5.1.1.1 Safe Shutdown Systems

Since any area containing systems or components required for safe shutdown could be affected either directly or indirectly by fire, these areas must be identified. In <Appendix 9A> (Fire Protection Evaluation Report, FPER), the systems required for safe shutdown have been identified in <Appendix 9A.3>. <Table 9A.3-1>, <Appendix 9A>, lists the components of these systems and their physical plant location.

9.5.1.1.2 Defense-in-Depth

The bases for the design of the fire protection program is to provide a defense-in-depth principle by achieving an adequate balance in:

a. Preventing a fire from starting.

b. Quickly detecting and extinguishing fires that do occur, thus limiting fire damage.

c. Designing safety-related systems so that a fire that occurs and burns out of control for a considerable length of time (despite fire protection activities) will not prevent safe shutdown.

Since not one of the above can always be achieved, the fire protection program is based on an interaction between them, thus ensuring that weaknesses in one is compensated for by strengths in another.

9.5.1.1.3 Fire Protection System Adequacy and Dependability

The fire protection program places special emphasis on detecting and suppressing fires which would endanger systems required for safe plant shutdown. The need for these fire detection and suppression systems to operate upon loss of offsite power was recognized. Therefore, the detection and protection systems are powered from electrical distribution systems which have backup power; where backup power is not available, self-contained battery-charger units are available unless analysis has shown that loss of the system will not compromise protection of safety-related or safe shutdown equipment to fire exposure. In addition, all open head suppression systems can be operated and all closed head systems can be readied for operation without electric power. Backup fire suppression capability is provided throughout the plant. In areas where safe shutdown equipment is located, the backup will consist of standpipe hose stations and fire extinguishers. Each of these hose stations will normally be fed from the fire protection water system with backup from the Seismic Category I emergency service water system. The adequacy of the fire protection for areas containing safe shutdown system components has been evaluated by analysis of the effects of a postulated fire on the ability to safely shutdown the plant. This analysis is found in <Appendix 9A.4>.

9.5.1.1.4 Quality Assurance

The plant fire protection program started with the design and is carried through all phases of construction and operation. Certain provisions of the quality assurance program have been implemented to ensure that the project commitments for design, installation, operations, testing, and administrative controls are satisfied.

9.5.1.1.5 Inadvertent Operation or Crack

The consequences of inadvertent operation of, or a crack in, a moderate energy line in the fire service water system meet the guidelines specified for moderate energy systems outside containment given in NRC MEB 3-1 and NRC APCSB 3-1. However, postulated failures of control complex piping over 6 inches in size, which are more severe than moderate energy cracks, require additional design protection. As a result, fire service piping all located in the control complex is seismically supported in cases where analysis showed that rupture could cause failure of safety-related equipment by flooding.

In the ESWPH building, protection is provided by qualifying safe shutdown equipment for the environmental conditions which may occur as a result of a moderate energy line failure of fire protection piping.

9.5.1.1.6 Hazardous Materials

Unusually hazardous materials to be used on the site are identified and evaluated in <Section 2.2.3>. Furthermore, the combustibles found in each fire area are discussed in <Appendix 9A.4>.

9.5.1.2 System Description

9.5.1.2.1 Structural Features

Adjoining plant buildings are separated by three hour walls. Additionally, most plant buildings are further subdivided into fire areas which are separated by three hour floors and walls. Openings in these three hour separations are provided with rated doors and fire seals of the corresponding three hour rating as described in <Appendix 9A.4>. Materials used for plant construction are noncombustible wherever possible. <Appendix 9A.4> gives a detailed description of fire barriers, construction materials and smoke removal systems. <Figure 9A-1>, <Figure 9A-2>, <Figure 9A-3>, <Figure 9A-5>, <Figure 9A-6>, <Figure 9A-7>, <Figure 9A-8>, <Figure 9A-10>, <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-14>, <Figure 9A-15>, <Figure 9A-16>, <Figure 9A-18>, <Figure 9A-19>, <Figure 9A-20>, <Figure 9A-22>, <Figure 9A-23>, <Figure 9A-24>, <Figure 9A-25>, <Figure 9A-26>, <Figure 9A-27>, <Figure 9A-28>, <Figure 9A-29>, <Figure 9A-30>, <Figure 9A-31>, <Figure 9A-32>, <Figure 9A-33>, <Figure 9A-34>, show fire barriers and exits.

<Figure 9.5-1>, <Figure 9.5-2>, <Figure 9.5-3>, <Figure 9.5-4>, <Figure 9.5-5>, <Figure 9.5-6>, show the equipment and devices that comprise the principal and auxiliary fire protection systems.

9.5.1.2.2 Fire Service Water Supply and System Seismic Requirements

The design of the fire water supply and distribution system meets the following basic requirements (additional details are found in parts E.2 and E.3 of <Appendix 9A.5>.

a. Supply is handled by two 2,500 gpm fire pumps, one diesel driven and one motor driven, each with the capability to meet the largest system demand.

b. A looped distribution piping system is provided which is arranged and valved so that a single worst break in the distribution piping will not prohibit any fixed water system from getting the required flow at the required pressure. Distribution piping to the Unit 2 Startup Transformer Deluge System is excluded from this requirement.

c. Design requirements include the capability of providing 500 gpm for hose streams operating simultaneously with any fixed fire suppression system.

d. Isolation valves are located to minimize the quantity of fire fighting equipment out-of-service at one time, and to prevent a single break from disabling both the primary suppression system and its backup.

The following seismic requirements have been implemented in the design of the fire protection system:

a. Piping is seismically supported in the case where analysis showed that rupture of an eight inch distribution main in the control complex could cause failure of safety-related equipment by flooding.

b. Standpipe systems supplying hose stations protecting safe shutdown equipment are seismically supported, designed in accordance with ANSI B31.1, except for limited sections of A120 pipe that analysis has shown to be of adequate strength, and provided with a connection to the emergency service water supply which is operated manually when needed.

9.5.1.2.3 Codes and Standards

As a minimum, the standards, guides and recommended practices of the National Fire Protection Association (NFPA) in effect in 1973, except as noted, were referenced in the design and installation of the plant fire protection system:

In addition, the following documents were also referenced:

a. Documents from American Nuclear Insurers (ANI), formerly NEL-PIA:

   1. Basic Fire Protection for Nuclear Power Plants, April 1976.

2. Specifications for Fire Protection of New Plant, NEL-PIA File No. N-195.

b. Pamphlets of the National Fire Protection Association (NFPA):

10	Portable Fire Extinguishers
11	Foam Extinguishing Systems
12	Carbon Dioxide Extinguishing Systems
12A	Halon 1301 Systems
13	Sprinkler Systems, Installation
14	Standpipe and Hose Systems
15	Water Spray Fixed Systems
20	Centrifugal Fire Pumps
24	Outside Protection
26	Supervision of Valves
30	Flammable and Combustible Liquids Code
37	Stationary Combustion Engines and Gas Turbines
50A	Gaseous Hydrogen Systems at Consumer Site
70	National Electrical Code
72D	Proprietary Signaling Systems(1)
72E	Automatic Fire Detectors(1)
75	Electronic Computer/Data Processing Equipment
78	Lightning Protection Code
80	Fire Doors and Windows
90A	Air Conditioning and Ventilating Systems
92M	Waterproofing and Draining of Floors
101	Code for Safety to Life from Fire in Buildings and Structures
194	Fire Hose Connections
196	Fire Hose
204	Guide for Smoke and Heat Venting
321	Basic Classification of Flammable Liquids
802	Nuclear Reactors

Note:

(1) NFPA 72 “National Fire Alarm and Signaling Code” 2016 edition was utilized in the design and installation of the Workstations,

Redundant CPU Fire Alarm Control Panel, Printers, field Fire Alarm Control Panels, as well as the Zone Adapter Modules and Individual Addressable Modules located at the LFPs. The remainder of the system down stream of these devices, such as smoke detector panels, fire protection control panels, valve position switches, manual pull stations, etc., as well as the selection and location of fire detectors remains governed by NFPA 72D and 72E in effect in 1973.

c. Ohio Building Code, 1970 Edition.

9.5.1.2.4 Multi-unit Requirements

The special fire hazards created and the fire protection required while Unit 1 is in operation.

9.5.1.2.5 General Description of Fixed Suppression and Detection Systems

The following list provides a general description of the types of fire protection systems at PNPP and identifies the areas or hazards protected by each type (<Figure 9A-001>, <Figure 9A-002>, <Figure 9A-003>, <Figure 9A-005>, <Figure 9A-006>, <Figure 9A-007>, <Figure 9A-008>, <Figure 9A-010>, <Figure 9A-011>, <Figure 9A-012>, <Figure 9A-014>, <Figure 9A-015>, <Figure 9A-016>, <Figure 9A-018>, <Figure 9A-019>, <Figure 9A-020>, <Figure 9A-022>, <Figure 9A-023>, <Figure 9A-024>, <Figure 9A-025>, <Figure 9A-026>, <Figure 9A-027>, <Figure 9A-028>, <Figure 9A-029>, <Figure 9A-030>, <Figure 9A-031>, <Figure 9A-032>, <Figure 9A-033>, <Figure 9A-034>, of the FPER show areas covered by the fire protection and detection systems in relation to safe shutdown systems and components for those areas):

a. Wet pipe automatic sprinkler system

Major components - alarm check valve, water flow pressure switch, shutoff valve with position switch.

1. Unit 1 turbine building below the operating floors, including areas beneath the turbine condenser (hydraulically designed).

2. Diesel fire pump room in the emergency service water pumphouse.

3. Radwaste storage and processing areas at Elevation 623’-6” of the radwaste building.

4. Unit 1 reactor core isolation cooling pump room at Elevation 574’-10” of the auxiliary building.

5. Control complex at Elevation 599’-0” and the southern portion of Elevation 574’-10”.

6. Service building, service building annex and technical support center, except CAS and Halon protected areas.

7. Auxiliary boiler building.

8. (Deleted)

9. Fuel oil pumphouse.

10. (Deleted)

11. Intermediate building above Elevation 599’-0” excluding the instrument storage area and hot instrument shop.

12. Intermediate building above Elevation 620’ excluding the Standby Liquid Control System area.

13. Auxiliary building 620’ elevation in corridor at west end.

14. Intermediate building Elevation 574’-10” in the tool decontamination and storage areas.

15. Sprinklers have been provided in other plant buildings where the fire hazard makes it necessary to detect a fire before it can propagate to plant structures, systems or components important to safety located in other buildings.

b. Water spray system

Major components - strainers, deluge valves, shutoff valve with position switch, waterflow pressure switch, control panel, spray nozzles, and heat detectors.

1. Unit 1 and Unit 2 outdoor oil-filled transformers.

2. Charcoal filter systems.

3. Unit 1 hydrogen seal oil unit at Elevation 605’-0” of the turbine building.

c. Preaction water spray systems

Major components - strainers, deluge valves, waterflow pressure switch, shutoff valve with position switch, fusible element or thermosensitive glass bulb type spray nozzle, control panel, heat detectors, and supervised air supply.

1. Unit 1 turbine generator bearings.

2. Unit 1 feedwater pump turbine bearings at Elevation 647’-0” of the heater bay.

d. Preaction sprinkler system

Major components - strainer, deluge valve, waterflow pressure switch, shutoff valve with position switch, sprinklers, fusible element type spray nozzles, control panel, heat detectors, and a supervised air supply.

Two systems exist: one for each cable spreading room (i.e., Unit 1, Division 1 and Division 2). These systems also cover the control complex cable chases, cable tunnels and penetration areas.

e. Carbon dioxide total flooding system

Major components - low pressure CO_2 tank, master valve, selector valve, control panel, fire detectors, and discharge nozzles.

1. Each of the three diesel generator rooms.

2. Unit 1 turbine lube oil tank room at Elevation 620’-0” of the turbine building.

3. Unit 1 turbine lube oil purifier room at Elevation 593’-0” of the turbine building.

4. Unit 1 computer room subfloor at Elevation 638’-0” of the control complex.

5. Unit 1 control room subfloor at Elevation 654’-0” of the control complex. The control room subfloor is isolated into three main subsections, each protected by its own CO_2 system.

f. Local application carbon dioxide systems

Major components - low pressure CO_2 tanks, master valve, selector valve, heat detectors, control panel, and discharge nozzles.

1. Two systems exist: one for each of the two reactor recirculation pump motors.

g. Fire detection systems

Major components - smoke detectors and fire detector panels.

Zone of coverage by building:

1. Control complex

   (a) Conference room, Elevation 654’-6”.

   (b) Above suspended ceiling, office and conference rooms, lunch room, and access areas, Elevation 599’-0”.

   (c) Pump room and heat exchanger rooms, Elevation 599’-0”.

   (d) Above suspended ceiling, laboratories, Elevation 599’-0”.

   (e) All electrical equipment areas, Elevation 620’-6”.

   (f) Access areas, Elevation 620’-6”.

   (g) Computer, cable spreading and battery areas, Elevation 638’-6”.

   (h) Control rooms, Elevation 654’-6”.

   (i) Equipment, access areas and service rooms, Elevation 574’-0”.

   (j) Mechanical equipment area, Elevation 679’-6”.

   (k) Chase area, Elevation 693’-0”.

   (l) Elevator/stairwell vestibule, Elevation 654’-6”.

2. Auxiliary building, Unit 1

(a) RHR pump rooms, Elevation 574’-10”.

(b) RCIC pump room, Elevation 574’-10”.

(c) Access areas and corridors, Elevations 574’-10”, 599’, 620’.

(d) RHR heat exchanger rooms, Elevation 599’-0”, 620’.

(e) RWCU pump room, Elevation 599’-0”.

3. Intermediate building

(a) Access and pump area, Elevation 574’-10”.

(b) Access areas, Elevation 599’-0”.

(c) (Deleted)

(d) Pump room, Elevation 599’-0”.

(e) Hatch areas, Elevation 599’-0”.

(f) Repair rooms, Elevation 599’-0”.

(g) Access areas, Elevation 620’-6”.

(h) Chases and annulus fan rooms, Elevation 620’-6”.

(i) Recombiner area, Elevation 654’-6”.

(j) Inspection rooms, Elevation 654’-6”.

(k) Access areas, Elevation 654'-6".

(l) Tank areas, Elevation 665'-0".

(m) Cable chases, Elevations 638'-6" and 654'-0".

(n) Access area, Elevation 682'-6".

(o) Ventilation rooms, Elevation 682'-6".

4. Reactor building, Unit 1

(a) Inside drywell at Elevation 576'.

(b) Outside drywell:

(1) At Elevation 664'.

(2) CRD area, Elevation 620'.

(3) HCU cooling area at Elevation 620'.

(4) RWCU area at Elevation 642'.

(5) At Elevation 654'.

(6) Containment access area at Elevation 599'.

5. Diesel generator building, Unit 1

6. Emergency service water pumphouse - entire building.

7. Radwaste building, control room, Elevation 623'-0".

8. Turbine power complex, Unit 1 (Unit 2 same)

   (a) General area, Elevation 620’-6”.

   (b) General area, Elevation 647’-6”.

   (c) Battery room, Elevation 620’-6”.

9. Fuel handling building, Elevation 623’-6”.

10. Technical support center.

11. (Deleted)

12. (Deleted)

13. HVAC ducts.

14. Elevator shafts.

15. Offgas building.

   (a) Gas dryer and cooler condenser rooms, Elevation 584’.

   (b) Filter and desiccant dryer rooms, Elevation 620’.

   (c) Access areas and exhaust equipment rooms, Elevation 647’ (partial detection).

16. Fire detection has been provided in other plant buildings where the fire hazard makes it necessary to detect and suppress a fire before it can propagate to plant structures, systems or components important to safety located in other buildings.

9.5.1.2.6 Protection for Specific Hazards

<Appendix 9A.4> discusses, on an area/zone basis, the protection and extinguishing systems available to every location containing any

equipment, instruments or cables required for safe shutdown. Also, <Appendix 9A.5>, addresses the protection for cables and specific operating areas, respectively.

9.5.1.2.7 Specific Design Features

Fire suppression equipment requiring 125 Vdc power is fed from the plant non-Class 1E 125 Vdc System A. This power system consists of a battery rated ≥ 890 Ampere-hours, 600 amp normal battery charger, 600 amp reserve battery charger, 1,600 amp switchgear lineup, and 600 amp power distribution panels. The battery is capable of powering this system for 15 minutes without input from either the normal or reserve battery charger. There is provision to automatically or manually transfer the normal and/or the reserve charger to a diesel-backed non-Class 1E 480V bus on failure of normal plant power. The manual transfer can be accomplished within the 15 minute duty cycle of the battery.

With the exception of the temperature alarms for the HVAC charcoal filter units, fire detection, suppression and monitoring equipment requiring 120 Vac power is fed from a 150 kVA uninteruptable power supply (UPS) system. The normal and alternate inputs to the UPS are from non-Class 1E 480V load centers. The UPS system alternate power supply is fed from a diesel-backed 480V bus. Transfer to the alternate source is automatic upon failure of the UPS or loss of normal input power to the UPS for a period of time until the battery voltage falls below the DC input undervoltage setpoint. The UPS battery is capable of supplying the fire detection, suppression and monitoring loads for one hour without AC power from either the normal or alternate inputs of the UPS. Manual transfer of the normal to alternate inputs of the UPS can also be accomplished within the one hour duty cycle of the battery.

The power supply for the temperature detection system in the HVAC charcoal filter units is powered by 120 Vac power which is not backed by batteries or the diesel generators. However, loss of power to the load centers feeding these units is alarmed in the Control Room.

In addition to the above, each of the fire protection systems have specific design features as follows:

a. Wet pipe automatic sprinkler systems

A temperature sufficiently above the normal ambient temperature in the area covered by sprinklers will cause one or more fusible elements to melt, allowing water discharge. In addition to the water being discharged on the fire, a waterflow switch in the discharge line will detect and send a fire signal to the fire alarm and signaling system. Each system has an individual indicating shutoff valve with a valve position tamper switch attached. If one of the valves is closed, a trouble signal will be transmitted to the fire alarm and signaling system.

b. Water spray systems

These systems are all hydraulically designed deluge systems provided with spray nozzles and a control panel.

The water spray systems for the Unit 1 and Unit 2 Interbus Transformers, Unit 1 Auxiliary Transformer and the hydrogen seal oil unit systems are automatically activated by heat detectors as well as manually activated at strategically located pull stations. Water spray systems for the Unit 1 Main Transformers and the Unit 1 and Unit 2 Startup Transformers are manually activated at the riser.

Fire signals received by the control panel, such as waterflow, heat detector alarm or deluge valve trip, are sent to the fire alarm and signaling system as a fire alarm signal.

A circuit failure or tamper switch signal to the control panel would be transmitted as a trouble signal to the fire alarm and signaling system.

The control panels and alarms associated with the HVAC deluge systems are arranged the same with the exception of the heat detection system, which is not alarmed through the fire system control panel.

The HVAC charcoal filters have a heat detector strip installed immediately downstream of the charcoal beds. This provides first and second stage high temperature alarms as well as analog temperature signals. These alarm in the Control Room. The second stage alarm annunciates at the Control Room HVAC control panel. It is set several hundred degrees less than the spontaneous ignition temperature of the charcoal to allow for corrective actions to be taken to control the temperature. If the control measures do not prevent ignition or the high temperature is due to a fire in the charcoal, the deluge systems can be actuated locally at the riser.

These heat detector alarms circuits are not supervised but there are multiple lines transmitting information to the Control Room. Periodic testing is done to insure operability of the system. Separate fire detection in the form of duct mounted and/or ceiling mounted smoke detectors as described in <Section 9.5.1.2.7.i> is also available.

c. Preaction water spray systems

These systems are hydraulically designed and equipped with a deluge valve, spray nozzles with fusible elements or thermosensitive glass bulbs, heat detectors, and a supervised air supply. System actuation (deluge valve trip) is achieved automatically by a signal from a heat detector or manually by operation of a manual release station. The deluge valve must trip and the fusible element must melt (or glass bulb break), before water will discharge from the spray nozzle. A leak, such as caused by a spray nozzle fusing (or glass bulb breaking), would allow air to escape faster than it could be replaced. A low air pressure signal would be sent to the system control panel, then transmitted to the fire alarm and signaling system as a trouble signal.

d. Preaction sprinkler system

These systems consist of both sprinklers and fusible element type spray nozzles, which are selected according to the necessary spray pattern for the particular hazard configuration in the area. These systems are hydraulically designed and they operate and/or transmit signals as described for the preaction water spray systems (discussed in item c, above).

e. Carbon dioxide total flooding systems

The diesel generator room, turbine lube oil tank rooms and turbine lube oil purifier rooms present a surface burning fire hazard and are protected by a minimum carbon dioxide concentration of 34 percent by volume in air. The computer rooms subfloor systems are designed in accordance with the requirements for deep-seated fire hazards. The design concentration for the computer room subfloors is 50 percent by volume. The design concentration for the modular control room subfloor system is a minimum of 34 percent by volume. The minimum design rate of application is based on achieving the design concentration for surface burning fire hazards within one minute, and for deep seated fires within seven minutes with a 30 percent concentration within two minutes.

Each carbon dioxide system is provided with a selector valve including a pilot solenoid valve assembly and trim piping for control of carbon dioxide to the distribution piping and nozzles.

Each system has a control panel which performs the following functions:

1. Automatically actuates the proper master control valve upon the receipt of an operation signal.

2. Automatically actuates the selector valve upon receipt of the operation signal.

3. Provides timed control of the valves using electrical timers.

4. Transmits a “Fire Alarm” signal to the fire alarm and signaling system upon operation of the selector valve and flow of carbon dioxide.

5. Transmits a “Trouble Alarm” (fire supervisory) signal to the fire alarm and signaling system upon a power or circuit failure.

6. Operates the predischarge horn.

7. Closes dampers for the diesel generator buildings, the turbine lube oil tank rooms and the turbine lube oil purifier rooms.

The operation of the carbon dioxide systems will be caused by the following initiation techniques:

1. Initiation of the control room subfloor system will be caused by a manual signal from the control room (detectors are provided but will transmit their signal to the fire alarm and signaling system).

2. Initiation of the diesel generator room systems, and the lube oil tank and purifier room systems will be caused by signals from cross zoned rate-of-rise (rate compensated type) fixed temperature detectors.

3. Initiation of the computer room subfloor system will be caused by a manual signal from the station mounted locally outside of the computer room (detectors are provided but will transmit their signal to the fire alarm and signaling system).

All systems (except control room subfloor) incorporate a predischarge delay.

f. Local application carbon dioxide systems

The entire reactor recirculation pump motors, associated bearing oil system and supports are considered the hazard for the subject design.

The total discharge rate is based on the volume of an assumed enclosure entirely surrounding the hazard. Assumed wall and ceiling locations are two feet from the hazard. No deduction is made for the volumes occupied by equipment. The system design rate is 1 lb/minute/cubic foot of assumed volume, with a minimum discharge time of 30 seconds.

Each system has a selector valve and a control unit which perform the functions described for the total flooding systems discussed in item e, except Item 7 which is not required.

The system is automatically operated by cross zoned heat detectors and can be manually operated from local stations.

Once the system has initiated and the piping upstream of the outboard containment isolation valve is pressurized with carbon dioxide, carbon dioxide will not discharge into the reactor recirculation pump area until the containment isolation valve is open. The control room operators need to open the containment isolation valve in order for the carbon dioxide to discharge into the reactor recirculation pump area.

g. Halon 1301 Total Flooding System:

The system will provide a minimum concentration of 5% in the protected space for a minimum of 10 minutes.

All systems are actuated either by manual release stations or automatically (after a time delay) by the associated smoke detector system. For automatic operation, a predischarge alarm is provided to allow personnel evacuation time prior to release of Halon.

h. Manual Fixed Foam System

The system is manually actuated from a local control panel. Foam is piped directly to the fuel oil storage tank for surface application and to hose stations in the fuel oil unloading area.

i. Fire Detection Systems

Detection systems have been designed to provide coverage for one or more of the following situations:

1. General area detection.

2. Specific hazard detection.

3. Specific equipment detection (primarily endangered by an exposure fire) detection.

4. Supplement protection of suppression systems for specific hazards (these detectors are in addition to the heat detectors provided with certain suppression systems).

The fire signals initiated by the detectors go to control panels which transmit them to the fire alarm and signaling system.

The panels are located at readily accessible locations and have visual displays indicating which zone is transmitting a fire or trouble signal. These fire detection systems remain operational in the event of a single ground fault or open condition (Class A pathway design).

In addition to the above systems, fire detection is provided in elevator vestibules and HVAC ducts.

j. Water standpipe and hose system

All areas of the plant are provided with manual fire fighting capability in the form of fire service water supplied hose stations. They are primarily 75 feet of 1-1/2 inch minimum diameter hose on a hose reel and are equipped with a fog nozzle. Where necessary, variations such as hose cabinets or additional hose are provided. Also, any hose station in the vicinity of safe shutdown equipment is provided with a backup water supply, by connection to the ESW System, and is designed and supported to remain functional in the event of a Safe Shutdown Earthquake.

k. Carbon dioxide manual hose systems

Low pressure carbon dioxide supplied hose stations have been provided at Elevations 620’-6” and 638’-6” of the control complex to fight electrical related fires. They have also been located at Elevations 620’-6” and 647’-6” of the turbine power complex for use on electrical and oil fires.

l. Portable fire extinguishers

Portable fire extinguishers of the type and size appropriate to match the hazard involved have been located throughout the plant.

9.5.1.2.8 Ventilation

<Appendix 9A> discusses the aspects of the plant ventilation system with respect to fire containment, detection and venting. <Appendix 9A.2.3.4> describes the factors considered regarding ventilation with respect to the areas of the plant covered by the analysis, <Appendix 9A.4> discusses the data assembled in accordance with <Appendix 9A.2.3.4> for each of those plant areas, and <Appendix 9A.5.D.4>, provides additional information on plant general design criteria with respect to ventilation.

9.5.1.2.9 Signaling System

All fire alarm (such as fire detection, system control panels, waterflow switches, pump running, and manual pull stations) and trouble alarm (such as tamper switches, system control panels, loss of power, and circuit failure) signals input to the fire alarm and signaling system. The Redundant Central Processing Unit Fire Alarm Control Panel (RFACP) with power supplies for the primary and secondary workstations (alarm receiving stations) are located in the Unit 2 Control Room. The primary workstation is located in the Unit 1 control room and the secondary workstation is located in the Unit 2 control room. Fire signals (or a trouble alarm from a fire system) will alarm on both the primary and secondary workstation. All alarms are annunciated, displayed on a screen and printed on hard copy.

Fire alarm (and trouble) signals are sent to the RFACP and workstations through field fire alarm control panels (FACP), zone adapter modules and individual addressable modules. The zone adapter modules and individual addressable modules are installed in LFPs.

Except where the signal from the device goes to an intermediate panel (such as a fire protection system control panel), the device is wired directly to the LFP. In accordance with NFPA Standard 72, all wiring from the RFACP to the Work Stations, FACPs and LFP’s is Class A. Wiring which goes directly from the LFP's to smoke detector panels, fire protection control panels, valve position switches, and waterflow devices is also Class A. All other wiring is Class B (trouble alarm on open or shorted condition) as a minimum. For a further discussion, refer to <Appendix 9A.5.E.1>.

All signal locations are coded so that the type of signal will be recognizable to the control room operator (i.e., the operator will be able to tell immediately if the alarm was a trouble, smoke detector signal or protection system operation). Additionally, the operator will be able to identify the location, and the particular type of device initiating the signal.

9.5.1.2.10 Cable

Depending upon the many unique situations and arrangements concerning the cable at PNPP, many variations of separation, detection and fire suppression methods have been used to limit, contain, control, and extinguish cable fires. <Appendix 9A>; 1) addresses these situations on an individual basis in <Appendix 9A.4> and <Appendix 9A.2>, <Appendix 9A.2.2.2> and <Appendix 9A.5.D.3> summarize general plant cable criteria such as physical characteristics and installation (separation) criteria.

Essential electrical circuitry needed for safe plant shutdown is considered as Class 1E circuits. The integrity of Class 1E circuits is provided for during a fire by separating Class 1E electrical equipment in accordance with the criteria set forth in IEEE 384 1974. The electrical cable used is suitable for use in either wet or dry locations.

The circuitry related to fire protection systems is non-Class 1E. The integrity of this circuitry is enhanced by installing the cable associated with the fire protection systems in conduit or in cable trays which meet the separation criteria for non-Class 1E circuits. System dependability is further ensured because all alarm transmission is installed per the requirements of a Class A system. In addition, all suppression systems can be manually activated in case of electrical failure.

Whenever cables or cable trays penetrate a fire barrier, the penetration is sealed to provide protection at least equivalent to that required by the fire barrier.

The insulation for electrical cables routed through the plant are fire retardant types. Those cable types that are acceptable for routing in cable trays were tested in accordance with the flame test specified in IEEE-383. Other cable types were tested in accordance with those fire resistance tests that were applicable to their specific installation and usage.

9.5.1.3 Safety Evaluation (Fire Hazards Analysis)

The overall plant fire protection program is such that if a fire occurs, the ability to perform safe shutdown functions and to minimize radioactive releases to the environment is maintained. This ability is shown in <Appendix 9A.4> which provides an evaluation of the effects of a postulated fire on each plant location housing and/or exposing equipment required for safe shutdown.

For each area identified as housing or exposing safe shutdown equipment, the fire hazards evaluation <Appendix 9A.4> uses both the fixed and transient combustibles in determining the fire loading and the potential fire intensity; the evaluation then analyzes a postulated fire in conjunction with fire barriers and fire fighting capability to determine the potential effects.

For the cases analyzed in <Appendix 9A.4>, it is assumed that an ignition source is present and that all fixed and transient combustibles are consumed. Where the areas analyzed are equipped with an automatic suppression system, the postulated fire was evaluated with and without the actuation of the system.

The release of a fire suppression agent due to some failure in the vicinity of safe shutdown equipment was evaluated as to the effect on the safe shutdown operation. <Table 9.5-1> provides an evaluation of the effects of failure of any portion of the fire protection system.

<Appendix 9A.4> evaluates the effects of the postulated fires on the structure and systems in the areas defined as containing safe shutdown equipment.

<Figure 9A-1>, <Figure 9A-2>, <Figure 9A-3>, <Figure 9A-5>, <Figure 9A-6>, <Figure 9A-7>, <Figure 9A-8>, <Figure 9A-10>, <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-14>, <Figure 9A-15>, <Figure 9A-16>, <Figure 9A-18>, <Figure 9A-19>, <Figure 9A-20>, <Figure 9A-22>, <Figure 9A-23>, <Figure 9A-24>, <Figure 9A-25>, <Figure 9A-26>, <Figure 9A-27>, <Figure 9A-28>, <Figure 9A-29>, <Figure 9A-30>, <Figure 9A-31>, <Figure 9A-32>, <Figure 9A-33>, <Figure 9A-34>, provided in <Appendix 9A>, show fire barriers, fire detection equipment, fire suppression equipment, and locations of equipment, instruments and cable associated with safe shutdown operations.

<Figure 9.5-1>, <Figure 9.5-2>, <Figure 9.5-3>, <Figure 9.5-4>, <Figure 9.5-5>, and <Figure 9.5-6> show the following:

a. Fire pumps and pressure maintenance components.

b. Underground distribution piping arrangement.

c. Internal distribution piping arrangement.

d. Hose stations.

e. Fire suppression systems.

<Appendix 9A.4> provides the following information for each area/zone:

a. A listing of all mechanical and electrical equipment that affects the safe shutdown operation.

b. A list of both permanent and reasonably expected transient combustibles.

c. Type of fire detection system provided.

d. Types of fire suppression equipment (primary and backup).

e. The effect of the postulated fire on the capability to safely shut down the reactor and on the potential release of radioactive material.

9.5.1.4 Inspection and Testing Requirements

Administration controls are provided through Plant Administrative Procedures (PAP), Instructions and the Operations Quality Program to ensure that the Fire Protection Program and equipment is properly maintained. This includes QA audits of the program implementation, conduct of periodic test inspections, and remedial actions for systems and barriers out-of-service. This program emphasizes those elements of fire protection that are associated with safe shutdown as described in <Appendix 9A> and their significance when evaluating program and equipment deficiencies.

All fire protection equipment and systems are subject to a complete inspection and acceptance test after installation with the requirements and acceptance criteria provided in the design documents. The National Fire Protection Association (NFPA) Standards, regulatory requirements, and vendor information in effect at the time of design are utilized as guidance in the preparation of the installation inspection and test instructions. The design documents also provide for documentation of justification for exceptions to regulatory requirements or NFPA Standards.

The Fire Protection Program provides for periodic inspections and tests of plant fire protection equipment, systems, and features, with the minimum inspection and testing frequency and the acceptable performance criteria described in administrative procedures. The inspections and tests are prepared and conducted in accordance with the plant surveillance program for nonsafety systems. The procedures for testing, inspections and administrative controls were developed utilizing the guidance of the Standard Technical Specifications for General Electric BWR6 and/or the NFPA Standards in effect in December 1985, and represent the program as reviewed and approved by the staff. Revisions and additions to these inspection procedures are maintained consistent with the requirements of this approved program with differences reviewed per <10 CFR 50.59> to provide documentation of justification for the changes and exceptions to the regulatory requirements or NFPA Standards governing the approved program.

The following fire protection features are subjected to periodic tests and inspections:

a. Fire alarm and detection systems

b. Water suppression systems (wet-pipe automatic sprinkler systems, water spray systems, automatic deluge systems, preaction water spray systems, preaction sprinkler systems)

c. Gaseous suppression systems (total flooding and local application carbon dioxide systems and halon systems)

d. Foam application system

e. Fire pumps

f. Yard mains and sectional isolation valves

g. Manual suppression equipment (fire hoses, hydrants, extinguishers)

h. Fire barriers protecting safety-related equipment (fire rated walls, fire doors, penetration seals, fire dampers, cable wrap)

Equipment out-of-service (impairments) including fire suppression, detection, and barriers are controlled by administrative procedures which provide a method of identifying acceptable performance criteria determining appropriate alternative protection measures and remedial actions, and documenting information on system status. The program requires that all impairments to plant fire protection systems be identified and appropriate notifications given to allow for compensatory measures to ensure an effective alternative level of fire protection, in addition to timely efforts to effect repair and restore equipment to service. Based on the condition, engineering analysis may be required to determine the extent of the fire hazard on safe plant operations or to recommend alternative compensatory measures. Documentation of the out-of-service fire protection systems status and protection alternatives also provides information for the fire brigade and the implementation of the fire hazard control programs.

9.5.1.5 Personnel Qualification and Training

The responsibility for the design, system equipment selection and development of test specifications for the completed physical aspects of the fire protection system was delegated to the fire protection consultant, Gilbert Associates, Inc., Reading, Pennsylvania. These responsibilities were conducted by or under the direct supervision of an engineer who was qualified for Member grade in the Society of Fire Protection Engineers.

The development of the plant fire protection program is the responsibility of the Fire Protection Staff. This staff is composed of personnel prepared by training and experienced in fire protection and personnel trained and experienced in nuclear plant safety to provide a balanced approach in directing the fire protection program.

Additional references to fire training can be found in <Section 13.2.5>. Specific administrative procedures, emergency plans, maintenance and testing procedures, and drills are described in the PNPP Operations Manual.

9.5.2 COMMUNICATIONS SYSTEMS

9.5.2.1 Design Bases

The communications systems are designed to provide the plant with multiple, independent, modes of concurrent information transmission between plant buildings and/or between the plant and offsite locations. Consequently, the plant communications systems employ multiple circuit and cable pathways and alternate power supplies.

Typical systems used for achieving diversity in communication between the operating areas within the plant include telephone, page/party public address, the plant intranet, emergency alarms, maintenance communication, and radios.

Plant-to-offsite communication is primarily via the private and public telecommunications systems. However, additional offsite communication system options are provided which include microwave, fiber optics, radio, data networks, the internet, and company-owned and commercial communications services and systems.

The communication systems conform with applicable codes, standards, ordinances, and Federal Communications Commission regulations.

Refer to the “Emergency Plan for PNPP” for a description of communications used to support in-plant, site, and offsite emergency response activities.

9.5.2.2 System Description

9.5.2.2.1 Private and Public Telecommunications Systems

Voice communication between administration office areas, selected plant areas, the control room, and points outside the plant, is provided by a commercial Private Branch Exchange (PBX) telephone system. Sufficient lines are provided to ensure adequate availability for all normal requirements. The PBX system is powered from a battery charging system, which is capable of being fed from a diesel generator backed power supply. The battery capacity of the system has been designed to sustain operation of the PBX system for four hours in the event of a loss of power.

The Off Premise Exchange (OPX) telephone system also provides an alternate voice communication system between the plant and locations offsite. This offsite communication system consists of telephones strategically located in the emergency response facilities and various areas within the plant. In the event of a power outage, the telephone system has a diesel generator backup power supply and battery backup with a capacity to sustain operation for three hours. Intra-company communication links, which employ backup power systems, provides communications channels to the commercial OPX carrier.

9.5.2.2.2 Intra-Company Communications

The OPX system is connected to PNPP via the company owned and operated intra-company communications network. The communications network electronics at PNPP are battery backed and will be available for eight (8) hours in the event of a loss of offsite power. The communications network electronics and supporting air conditioning can be powered from an 11kV feeder with a spare feeder as a backup supply. In the event of a loss of both feeders, a diesel backup can also power the communications network and supporting air conditioning. Intermittent power to the electronics is supplied via the battery until the diesel assumes the system load.

Communications between the control room and the system switching authority are established to transmit voice and data signals. Voice communications are backed by radio.

9.5.2.2.3 Radio Systems

The plant system consists of radio transceivers operating through an antenna system, to provide radio coverage outdoors and in the plant. This system provides multiple voice or data channels for communications to various portable and mobile radio devices for Operations, Instrumentation and Controls, Maintenance, Fire Brigade, Emergency, and Security. These channels may also support other site organizations and functions as needed.

Radio links are provided to allow communications with the local law enforcement agency and the system switching authority. Direct wired radio remote devices are also provided in areas where radio transmissions are prohibited, or dispatch function or convenience is desired. These direct wired devices may include radio consoles, radio phones, telephone interconnect equipment, etc. Primary radio remotes are powered from an uninterruptible power supply and each repeater has a battery backup.

9.5.2.2.4 Page/Party Public Address

An independent, outdoor, public address (PA) broadcast system consisting of high power amplifiers and speakers provides functions such as security, emergency, or site accountability announcements. This system may broadcast a prerecorded message or a live broadcast, via microphone, which is audible over the entire exclusion area shown on <Figure 9.5-7>. Broadcasts over the exclusion area paging system are also audible in the plant via an interconnection into the PA system. The exclusion area paging system is powered by a battery uninterruptible power system that is capable of being supplied from a diesel.

The plant page/party system consists of multiple channels, which are powered from a diesel generator backed 120 Vac distribution system. The individual PA stations are independently amplified and the system is designed for utility and heavy industrial applications where intelligible communications is desired. Party line conversations are not carried over the plant speaker system and more than two operators may engage in a party conversation. The page system utilizes its own conduit system, which has been designed with a branch circuit arrangement and testing/isolation stations connecting the branches to one of the three trunks. A component failure or short circuit can be isolated from the rest of the system. Also, the loss of any one branch line will only cause the loss of communications in a limited area of the plant.

9.5.2.2.5 Emergency Alarms

Emergency alarms are provided to accommodate emergency and fire evacuations. A plant PA system multi-tone generator provides high volume evacuation or alarm signals that are broadcast through the plant PA system speakers. In high ambient noise areas, battery backed strobe light units provide a visual notification of fire or evacuation alarm in addition to the audible alarms. The strobe units are activated with the emergency and fire alarms.

9.5.2.2.6 Maintenance Communications

A maintenance and calibration communication system is provided, which is an isolated communications network. This system utilizes a multi-channel, amplified audio, patch panel to interconnect to individually wired headset jacks, which are located throughout the plant and control room. Back-up power for the maintenance and calibration jack communications system is from a battery backed uninterruptible power supply.

9.5.2.3 Inspection and Testing Requirements

The design of the communications system provides for most routine surveillance and testing activities without disrupting normal communication facilities. Alternate communications channels or systems can be utilized during maintenance outages. Branch circuit arrangements in the PA system permits disconnection of individual communications loops without affecting the overall system.

9.5.3 LIGHTING SYSTEMS

9.5.3.1 Design Bases

The lighting system is designed to provide illumination for specific visual tasks, and access and egress throughout the plant.

The following was considered in the design of this system:

a. Lighting fixtures and switches containing mercury and its compounds are excluded from use in the reactor building, fuel handling area and personnel access hatches. Mercury vapor luminaries are used in other areas of the plant.

b. Essential lighting operates in conjunction with normal lighting and is provided in areas requiring highly reliable illumination. This system provides for safe access and egress. This system also provides lighting in support of continued plant operations.

c. Lighting and miscellaneous lighting hardware is supported, where appropriate, in a way that will avoid hazardous locations or become a missile to Class 1E components.

d. Illumination design footcandles are based on Illuminating Engineering Society recommended values.

e. Control room illumination is accomplished by a special low brightness diffuser with intensity controls.

f. Outdoor area lighting provides illumination levels required for plant operation, maintenance and security.

9.5.3.2 System Description

9.5.3.2.1 Normal Lighting

The normal lighting system provides the majority of the plant lighting. It is supplied at 120 volt, 208 volt or 480 volt, fed from normal lighting panels. These panels are powered from the non-Class 1E buses. Lighting in the reactor building and other potentially high radiation areas will be accomplished exclusively with incandescent and Light Emitting Diodes (LED) fixtures.

9.5.3.2.2 Essential Lighting

The essential lighting system operates in conjunction with the normal lighting and is used in those areas where highly reliable illumination is required for safe access or egress, or the continuation of critical tasks. It is supplied at 120 volt, 208 volt or 480 volt, fed from essential lighting panels. These panels are powered from a 480-volt interruptible diesel generator powered bus from Unit 1. Essential lighting is provided for safe passage in the reactor building, auxiliary building, diesel generator building, intermediate building, fuel handling building, radwaste building, offgas building, and control complex. It is also provided for the support of plant operations at the diesel control panels, switchgear, computer room, remote shutdown panels, and the control room.

The motor control centers (MCCs) which feed the essential lighting system are of the same design and manufacturer as the Class 1E MCCs. The essential lighting system is routed in separate conduit and the supports for lighting fixtures and conduit in safety-related buildings have been designed to withstand the design basis seismic event for safety-related buildings.

9.5.3.2.3 Emergency Lighting

Emergency illumination is provided for those pedestrian areas where a potentially high radiation hazard might exist, and where failure of the normal lighting system might hamper safe personnel egress. In the control room, and parts of the controlled access area and diesel generator rooms, emergency lighting is provided for the support of plant operations if all other light sources are lost. This lighting does not form a part of the lighting routinely supplied to the area and will only become energized if the feeder to that lighting is lost. Emergency lighting is supplied from the 125 volt dc non-Class 1E batteries.

To meet the requirements for emergency lighting in case of a fire, a separate system of fixed self-contained lighting packs with 8-hour battery supplies is provided. The lighting units are seismically mounted or mounted in locations where their displacement would not damage nearby safety-related equipment during a seismic event. This fixed self-contained lighting is provided in areas that must be manned for safe shutdown including access and egress routes, except for the control room which is discussed below. The emergency 8-hour lighting system was procured and installed in accordance with certain provisions of the quality program.

Control room AC emergency lighting credited for safe shutdown is locally powered from either of two lighting panels (one from each division) located in the Unit 1 control room. Illumination is provided directly over the horseshoe and other areas of the control room that may be required for safe shutdown.

Adequate illumination is provided for operations personnel to perform safe shutdown. This light source is always on, however, power under emergency conditions is provided as described below:

Division 1 source emergency lighting in the control room will be provided by a single lighting transformer and distribution panel. The normal power source for the lighting transformer will be the Division 1 Class 1E, 480V motor control center. The power supply to the motor control center is from a 480V bus supplied via a transformer by the 4.16 kV bus which is powered by the Division 1 diesel generator.

The Division 2 source of emergency lighting in the control room will be provided by a single lighting transformer and distribution panel. The normal power source for the lighting transformer will be a nonsafety, 480V motor control center. On loss of offsite power, the power supply to the motor control center will automatically transfer to a 480V bus supplied by the Division 2 stub bus via a step down transformer, the Division 2 stub bus is fed by the 4.16 kV safety-related bus (EH12) which is powered by the Division 2 diesel generator.

These two sources of power to control room lighting are independent and have been analyzed and protected to ensure that at least one divisional source is available, given a fire in any area outside the control room.

9.5.3.2.4 Security Lighting

The security lighting system is designed to provide illumination within the main perimeter fence, at levels measured horizontally at ground level equal to or greater than the required minimums established by <10 CFR 73.55>.

The system consists primarily of 1,000 watt high pressure sodium luminaries mounted on 100 and 150 foot poles. In areas where poles are not feasible, 400 and 1,000 watt high pressure sodium luminaire clusters are mounted from the building.

The system power supply is non-Class 1E, fed from two separate supplies to provide source reliability. System circuitry is arranged in such a way that the loss of either supply source will result in no more than a 50 percent reduction in light.

Control of the lighting system is photoelectric and is accomplished by means of four photocells connected in parallel to the master control relay. The system is fail safe, i.e., loss of the control circuit power or failure of any photocell will automatically turn on the security lighting system.

A manual override switch is provided to allow for test and maintenance of the system. The switch is in parallel with the photo controls and cannot defeat the fail safe operation.

9.5.3.3 Safety Evaluation

If BOP power is lost, the normal ac lighting system becomes inoperative. The essential backup supply will remain on until there is a loss of the essential supplied bus. If both the BOP and essential bus are lost, the dc emergency system is activated by contactors and the system is energized, thereby providing illumination in support of continued plant operations. When the diesel generator picks up the essential bus, dc lights go out and essential lighting is restored.

The diverse and separate systems for essential and emergency (including 8-hour) lighting provide lighting to achieve safe shutdown for a design basis seismic event or lighting for safe shutdown following a fire and postulated loss of all offsite power.

9.5.3.4 Inspection and Testing Requirements

Everyday use of the normal and essential lighting systems is considered to be proof of system integrity. A test feature is provided to simulate the loss of the normal lighting system to periodically test the emergency lighting systems.

9.5.4 DIESEL GENERATOR FUEL OIL STORAGE AND TRANSFER SYSTEM

The sections that follow discuss the fuel oil storage and transfer system for the standby diesel generators. This system for the high pressure core spray (HPCS) diesel generator is discussed in <Section 9.5.9.1>.

9.5.4.1 Design Bases

Separate fuel oil storage and transfer facilities are provided for each of the two standby diesel generators for at least seven days of operation carrying the design electrical load of the associated generator. This storage capacity criterion is considered adequate since fuel oil delivery from the Cleveland area, in the amounts required, is considered to be available with a two or three day delivery notice. Tank trucks will deliver the fuel oil to a central fill station.

There are numerous fuel oil dealers in metropolitan Cleveland capable of supplying the needed quality of fuel oil in the amounts required. <Table 2.2-2> and <Figure 2.2-2> show the major roads, their proximity to the plant and the daily traffic. As the roads are heavily traveled, they are kept clear by the State Highway Department.

In the event of extreme environmental conditions, special arrangements will be made as necessary to ensure fuel oil delivery.

All system components are accessible for an inservice inspection without affecting the availability of fuel to either of the standby diesel generators.

Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Position APCSP 9.5-1, as related to fuel oil system fire protection, is detailed in <Appendix 9A>.

Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have also been considered in the design of this system, as discussed in <Chapter 8>.

The specific Emergency Diesel Generator (EDG) fuel oil volumes contained in the diesel fuel oil storage tanks(s) necessary to ensure that EDG run-duration requirements are calculated using <Section 5.4> of American National Standards Institute (ANSI) N195-1976, “Fuel Oil Systems for Standby Diesel-Generators”. The “time dependent + 10%” methodology, which is described in ANS-59.51/ANSI N195-1976, is used for calculating the fuel oil storage requirements for the Division 1 and Division 2 Diesel Generators. This method is used because these units are not loaded to near full capacity. This fuel oil calculation methodology is one of the two approved methods specified in Regulatory Guide (RG) 1.137, Revision 1, “Fuel Oil Systems for Standby Diesel Generators”, Regulatory Position C.1.c.

9.5.4.2 System Description

The standby diesel generator fuel oil system is shown in <Figure 9.5-8> and the layout arrangement is shown in <Figure 1.2-5>. Each standby diesel generator has its own separate fuel oil system consisting of the following components with associated piping, valves, strainers, filters, and controls:

a. Fuel oil storage tank.

b. Fuel oil day tank.

c. Two fuel oil transfer pumps.

d. Motor driven fuel oil booster pump.

e. Engine driven fuel oil booster pump.

The fuel storage tanks are buried, horizontal, cylindrical, atmospheric tanks. Each tank has a 90,000 gallon storage capacity which is sufficient to operate its corresponding diesel generator for seven days during the postulated emergency reactor shutdown under postaccident conditions. This volume also includes capacity for diesel generator operability testing.

The design of each diesel generator fuel oil storage tank is such that a minimum amount, if any, of entrained sediment would be drawn into the eductor inlet as the result of filling the storage tank during engine operation. The flow currents in this large volume caused by the new oil entering the tank will be very low beyond a few feet from the fill discharge point, and are unlikely to disturb sediment in the remainder of the tank. There will be no stirring action throughout the tank except at the point of discharge from the fill pipe.

The eductor inlet is 18 inches off the bottom of the tank. The disturbed particles around the fill pipe would have to travel more than one half the length of the tank before entering the eductor inlet. The horizontal velocity of the fuel oil in the bottom of the tank will be so low that the probability of a significant amount of particles remaining entrained (not settling out) and entering the eductor is very low.

In addition, the diesel generator fuel oil supply system is provided with redundant pump strainers with high ΔP alarms in the transfer loop, from the underground storage tank to the day tank, as well as duplex filters with alarms from the day tank to the diesel engine.

For these reasons, any sediment disturbance caused by filling the tank during diesel operation could not decrease the fuel oil quality to a point that would cause ultimate failure of the diesel generator.

The fuel oil day tanks are 550 gallon, vertical, cylindrical, atmospheric tanks mounted in the respective standby diesel generator room at an elevation that provides the required priming head for the diesel generator engine mounted and driven fuel oil booster pump. Each day tank is equipped with an overflow line which will return excess fuel oil delivered by the transfer pump back to the fuel oil storage tank.

The transfer pumps transport fuel between the underground storage tank and the day tank. The transfer pumps are located in the diesel generator building. Each pump motor is 15 horsepower, 460 volts, 3 phase, 60 Hz and is powered from a safety-related Class 1E 480 volt motor control center. Each pump has a capacity of 90 gpm at a discharge pressure of 75 psig.

The fuel oil transfer pumps may be operated with manual control switches; however, they are normally operated automatically by the level switches on the day tanks. During normal system operation, day tank fuel oil level drops as the result of fuel consumption by the engine. When fuel level drops to the primary pump low level setpoint, the primary pump starts and begins to refill the day tank. The fuel level continues to increase to the primary pump stop setpoint, where the primary pump stops.

In the event that the fuel oil level in the day tank should continue to drop below the low level setpoint to the low-low-low primary pump setting, the primary pump will stop. As the level continues to fall due to fuel oil consumption by the EDG, the secondary pump low level setpoint will be reached and the secondary pump will start. Upon restoring level to the secondary pump high level setpoint in the day tank, the secondary pump will stop. As the day tank level increases from secondary pump operation, the primary pump low-low-low stop is automatically reset, allowing the primary pump to function automatically. This occurs when the fuel oil level rises above the low-low-low stop reset for the primary pump.

In the unlikely event that the fuel oil level should drop to the secondary pump low-low-low level setpoint in the day tanks, the secondary pump will stop. This is the minimum safe level for operation of the pumps.

In the event of a standby diesel generator start, the standby diesel generator fuel oil system operates automatically to support the operation of the diesel generator by supplying fuel to the day tanks.

In the event of failure of the automatic operation of the normal transfer pump, the backup pump, with separate automatic controls, is provided as emergency backup.

One engine driven fuel oil booster pump is supplied with and located on each diesel engine. The booster pump is driven by the diesel engine, has a capacity of 35 gpm, and a discharge pressure of 40 psig.

One motor driven fuel oil booster pump is supplied with each standby diesel generator. The pump motor is two horsepower, 125 Vdc, and is fed from a 125 Vdc nonsafety battery supply. The pump has a capacity of 35 gpm and a discharge pressure of 40 psig.

Each fuel oil booster pump supplies fuel from the day tank to the engine manifolds, and starts when the diesel start signal is received. The motor driven fuel oil booster pump is automatically started on any manual or automatic diesel start signal and will automatically stop when the engine driven fuel oil pump’s discharge pressure has increased sufficiently to demonstrate that the engine driven pump is functioning properly. When the diesel generator is operating, the motor driven fuel oil booster pump will auto start anytime the discharge pressure of the engine driven fuel oil pump drops low indicating a potential pump failure. After any motor driven booster pump auto start due to engine driven pump failure, the pump is automatically stopped when the diesel generator is shutdown.

The fuel not consumed by the engine is returned to the day tank from the fuel bypass header. Back pressure is maintained on the fuel bypass header and fuel return piping by a regulating valve which discharges to the day tank.

The fuel which, by design, leaks through the injection pumps is collected in the drip waste header which drains to the underground fuel oil storage tank via piping which connects to the day tank overflow/drain line for the Unit 1 standby diesel generators.

Control of the system is normally automatic during all modes of plant operation.

Refer to <Section 8.3.1> for further details on the diesel generator starting sequence.

Refer to <Section 9.5.9.1> for description of the HPCS diesel generator fuel oil storage and transfer system.

9.5.4.3 Safety Evaluation

The standby diesel generator fuel oil system meets the single failure criterion; i.e., if a failure in the system prevents the operation of the associated diesel generator, the other two divisions of the emergency power system <Section 8.3> will provide adequate power to safely shut down the plant or to mitigate the consequences of any of the postulated accidents.

The standby diesel generator fuel oil system is designed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code, the National Fire Protection Association Standards 30 and 37, State of Ohio safety regulations, and Diesel Engine Manufacturers Association (DEMA) standards. The system is classified Safety Class 3 and Seismic Category I, with the exception of vents, overflows, fill lines, fuel oil drip return system, booster pump dc motors, and dipstick and water removal lines which are nonsafety. The fuel return piping regulating valves are safety-related and seismically qualified. All underground fuel oil lines and lines which extend above grade outside the diesel generator building are ASME Section III, Class 3, Seismic Category I and missile protected for the first six inches above grade. This includes vents, overflow, dipstick, water removal, and fill lines. The diesel generators and their auxiliary systems, including the fuel oil storage and transfer system, are isolated from one another by a reinforced concrete wall. The exposed walls and roof of the diesel generator building, including the dividing walls, are designed and constructed as discussed in <Section 3.5.3>. Any external openings to the outside are protected as discussed in <Section 3.5.2> and <Table 3.5-5>. The overall description of the diesel generator building as a Seismic Category I Structure is given in <Section 3.8.4.1.7>. The effects of postulated high energy pipe ruptures are discussed in <Section 3.6.1.2.1(g)>. No openings in the walls separating the individual diesel generators exist.

Two 100 percent capacity fuel transfer pumps are provided for filling each of the day tanks. The standby pump is started automatically by a low-low level switch in the day tank if the primary pump fails and the day tank level continues to fall. No physical interconnection of piping exists between the standby or high pressure core spray diesel generators.

The fuel oil day tanks are located no less than approximately ten feet from the exhaust manifold piping. In addition, the day tanks are protected to obtain a three hour fire resistance rating. The fuel oil piping is routed such that the nearest distance to hot surfaces is at the connection to the diesel engine.

Corrosion protection for the tanks and piping includes providing a corrosion allowance to the tank wall thickness and the external use of bituminous coatings applied to thicknesses to assure complete uninterrupted coverage. Cathodic corrosion protection of the buried storage tanks and piping is used to withstand corrosive conditions in the system. The underground yard piping is coated with coal-tar enamel and bonded double asbestos-felt wraps, following the American Water Works Association's Standard C-203, "Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied." All diesel generator fuel oil storage tanks are coated internally with a one coat, 2 mil-thick coating of Rustoleum.

Leakage due to corrosion, allowing water to enter the tank, will be detected by a slow increase in the fuel level; this level will be read and logged at regular intervals. Such a leak would be slow starting and would increase at a slow enough rate to allow pumping the water out of the tank. Corrective action could be taken before the water accumulates to an amount that interferes with the quality of the fuel at the level of the eductors.

A program of sampling and periodic replacement of the oil will be conducted to prevent long term deterioration of the fuel oil. Due to fuel consumption during periodic testing, it is anticipated that fuel oil replacement for deterioration will not be required.

Algae growth in the tank will be prevented by routinely removing the water in which it grows, and if necessary, by using an algae inhibiting additive in the oil.

The fuel oil storage tanks are provided with porous Class A bedding and backfill as an extension from the main plant underdrain system.

The Probable Maximum Flood (PMF) level is lowered to a point 10 feet below the bottom of the tanks in this area due to the main plant underdrain system and Class A bedding; this will avert the threat of possibly lifting the storage tanks due to hydrodynamic forces from a buildup of water around the tanks <Figure 9.5-21>, and <Figure 9.5-22>. The storage tanks are designed so that all openings are above the ground water and PMF levels to prevent the entrance of water. The only anticipated source of water into the tanks will result from moisture being carried with air that enters the tank through the vent. The maximum rate of this accumulation would occur during a prolonged run of the standby diesel generator when air is drawn into the tank to displace fuel used. Under the worst possible conditions on a hot humid day, approximately 42 cubic feet per hour of air will enter the tank and approximately 0.30 gallons of water per day will be deposited. This accumulation of water will be detected by routine sampling and will be pumped out as required.

9.5.4.4 Inspection and Testing Requirements

Proper operation of the transfer pumps and the level alarm signals will be checked at scheduled intervals to assure their availability. This includes checks of the following:

a. Primary transfer pumps start and stop automatically at the desired levels.

b. Standby transfer pumps start and stop automatically at the desired levels.

c. Alarm signals for high and low day tank levels function at the designated levels.

d. Low level signals for the storage tanks function at the designated levels.

The fuel oil that supplies the emergency diesel generators is No. 2-D diesel fuel oil which meets the following specifications based on the ASTM standards listed in the Bases of Technical Specification 3.8.3, and meets or exceeds the manufacturers' recommendations for fuel oil:

	Maximum	Minimum
Kinematic Viscosity, centistokes, 40°C	4.1	1.9
Gravity, Deg. A.P.I.	39	26
Sulphur, Weight %	0.015	-
Copper Strip Corrosion	No. 3	-
Carbon Residue on, 10% Residuum, %	0.35	-
Ash, Weight %	0.01	-
Water and Sediment, (Clear and Bright Test)	None Detectable	
Flash Point, °F	-	125 or legal
Distillation, °C 90% point	338	282[1]
Ignition Quality, Cetane Number	-	40
Cloud Point, °C	-3	-
Particulate Contamination, mg/1	10	-

NOTE:

(1) When a cloud point temperature less than -12°C is measured, the minimum 90% recovered temperature shall be waived.

The above specification covers fuel oils classed as Grade No. 2-D.

The procedure for testing newly delivered fuel, periodic sampling and testing of onsite fuel, periodic inspection, and periodic removal of condensate is done in accordance with <Regulatory Guide 1.137>, as clarified in USAR <Table 1.8-1>.

9.5.4.5 Instrumentation Requirements

The standby diesel generator fuel oil storage and transfer system is provided with controls for automatic transfer of fuel oil from the storage tanks to the day tanks. In addition, alarms and indicators of sufficient number and at appropriate locations are provided to ensure that the operator can determine system status and operation from the control room. Details of the instrumentation and controls for the standby diesel generator fuel oil storage and transfer system are presented in <Section 7.3.1>.

9.5.5 DIESEL GENERATOR COOLING WATER SYSTEM

The sections that follow discuss the cooling water system for the standby diesel generators. This system for the high pressure core spray (HPCS) diesel generator is discussed in <Section 9.5.9.2>.

9.5.5.1 Design Bases

The standby diesel generator cooling water system is designed to dissipate the heat given up by the turbocharger intercoolers, the lube oil heat exchanger, the governor oil cooler, the engine water jackets, and the jacket water heat exchanger. There are no shared systems or piping interconnections among each of the standby diesel generators' cooling systems. The jacket water heat exchanger is cooled with water from the emergency service water system. Cooling for the engine water jackets, the lube oil heat exchanger, governor oil cooler, and the turbocharger intercoolers is provided with a closed loop cooling system. The jacket water system coolant consists of demineralized water with corrosion inhibiting additives. Ethylene glycol may be added as allowed by manufacturer's recommendations. The performance and water chemistry of the diesel generator cooling water system is in conformance with the manufacturer's recommendations.

Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have been considered in the design of this system as described in <Chapter 8>.

9.5.5.2 System Description

The standby diesel generator jacket water cooling system is shown on <Figure 9.5-9>.

For each standby diesel engine, the jacket water cooling system consists of a closed loop in which a coolant solution is circulated through the engine. The coolant is drawn from the standpipe, into the engine driven centrifugal pump. Then, it passes through a three-way temperature control valve (R46-F507 A,B) which directs the coolant through or around the jacket water heat exchanger, as necessary, to maintain the required coolant temperature. The coolant is cooled by emergency service water in the jacket water heat exchanger. Upon leaving the jacket water heat exchanger, the coolant flow diverges and either cools the lube oil by flowing through the lube oil heat exchanger or bypasses the lube oil heat exchanger and instead flows to the turbocharger intercoolers. The flow paths combine to supply the engine jacket water passages and the governor oil cooler. When the coolant leaves the engine, it discharges into the standpipe and the loop is repeated.

The 100 percent capacity engine driven cooling water pump has a capacity of 1,550 gpm at 43 psig discharge pressure and operates whenever the diesel generator is in operation.

The jacket water heat exchanger is a shell and tube type, with emergency service water on the tube side and jacket cooling water on the shell side. The lube oil heat exchanger is a shell and tube type with jacket cooling water on the tube side and lube oil on the shell side.

The closed cycle system also includes a jacket water standpipe and a heating system to keep the system warm for standby purposes. The diesel generator cooling water system standpipe (expansion tank) is a 30 inch diameter, vertical tank, 18 feet 10 1/2 inches high, having a working water volume of 651 gallons with the system at operating temperature. The standpipe is skid mounted and adjacent to the diesel engine. The heating system includes a 75 kW, 460 volt electric heater inside the jacket water standpipe and a motor driven pump to circulate warm coolant at a minimum temperature of 140°F through the engine. A check valve is included in the warmup line to prevent back flow during operation of the engine. The cooling water system is vented to ensure that all spaces are filled with water.

The keepwarm pump is of the horizontal, centrifugal type with a capacity of 50 gpm at 50 ft head with a three horsepower, 460 volt, 3 phase, 60 Hertz motor. The motor is powered from a safety-related Class 1E motor control center. The pump may be momentarily stopped manually with its control switch; however, with its control switch in AUTO it will operate continuously with the diesel in standby and will de-energize when the diesel receives a start signal.

The standby diesel jacket water heat exchanger may be without emergency service water flow for approximately 70 seconds from the start of the diesel generators. Ten seconds are required to bring the diesel generator up to speed and 60 seconds or less elapse before the sequential loading process initiates emergency service water system operation. The standby diesel generator cooling water system can operate without emergency service water for 1-1/2 minutes before the maximum allowable cooling water temperature of 200°F is reached. The standby diesel generator cooling water system is designed to remove 24,500,000 Btu/hr, with a required heat removal rate calculated to be 20,650,000 Btu/hr. The temperature of the cooling water coming out of the standby diesel during normal operation is in the range of 158°F to 168°F.

Control of the system is normally automatic during all modes of plant operation.

Details of the diesel generator starting sequence are discussed in <Section 8.3.1>. The cooling water system for the HPCS diesel generator is discussed in <Section 9.5.9.2>.

9.5.5.3 Safety Evaluation

The standby diesel generator cooling water system is designed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code and TEMA and DEMA standards. The system is classified Safety Class 3 and Seismic Category I.

Each diesel generator set, with its attendant cooling water system, is located in a separate Seismic Category I structure. No non-Seismic Category I structures or components are located close enough to impair diesel generator cooling water system operation. The system meets the single failure criterion; i.e., if a failure in the system prevents the operation of the associated diesel generator, the other two divisions of the emergency power system <Section 8.3> will provide adequate power to safely shut down the plant or to mitigate the consequences of any of the postulated accidents. Each standby diesel generator cooling water system is cooled by a separate emergency service water system loop <Section 9.2.1>.

Water from the emergency service water system can be used as an emergency makeup source for the diesel jacket watering cooling systems (Div. 1 and Div. 2) to maintain availability of the standby diesel generators during accident and/or loss of offsite power (LOOP) conditions, when/if jacket water inventory is less than needed and the normal demineralized water sources are unavailable.

9.5.5.4 Inspection and Testing Requirements

To ensure the availability of the standby diesel generator cooling water system, scheduled inspection and testing of the equipment are performed as part of the overall engine performance checks. Instrumentation is provided to monitor cooling water temperatures and head tank level. These instruments will receive periodic calibration and inspection to verify their accuracy.

During standby periods, the keepwarm feature of the engine jacket water cooling closed loop system is checked at scheduled intervals. This will ensure that the water jackets are warm enough to assist quick starting of the engine.

The cooling water in the engine jacket water closed loop system will be analyzed at regular intervals and will be treated, as necessary, to maintain the desired quality as specified by the manufacturer.

9.5.5.5 Instrumentation Application

The diesel generator cooling water system is provided with sensors, controls and alarms as required to ensure complete monitoring of satisfactory system performance, safe engine operation and to alert the plant operators to abnormal conditions requiring investigation and corrective action.

The diesel generator cooling water system is instrumented as shown on <Figure 9.5-9> and described below. Instrumentation and controls are provided to monitor system pressure, cooling water temperatures in and out of the engine and standpipe level and to provide automatic operation of the keepwarm circulating water pump and heater.

To alert the plant operators to abnormal conditions which should be investigated for corrective action, alarms are provided for the following parameters:

a. Water pressure low.

b. Standpipe level low.

c. Water into engine temperature low.

d. Water into engine temperature high.

e. Water from engine temperature low.

f. Water from engine temperature high.

g. Circulating water pump/heater control switch not in "AUTO".

h. Trip of unit due to high temperature water from engine.

With the exception of Item g., each parameter actuates a separate alarm on the local diesel generator control panel. The local alarm for Item g. is shared with other control switches which are normally to be in an AUTO position. Actuation of any of the alarms also actuates a common diesel generator trouble alarm in the control room.

During the periodic surveillance testing of the complete diesel generator unit, the engine will automatically trip if the cooling water temperature from the engine exceeds 200°F. This condition also actuates an alarm, Item h., above.

However, when the diesel generator is automatically started in response to a LOCA or bus under/degraded voltage signal, this trip feature is defeated but the alarms still actuate. This allows the plant operators to evaluate the operating condition of the engine against overall plant requirements and make a decision as to whether or not to shut down the diesel generator.

The circulating water pump is provided with controls permitting automatic or manual operation. Except for testing situations, the pump is operated automatically. The pump controls are interlocked with the diesel generator so that under the automatic mode the pump runs continuously whenever the diesel generator is not running. The keepwarm heater control is interlocked with the circulating pump so that the heater cycles on and off in response to its thermostatic control switch only when the pump is running. When the pump is not running, the heater cannot be energized.

Water level indication is provided on the jacket water standpipe. System pressure at the engine inlet is indicated on the local diesel generator control panel. Thermocouples in the jacket water piping feed signals corresponding to water temperature in and out of the engine to the multiple position temperature selector switch on the local control panel. Through the use of this switch, which also receives signals from the combustion air intake and exhaust system and the lubricating oil system, these temperatures may be displayed on the digital temperature meter on the local control panel.

Another set of thermocouples in the jacket water piping feed water temperature in and out of the engine signals to a slow speed recorder in the local control panel. This recorder operates continuously and provides documentation of important engine temperatures for performance monitoring, trending and engine diagnostics.

9.5.6 DIESEL GENERATOR STARTING AIR SYSTEM

The sections that follow discuss the starting system for the standby diesel generators. This system for the high pressure core spray (HPCS) diesel generator is discussed in <Section 9.5.9.3>.

9.5.6.1 Design Bases

The standby diesel generator starting air system provides a supply of compressed air for starting the standby diesel generator engines. Separate and independent starting air systems are provided for each engine; each system is designed for complete redundancy and is capable of supplying enough air for a minimum of five consecutive engine starts.

Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with applicable regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and

<Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have been considered in the design of this system as described in <Chapter 8>.

There are no shared systems and no piping interconnections between systems.

9.5.6.2 System Description

The standby diesel generator starting air system is shown in <Figure 9.5-10>. It provides a separate starting air facility for each of the diesel engines. Each facility includes two 100 percent capacity redundant trains of components/piping. Each train has an air compressor, aftercooler, air dryer, and a receiver tank. Two redundant, solenoid operated, starting air admission valves are provided for each engine air admission line. A strainer is provided in each starting air line to each engine to preclude the blocking of the starting air valves with contaminants.

Each redundant diesel generator starting air system train is capable of providing five cranking start cycles, each with a duration sufficient to successfully start the diesel generator.

Each air compressor is capable of recharging one air receiver tank from minimum operating pressure to maximum starting air pressure in under 30 minutes. The PY-1R44C0001B air compressor is reciprocating, three stage, air cooled type with a capacity of 87.1 scfm at a discharge pressure of 300 psig and is powered by a 40 horsepower motor. The remaining air compressors are reciprocating, two stage, air cooled type with a capacity of 83.6 scfm at a discharge pressure of 250 psig and each is powered by a 30 horsepower motor.

The compressors may be operated with manual control switches; however, they normally are operated automatically by pressure switches which sense the air pressure from the respective receiver tanks. The pressure switches start and stop the compressors, as necessary, to maintain the desired system pressure range.

An air-to-air aftercooler is provided on the downstream side of the motor driven starting air compressors to cool the compressed air prior to entering the air dryer. The compressed air passes on the tube side of the cooler and cooling air is fan-blown over the finned tubes. Each aftercooler operates continuously in conjunction with its respective compressor.

Each starting air dryer assembly consists of a prefilter, two dehydrator towers, an after-filter, and the interconnecting piping and valves which control the air flow to each tower. Air dryer assembly PY-1R44D0001B processes 87.1 scfm of air at 140°F and 250 psig through one of the two available dehydrator towers which contain desiccant to remove moisture. The remaining air dryer assemblies processes 77 scfm of air at 140°F and 250 psig through one of the two available dehydrator towers which contain desiccant to remove moisture. While one tower dries the air, the other tower is purged with a portion of the dried air to reactivate the desiccant. An automatic control system provided with the air dryer assembly reverses the modes of the towers on a timed basis, thus ensuring the air is dried with freshly regenerated desiccant. The air dryer reduces the starting air dewpoint to at least 20°F below the coldest anticipated room temperature. The prefilter removes entrained water from the air entering the air dryer and the after-filter removes any desiccant which may become airborne during drying.

The desiccant type air dryer typically produces an air dew point temperature in the range of -40°F, and is very simplistic in design; the only active components being electrical controls, purge valves, relief valves, and a drain trap.

The air receiver tanks are 305 cubic foot, horizontal, cylindrical type with a design pressure of 275 psig at 250°F.

Control of the system is normally automatic during all modes of plant operation. Following receipt of the start signal, starting air is admitted to the engine's cylinders with a cranking cycle duration of approximately three seconds. Once started, the diesel generator will continue to run without the need for starting air other than that required for the diesel generator protective features described in <Section 8.3.1.1.3.2.b>. These protective features are pneumatically operated.

Control air for the diesel generator protective features is supplied from the starting air system's air receiver. Upon loss of starting air pressure, low control air pressure alarms will annunciate on the local control panel and a DG trouble alarm will annunciate in the Control Room. Upon receipt of any one of these alarms any corrective action can then be implemented.

The performance of the diesel generator starting air system filters and strainers for the standby diesel generators is monitored by a pressure sensor located in each of the starting air lines, just upstream of the solenoid valves which admit air to the air header on the engine. The pressure sensors detect pressure downstream of the final strainer in the system and signal an alarm on the engine control panel when starting air pressure is low. The filters and strainers are manually checked for cleanliness during routine testing and inspection.

A normally open valve is provided in the common, safety-related, air receiver tank drain piping. Closure of this valve by operator action and subsequent opening of the air receiver tank drain valves provides for temporary cross-charging capability between the normally independent, redundant sections through the common drain header in the event of air compressor failure or maintenance.

Details of the instrumentation and controls for the standby diesel generator air start system are discussed in <Section 7.3.1>.

9.5.6.3 Safety Evaluation

Each standby diesel generator set, with its attendant starting air system, is located in a separate Seismic Category I structure. No non-Seismic Category I structures or components are located close enough to impair diesel generator starting system operation.

Essential components of the standby diesel generator starting air system are designed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code. The system is classified Safety Class 3 and Seismic Category I from the check valve upstream of the receiver tanks to the connection at the diesel engine. The system is nonsafety from the compressors to the check valve upstream of the receiver tanks. The components located on the standby diesel engine are manufactured to DEMA standards.

The starting air facilities for each of the standby diesel engines are completely redundant with each redundant section capable of supplying enough air for a minimum of five engine starts. The capacity of the starting air system will provide cranking capacity for five cranking cycles, each with a duration sufficient to successfully start the diesel generator. The system can be recharged from minimum starting air pressure to maximum starting air pressure within 30 minutes.

If starting air pressure at the engine from either of the two redundant sections drops below the required minimum, alarms are annunciated both in the main control room and at the local diesel control panel.

The drain/cross-connect valve is located in a safety-related common drain header that is normally open to atmosphere downstream of the safety-related air receiver tank drain valves. The valve is normally open in order to maintain necessary facility/train redundancy. This valve will only be placed in the closed position if it is necessary to cross-charge the starting air receiver tanks in the event of air compressor failure or maintenance.

9.5.6.4 Inspection and Testing Requirements

Proper operation of the air compressors, aftercoolers, dryers, system low pressure alarms, and engine air admission valves will be checked at scheduled intervals to assure their availability. The following will be checked:

a. System pressure control pressure switches automatically start and stop the compressors, as required, to maintain the desired pressure range in their respective receiver tanks.

b. Low pressure alarm signals for low air pressure to the engine are actuated at the designated pressure.

c. Engine air admission valves function properly in response to the engine start control.

d. Pressure gauges on the receiver tanks indicate accurately.

9.5.7 DIESEL GENERATOR LUBRICATION SYSTEM

The sections that follow discuss the lubrication system for the standby diesel generators. This system for the high pressure core spray (HPCS) diesel generator is discussed in <Section 9.5.9.4>.

9.5.7.1 Design Bases

The standby diesel generator lubrication system is designed to supply lube oil to the engine bearing surfaces at controlled pressure, temperature and cleanliness conditions. The system includes provisions for keeping the bearings flooded and the oil warm for fast start purposes. Each standby diesel generator lubrication system is housed in a separate cubicle of a Seismic Category I structure. No non-Seismic Category I structures or components are located close enough to impair standby diesel generator lubrication system operation. Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with applicable regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. Conformance with Branch Technical Position APCSB 9.5-1 is detailed in <Appendix 9A>.

9.5.7.2 System Description

The standby diesel generator lubrication system is shown in <Figure 9.5-11>. The system consists of an oil sump tank with electric heater, an engine driven pump, a lube oil heat exchanger, a duplex filter, and a keepwarm pump. The engine driven pump takes oil from the sump through a strainer, passes it through the lube oil heat exchanger, the duplex filter, and the lube oil strainers and delivers it throughout the engine including the bearings and back to the sump.

Constant oil pressure is maintained on the engine main lube oil header with pressure regulating valves which bypass excess oil flow to the sump.

The circulating lube oil picks up heat from the diesel engine and rejects it to the lube oil heat exchanger.

The lube oil heat exchanger is of the shell and tube type in which lube oil flows through the shell and coolant from the jacket water system flows through the tubes. As a result, during engine operation, the lube oil temperature is maintained by regulation of the jacket water system temperature. The system has been designed and fabricated by the standby diesel manufacturer to provide proper cooling for the lube oil.

The engine driven lube oil pump has a capacity of 500 gpm at 70 psig discharge pressure and operates whenever the diesel generator is in operation. The lube oil sump tank is a cylindrical, two-partitioned, atmospheric type with an integral strainer and a total capacity of 450 gallons.

The system also includes a standby preheating system to keep the engine ready for fast start operation. It consists of a positive displacement, keepwarm pump with a 15 hp, 460 volt, 3 phase, 60 Hertz motor which takes oil from the sump through an electric heater and directs it through a filter, a strainer, to the engine and bearings and back to the sump. The pump has a capacity of 98 gpm with a discharge head of 15 psi. The motor is powered from a safety-related Class 1E motor control center.

The keepwarm pump may be operated with a manual control switch; however, with its control switch in AUTO it will operate continuously with the diesel in standby and will de-energize when the diesel receives a start signal.

Each turbocharger is equipped with a prelubrication system to minimize wear incurred during engine starts. The turbocharger drip system regulates lube oil drip rate to the turbocharger bearings during standby conditions. The lube oil keepwarm pump supplies oil to the turbocharger drip system. The lube oil drip rate is regulated such that the turbocharger bearings are not subjected to “dry” emergency starts and are not lubricated excessively to allow accumulations of oil in the turbocharger housing. The standby diesel engines are subjected to a turbocharger prelubrication period of 2 to 5 minutes prior to every planned engine start to further minimize wear incurred to turbocharger bearings. The turbocharger drip system is designed and installed in accordance with manufacturer's recommendations.

Prelubrication of the engine rocker arms is accomplished concurrent with the above turbocharger prelubrication period through cross-connect tubing and valves between the "normal" and "bypass" turbocharger lube oil supply lines.

The heater in the lube oil is an electric, immersion type with an output of 50 kW and is automatically operated from a temperature switch in the heater assembly to maintain the circulating lube oil at a temperature of approximately 150°F.

The lube oil system is provided with various filters and strainers to maintain the required quality of the lube oil during engine operation. The filters are changed and the strainers are cleaned in accordance with the manufacturer's instructions to assure an adequate supply of clean oil to the engine. In addition, clogged oil filters are annunciated.

The diesel engine manufacturer has provided a specification for the lube oil to be used in the engine. The required oil quality is maintained by performing monthly laboratory analysis on a sample of the lube oil. From the results of the analyses, it is determined if the oil quality has degraded and replacement is necessary.

Several measures are taken to prevent entry of deleterious materials into the lube oil system by personnel error. The valves and entry points used during recharging of lube oil are clearly marked to prevent entry of deleterious materials due to operator error. In addition, new lubricating oil is stored in a designated lube oil storage facility. The storage of lubricants is in containers designed to minimize the possibility of contamination and to provide safe storage. Samples of new oil are taken to verify contents and specifications of oil.

Personnel are trained in the procedures to add lube oil. Training includes the system purpose, basic operation and the system operating instruction which describes lube oil transfer. The instruction includes provisions to eliminate entry of foreign material during the transfer.

Details of the diesel generator starting sequence are discussed in <Section 8.3.1>. The lube oil system for the HPCS diesel generator is discussed in <Section 9.5.9.4>.

9.5.7.3 Safety Evaluation

The standby diesel generator lubrication system is an integral part of the diesel generator. The system meets the single failure criterion, since if a failure in this system prevents the satisfactory operation of the associated diesel generator, the other two divisions of the standby power system <Section 8.3> will provide adequate power to safely shut down the plant or to mitigate the consequence of any of the postulated accidents. There are no shared systems or piping interconnections between systems. The standby diesel generator lubrication system for each diesel is cooled by a separate, redundant, safety-related, cooling water system <Section 9.5.5>.

The design and fabrication of the standby diesel generator lubrication system are in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code, the National Fire Protection Association Standard 37 and DEMA Standards. The standby diesel generator lubrication system is classified Safety Class 3 and Seismic Category I. No protective interlocks in the lubrication system will preclude standby diesel generator operation during LOCA or bus under/degraded voltage operations.

9.5.7.4 Inspection and Testing Requirements

The operability of the diesel generator lubrication system is tested and inspected along with the overall engine during scheduled testing of the engine. Instrumentation is provided to ensure proper operation of the system by monitoring the lube oil temperature, pressure and sump level.

During standby periods, the keepwarm feature of the system is checked at scheduled intervals. This will ensure that the oil is warm enough for quick starting of the engine.

Leakage from the standby diesel generator lubrication system will be detected by lube oil pressure and sump level instrumentation or visual inspection of the system. An increase in the rate of oil level reduction could signify a leak in the system. Lube oil filters and strainers are duplex type to allow for inservice cleaning or replacement.

9.5.8 DIESEL GENERATOR COMBUSTION AIR INTAKE AND EXHAUST SYSTEM

9.5.8.1 Design Bases

The standby diesel generator combustion air intake and exhaust system supplies air of reliable quality to the standby diesel generators and exhausts the products of combustion from the diesel generators through the missile barrier to the atmosphere. The system is designed so that each standby and HPCS diesel generator has its own separate and independent combustion air intake and exhaust system. Also, failure of any one component on one combustion air intake and exhaust system does not lead to the loss of function of more than one diesel generator.

The standby diesel generator combustion air intake and exhaust system is safety-related from the inlet filter to the missile barrier discharge. The exhaust silencer is nonsafety-related since any blockage of the silencer would be automatically bypassed through the missile barrier discharge. The system design conforms with the requirements of GDCs 1, 2, 4, 5, and 17 <Section 3.1>. Guidance presented in <Regulatory Guide 1.26>, <Regulatory Guide 1.29>, <Regulatory Guide 1.68>, <Regulatory Guide 1.102>, and <Regulatory Guide 1.117> has been considered in the design of the system. The degree of conformance with these regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as relates to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have also been considered in the design of this system as discussed in <Chapter 8>.

The standby diesel generator combustion air intake and exhaust system is classified as Safety Class 3, Seismic Category I, except for the crankcase vent lines and exhaust silencers which are nonsafety-related. The system is designed in accordance with the requirements of ASME Code Section III, Class 3, NFPA-37 and DEMA Standards.

9.5.8.2 System Description

Each standby diesel generator combustion air intake and exhaust system consists of two air intake filters, two air intake silencers, expansion joints, two exhaust silencers, and associated piping connecting the equipment.

Combustion air at a rate of 14,078 scfm (each filter) is drawn through 50 percent capacity, oil bath type, air intake filters located in louvered cubicles on the diesel generator building roof. These filters clean the ambient air for admittance to the diesel generator. The air then passes through skid mounted, 50 percent capacity, tubular duct type inlet silencers located in the diesel generator room. These silencers are provided to reduce the noise level in the diesel generator room.

Before being released to the atmosphere, diesel generator exhaust passes through spark arresting type exhaust silencers in parallel at rates of approximately 55,700 cfm and 20,200 cfm. The silencers are mounted on the diesel generator roof and are provided to reduce the noise level in the vicinity outside the diesel generator building.

Several protective features are provided to prevent crankcase explosion. Crankcase pressure is maintained at approximately atmospheric level. During testing, two motor driven blowers draw directly from each crankcase, through oil separators, and discharge the vapor to the atmosphere, outside of the engine room. Crankcase pressure readings are taken to detect changes. Crankcase pressure readings are observed during heavy load operations. Should the pressure go to a high positive reading beyond the diesel trip setpoint, the engine will be shut down immediately except when operating under LOCA or bus under/degraded voltage conditions. Engine covers will not be removed for fifteen minutes after such a trip, to allow fumes and vapors to dissipate. The cause of the high pressure will be determined and corrected before continuing operation. The doors on the crankcase will automatically open if the pressure inside the crankcase exceeds the ambient atmosphere pressure by 0.7 psi.

Details of the standby diesel generator starting sequence are discussed in <Section 8.3.1>.

The intake and exhaust systems contain no flow control devices (louvers, dampers). The standby diesel generator combustion air intake and exhaust systems are shown in <Figure 9.5-12>, and the layout arrangement is shown in <Figure 1.2-6> and <Figure 1.2-13>.

9.5.8.3 Safety Evaluation

Each standby diesel generator is provided with a completely separate and independent combustion air intake and exhaust system. These systems are not redundant since there are three divisions of the emergency power system <Section 8.3>. The elevation of this system is well above the maximum flood design water level <Section 3.4>.

Arrangement and location of combustion air intake and exhaust, as shown in <Figure 1.2-6> and <Figure 1.2-13>, are such that the dilution or contamination of intake air by exhaust products will not preclude the operation of the standby and HPCS diesel generators. Recirculation of standby diesel engine combustion products to the air intakes is prevented by locating the exhaust stacks at a higher elevation away from the intakes. Since hot exhaust gases rise and disperse, significant recirculation into the intakes cannot occur. Combustion gases exhaust from the standby diesel engine at a rate of 30,500 scfm. These gases exhaust through a spark arresting type exhaust silencer. It would be necessary for more than 13.2 percent of the exhaust gas (4,026.4 scfm) to be recirculated into the air intakes to deteriorate operation of the standby diesel generator. This same percentage recirculation, 13.2 percent, would apply to the HPCS diesel generator air intake before degradation of performance would occur.

The exhaust plane of the silencer for the standby diesel generator exhaust system is 44 feet horizontal distance from the air inlet piping and 5’-7” above the high point of the inlet louvers. The exhaust plane of the HPCS diesel exhaust silencer is 29 feet horizontal distance from the air inlet and 6 feet above the high point of the inlet louvers. In both cases, the plume effect and exit velocity of the hot exhaust gases plus the removal distance, with intervening structure blockage, will minimize recirculation.

Additionally, the potential for infiltration of carbon monoxide from a diesel exhaust through the control complex air intakes into the control room has been evaluated. The carbon monoxide is diluted to a low enough concentration to be harmless to the control room operators and will not pose a threat to the safe conduct of operations of the plant.

The accidental release of onsite stored gases (N_2 and H_2) in the yard <Table 2.2-10> will not affect the performance of the diesel generators. The maximum concentration of these gases at the diesel generator air intake was calculated assuming total release of the stored inventory in accordance to <Regulatory Guide 1.78> and are as follows:

Stored Gas	Stored Inventory in Yard	Gas Concentration % by Vol.	O_2@ Intake % by Vol.
N_2	102,646 ft^3	9.5	18.9
CO_2	4 tons	7.5	19.4
H_2	7,387 ft^3	5.5	19.8

The required oxygen content at the diesel air intake, to ensure no degradation of the diesel generator performance, is 18 percent by volume, which is equivalent to a gas concentration at the intake of 14.3 percent by volume.

The only plant carbon dioxide fire extinquishing systems in the vicinity of the emergency diesel generator air intakes are located within the diesel generator rooms and in the control complex. If the carbon dioxide fire extinguishing system is activated for a diesel generator room, the fire dampers for the respective room are automatically closed and the area isolated to prevent air, smoke or carbon dioxide from being exhausted. The isolated area will remain isolated until the fire is controlled and it is determined that gases can be safety vented from the isolated area. In the diesel generator room, the gases are vented from the exhaust outlets, which are remote from the air intake vents and at a higher elevation, as described above.

Any gases released from an isolated area would be a less critical situation than described above by a single release from the onsite storage of gases.

If a postulated fire occurred in the 500,000 gallon fuel oil storage tank located above ground and over 650 ft from the intakes, it would be controlled using a foam extinguishing system discussed in <Section 9.5.1>. The foam is composed of water, foam concentrate and air. The concentrate is proportioned with water at a 3 to 4 percent concentration and air is induced into the resulting solution to form foam bubbles. The foam bubbles form an extinguishing blanket which excludes oxygen from the seat of the fire and extinguishes it. No carbon dioxide is involved or generated in the extinguishing process.

An analysis made of the actual burning process, assuming ideal combustion, results in a carbon dioxide generation rate of 4,270 lb/min. The total combustion gases would be approximately 20,900 lb/min. Very high flame temperature, in the vicinity, of 3,000°F would exist during such a fire. The large temperature difference between the fire and the atmosphere would cause a significant stack effect. Under low wind conditions, the stack effect could be several thousand feet and would not drop below several hundred feet with higher winds over 39.6 ft/sec. The results of assuming the minimum stack effect and a 12 m/sec wind speed indicates a maximum gas concentration at the intakes of 5.45×10^{-22} lb/min of combustion products. Slower wind speeds would result in lower concentration due to the higher stack effect.

It has been determined that the postulated fire in the 500,000 gallon fuel oil storage tank described above would be the most critical case in reference to the diesel generator air intake quality and other postulated fires, including the ESF and interbus transformers.

The essential system components exposed to atmospheric conditions such as ice and snow are protected from possible clogging during standby or operation of the system. The essential portions of the system are housed within Seismic Category I structures provided with louvers. The standby diesel generator combustion air intake and exhaust system components and piping are protected from missiles, pipe whip and jet impingement that might result from piping cracks or breaks. Refer to <Section 3.5> and <Section 3.6> for a discussion of missile and pipe whip protection. The system components and piping are designed or protected from the effects of earthquakes, floods, tornadoes, and internally and externally generated missiles.

The first part of the exhaust pipe and the missile barrier discharge on the exhaust system are tornado missile protected. A horizontal barrier and a vertical barrier protect the missile barrier discharge from a tornado missile.

The diesel generator electrical equipment associated with the starting of the diesel engines are enclosed in a National Electrical Manufacturers Association (NEMA) Type 12 enclosure. The enclosures are designed to protect the enclosed electrical equipment against fibers, filings, dust, dirt, lint, light splashing, seepage, dripping, and external condensation of noncorrosive materials, thus ensuring that the electrical equipment associated with the starting of the diesel generators will not cause the diesel generator to become inoperable due to the accumulation of foreign material.

The design of the diesel generator rooms' ventilation system incorporates certain features to minimize entry of dust and foreign material. The rooms' ventilation system operates whenever the diesel generator operates. During normal operation of the plant when the diesel generators are not operating, the two ventilation fans for each diesel generator are inactive, and the inactive supply fans are isolated from the outside environment by controlled dampers. The design of the air inlets also renders them unaffected by snow, freezing rain or sleet. During normal plant operation, periodic test and maintenance will be performed on the fans, dampers, controls, and starting system; this will ensure their reliability and ability to function when necessary with equipment and personnel access doors kept closed.

The ingestion of dust and other deleterious materials into the diesel generator combustion air intake and exhaust system is precluded by the use of an air filter on the combustion air intake lines of the standby diesel generators. The filters will be cleaned on a periodic basis per the preventive maintenance program.

The cabinets in the areas are dust tight NEMA Type Three by design specification. The floors and walls were coated with an epoxy surfacer to protect its finish.

Any concrete dust generated by maintenance is controlled by the housekeeping procedure, PAP-0204, as will all waste, debris, scrap, oil spills, or other combustibles resulting from the work activity. These shall be removed from the area immediately following completion of the maintenance activities or at the end of each work shift, whichever comes first. In addition, the areas shall be routinely inspected for proper housekeeping requirements and any discrepancies shall be noted and corrected.

9.5.8.4 Inspection and Testing Requirements

Each system is tested in accordance with the manufacturer's recommendations during initial tests and operation. The standby diesel generators are operated every month for periodic testing. Operation of diesel generator combustion air intake and exhaust system components is verified during this testing. Additional inspection, checkout and maintenance are performed as required.

9.5.8.5 Instrumentation Applications

The diesel generator combustion air intake and exhaust system is instrumented as shown on <Figure 9.5-12>. A pressure indicator is provided on the local diesel generator control panel which displays intake manifold air pressure. Either the left or right bank pressure may be selected for display through use of a manual slide valve. A temperature selector switch and temperature indicator are also located on the local diesel generator control panel. By using the selector switch, one of the following temperatures may be selected for display: intake manifold air temperature, either the left or right bank; exhaust stack gas temperature, either the left or right bank; or each individual cylinder exhaust gas temperature. The selector switch and temperature indicator may also be used for local display of jacket water and lubrication oil temperatures.

The diesel generator combustion air intake and exhaust system parameters which are displayed on the local diesel generator control panel are logged during the periodic engine testing. This information is used for engine performance monitoring, trending and engine malfunction diagnostics.

9.5.9 HIGH PRESSURE CORE SPRAY DIESEL GENERATOR

The sections that follow discuss the applicable high pressure core spray (HPCS) diesel generator auxiliary systems.

The HPCS system power supply unit is a part of ECCS system power supplies. The HPCS diesel generator, by itself, does not meet the single failure criterion. However, this criterion is met at the system level.

9.5.9.1 HPCS Diesel Generator Fuel Oil Storage and Transfer System

The sections that follow discuss the fuel oil storage and transfer system for the HPCS diesel generator.

9.5.9.1.1 Design Bases

Separate fuel oil storage and transfer facilities are provided for the HPCS diesel generator to provide sufficient fuel oil for at least seven days of operation carrying the design electrical load. This storage capacity criterion is considered adequate as discussed in <Section 9.5.4.1>. Tank trucks will deliver the fuel oil to a central fill station. Availability of diesel fuel oil from local distribution sources is discussed in <Section 9.5.4.1>.

All system components are accessible for an inservice inspection without affecting the availability of fuel to the HPCS diesel generator.

Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Position APCSB 9.5-1, as related to fuel oil system fire protection, is detailed in <Appendix 9A>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have also been considered in the design of this system, as discussed in <Chapter 8>.

The specific Emergency Diesel Generator (EDG) fuel oil volumes contained in the diesel fuel oil storage tank(s) necessary to ensure that EDG run-duration requirements are calculated using <Section 5.4> of American National Standards Institute (ANSI) N195-1976, "Fuel Oil Systems for Standby Diesel-Generators", and are based on applying the conservative assumption that the EDG is operated continuously at rated capacity. The "rated capacity" methodology, which is described in ANS-59.51/ANSI N195-1976, is used for calculating the fuel oil storage requirements for the Division 3 Diesel Generator. This method is used because the Division 3 Diesel Generator is loaded to near full capacity. This fuel oil calculation methodology is one of the two approved methods specified in Regulatory Guide (RG) 1.137, Revision 1, "Fuel Oil Systems for Standby Diesel Generators", Regulatory Position C.1.c.

9.5.9.1.2 System Description

An independent and physically separate diesel generator fuel oil storage and transfer system is provided for the HPCS diesel generator. The HPCS diesel generator fuel oil storage and transfer system consists of one diesel fuel oil storage tank, one diesel fuel oil day tank, two diesel fuel oil transfer pumps, one diesel generator set, and necessary piping, valves, strainers, filters, and instrumentation. A diagram of the system is shown in <Figure 9.5-15>.

The underground storage tank is of the horizontal type and is located outside the diesel generator building. The tank has a nominal capacity of 39,375 gallons sufficient to operate the diesel generator for 7 days while supplying post-LOCA design maximum electrical load demands. This volume also includes capacity for operability testing. The storage tank is provided with a flame arrester which prevents the ignition of flammable vapors on one side of the arrester if the other side is exposed to an ignition source. The storage tank is internally protected with a corrosion inhibiting coating. The outside of the tank is covered with a prime coat and finish coat of paint.

The design of the fuel oil storage tank fill system with respect to minimizing the creation of turbulence of the sediment in the tank is discussed in <Section 9.5.4.2>.

The day tank is located in the diesel generator building and has a capacity of 555 gallons. The day tank is fitted with a flame arrester.

Two transfer pumps transport fuel between the storage tank and the day tank. The transfer pumps are located close to the day tank in the diesel generator building. Each pump motor is 15 horsepower, 460 volts, 3 phase, 60 Hz and is fed from a Class 1E motor control center. Each pump has a capacity of 90 gpm at a discharge head of 200 feet.

The fuel oil transfer pumps may be operated with manual control switches; however, they are normally operated automatically by the level switches on the day tanks. During normal system operation, day tank fuel oil level drops as the result of fuel consumption by the engine. When fuel level drops to the primary pump low level setpoint, the primary pump starts and begins to refill the day tank. The fuel level continues to increase to the primary pump stop setpoint, where the primary pump stops.

In the event that the fuel oil level in the day tank should continue to drop below the low level setpoint to the low-low-low primary pump setting, the primary pump will stop. As the level continues to fall due to fuel oil consumption by the EDG, the secondary pump low level setpoint will be reached and the secondary pump will start. Upon restoring level to the secondary pump high level setpoint in the day tank, the secondary pump will stop. As the day tank level increases from secondary pump operation, the primary pump low-low-low stop is automatically reset, allowing the primary pump to function automatically. This occurs when the fuel oil level rises above the low-low-low stop reset for the primary pump.

In the unlikely event that the fuel oil level should drop to the secondary pump low-low-low level setpoint in the day tanks, the secondary pump will stop. This is the minimum safe level for operation of the pumps.

An overflow line is provided from the day tank to the associated diesel fuel oil storage tank to provide a closed recirculation loop. Because the day tanks are always full, corrosion of these tanks are minimized.

The diesel oil day tanks are located inside the diesel generator building, a Seismic Category I structure. The connecting diesel oil piping is physically separated from all hot surfaces or other potential ignition sources within the diesel generator room.

The location of the day tanks meets the following requirements of the diesel engine manufacturer:

a. There should not be a positive fuel head on the engine injectors.

b. Suction of the fuel oil booster pump and the engine driven fuel pump should remain flooded.

One engine driven fuel oil pump is supplied with and located on the HPCS diesel engine. This pump, which is driven by the diesel engine, has a rated capacity of 4.0 gpm at 60 psig and will be used to supply fuel from the day tank to the diesel engine fuel injectors. During startup of the diesel generator, there is also a motor driven fuel oil pump which transfers fuel from the day tank to the fuel injectors. The motor driven fuel oil pump motor is 1/4 horsepower and 125 Vdc and is fed from its respective Class 1E dc power source. The motor driven fuel oil pump has a rated capacity of 3.6 gpm at 60 psig. The initial responsibility of the motor driven fuel oil pump is to prime the fuel oil system tubing and components downstream of the engine driven fuel oil pump after maintenance, in order to purge any air trapped in the system. This pump also starts automatically upon receipt of an engine start signal and continues to operate with the engine as a backup to the engine driven fuel oil pump.

The fuel pumps draw more fuel oil from the day tank than is consumed by the engine. The excess fuel is returned to the day tank by a separate return line. The transfer pump transfers fuel oil to the day tank at a much higher rate than the fuel pump draws out. In the event of oversupply, the excess fuel will be returned to the storage tank through a separate overflow line. The day tank is located above the suction elevation of the fuel oil booster pump to assure a slight positive pressure on the booster pump inlet.

The eductor inlet of each storage tank is 18 inches from the tank bottom to prevent any sediment that accumulates from entering the day tank.

A strainer in the inlet lines to each of the HPCS diesel fuel pumps (priming or booster) and a duplex filter in each line from the fuel pumps to the engine are provided to remove particulates which could hamper engine operation. To further purify the oil, the injector assemblies each contain filters, one in the inlet and one in the return line to the day tank. Maintaining the day tank full at all times will also minimize the accumulation of any appreciable amount of water.

A break in the fuel oil transfer line, from the transfer pump to the day tank, is detected by a low level in the day tank. The low day tank level is alarmed in the control room.

All storage and day tanks are located at sufficient distance from the plant control room to preclude any danger to control room personnel or equipment resulting from explosion and/or fire.

The diesel fuel oil is grade No. 2-D in compliance with the requirements discussed in <Section 9.5.4.4>.

The diesel fuel oil storage and transfer system conforms to <Regulatory Guide 1.137> and ANSI N-195 with exceptions as discussed in <Section 1.8>.

Component data for the diesel generator fuel oil system is shown in <Table 9.5-3>.

9.5.9.1.3 Safety Evaluation

The HPCS diesel generator fuel oil storage and transfer system, except for components located on the diesel generator skids, is designed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code, the National Fire Protection Association Codes 30 and 37 and State of Ohio safety regulations.

All underground fuel oil lines and lines which extend above grade outside the diesel generator building are ASME Section III, Class 3, Seismic Category I and missile protected for the first six inches above grade. This includes vents, overflow, dipstick, water removal, and fill lines. Components located on the diesel generator skids are designed and manufactured to DEMA standards. The system is classified Safety Class 3 and Seismic Category I.

The fuel oil day tanks are located no less than ten feet from the exhaust manifold piping. In addition, the day tanks are protected to obtain a three hour fire resistance rating. The fuel oil piping is routed such that the nearest distance to hot surfaces is at the connection to the diesel engine.

Corrosion protection for tanks and piping is discussed in <Section 9.5.4.3>.

9.5.9.1.4 Inspection and Testing Requirements

Proper operation of the transfer pumps and the level alarm signals are checked at scheduled intervals to assure their availability. This includes checks of the following:

a. Primary transfer pumps start and stop automatically at the desired levels.

b. Standby transfer pumps start and stop automatically at the desired levels.

c. Alarm signals for high and low day tank levels function at the designated levels.

d. Low level signals for the storage tanks function at the designated levels.

The HPCS diesel generator fuel oil storage and transfer system is designed to permit periodic testing as described in <Section 8.3> and has been designed to provide accessibility to all active components for periodic inspection and maintenance. The operability of the HPCS diesel generator fuel oil storage and transfer system is demonstrated during the regularly scheduled diesel generator tests.

9.5.9.1.5 Instrumentation Requirements

The HPCS diesel generator fuel oil storage and transfer system is provided with controls for automatic transfer of fuel oil from storage tanks to the day tanks. In addition, alarms and indicators of sufficient number and at appropriate locations are provided to ensure that the operator can determine system status and operation from the control room. Details of the instrumentation and controls for the HPCS diesel generator fuel oil storage and transfer system are presented in <Section 7.3.1>.

9.5.9.2 HPCS Diesel Generator Jacket Water Cooling System

A schematic diagram which shows the relationship between the HPCS diesel generator jacket water cooling system and the other parts of the HPCS diesel generator is found in <Figure 9.5-16>.

9.5.9.2.1 Design Bases

a. The HPCS diesel generator jacket water cooling system is designed to remove sufficient heat from the diesel generator assembly to permit continuous operation at maximum load. Heat removed from the system is transferred to the emergency service water system <Section 9.2.1>.

b. The system is also designed to provide heat to the engine to maintain it in a standby condition.

9.5.9.2.2 System Description

A separate jacket water cooling system is provided for the HPCS diesel generator.

The HPCS diesel generator jacket water cooling system is supplied as a part of the diesel generator structure, and connects to the emergency service water system. Heat from the diesel generator in the engine jacket water cooling system is dissipated into a closed loop in which coolant is circulated through the engine, the lube oil cooler and the turbocharger after-coolers by means of two engine driven pumps. The closed jacket water cooling system consists of an immersion heater, expansion tank, temperature regulating valve, lube oil cooler, two engine driven pumps, and jacket water cooler.

The immersion heater is thermostatically controlled and maintains the jacket water at a steady temperature during standby condition.

The immersion heater is 15 kW, 460V ac, 3 phase, 60 Hz, and is fed from its associated Class 1E motor control center. During engine shutdown conditions, jacket water will circulate through the lube oil cooler, as described below, to warm the lubricating oil which is circulated by an ac motor driven pump. This keepwarm feature will provide the engine with capability of quick start and load acceptance. The engine low lube oil temperature condition is alarmed locally and annunciated on the main control room HPCS diesel generator trouble alarm.

The closed loop jacket water cooling system connects to an external heat exchanger which dissipates heat to the emergency service water system.

The engine of the HPCS diesel generator is provided with two 50 percent capacity pumps. Both pumps are driven by the diesel engine. When the diesel engines are in the standby condition, the cooling water is maintained at a constant temperature by the electric immersion heater. The jacket water heater element is installed near a low point in the diesel generator jacket water supply, and by natural convection circulation, the hot water from the heater, by being less dense, rises causing a natural flow. This flow causes a thermosyphon effect drawing water over the heater. The heat conduction from the water channels in the lube oil cooler and the engine will keep the lube oil, as well as the engine block, warm. The jacket water heater is set to maintain the engine in a prewarmed condition which is monitored by a temperature switch which annunciates the lube oil low temperature alarm on the local panel and the HPCS diesel generator trouble alarm in the control room.

Operating experience has demonstrated that a motor driven jacket water keepwarm pump is not necessary. This keepwarm feature helps to provide the engine with high reliability and enhances its capability of quick start and load acceptance.

The HPCS diesel generator jacket water cooling system also provides a sufficient heat sink to permit a hot HPCS diesel engine to start and operate for 2 minutes without emergency service water flow through the diesel generator jacket water cooling system heat exchanger. Emergency Service Water flow is initiated well before 2 minutes even considering the following delay sequence; an initial delay of 13 seconds for the HPCS diesel generator to provide power to the bus; followed by a 28 second setpoint on a load sequencing time delay relay; and lastly a delay of approximately 5 seconds for the ESW discharge valve to stroke open, which subsequently initiates pump operation via the limit switches.

The HPCS diesel generator jacket water cooling system has a built-in provision to assure all components and piping are completely filled with water by having two system high point vents, one coming off the manifold, and the other coming off the water side of the lube oil cooler. These high point vents are attached directly to the cooling water expansion tank to maintain the closed system. In addition, there is a low positive pressure in the system from the engine-driven jacket water circulating pump which helps drive out any entrapped air in the system.

The high point vents are of adequate size upon startup to remove air in the crossover manifold, above the expansion tank, to prevent the air from reaching the circulating pumps and causing binding.

The system leakage during seven days of continuous operation is conservatively estimated to be less than one gallon. Capacity of the expansion tank is approximately 88 gallons, therefore, sufficient capacity is provided so as not to require a continuous make-up source.

In addition, the tank provides a constant head source to the pumps and is located approximately 18” above the pumps suction line. Minimum water level is maintained in the tank to provide NPSH requirements under all operating conditions.

The HPCS diesel generator cooling water is treated as appropriate to preclude long term corrosion and organic fouling.

Demineralized water is used for makeup to the HPCS diesel generator jacket water cooling system. In the unlikely event that both the immersion heater and the diesel generator ventilation system fail, with concurrent severe weather conditions, ethylene glycol antifreeze may be added per manufacturer’s recommendations. Since failure of these support systems would render a diesel generator inoperable, without corrective action, plant alarm response instructions provide adequate assurance that action would be taken.

These additives are compatible with the carbon steel material construction of the jacket water cooling water system for diesel generators and manufacturer’s recommendations. Water chemistry complies with generally accepted water quality standards of the industry.

A diagram of the diesel generator cooling water system is shown in <Figure 9.5-16>. Component data for the diesel generator cooling water system is shown in <Table 9.5-4>.

9.5.9.2.3 Safety Evaluation

The HPCS diesel generator jacket water system piping is designed in accordance with the requirements as detailed in <Table 3.2-1>. Components located on the diesel generator skid are designed to DEMA standards except for the jacket water heat exchanger which is designed to the requirements of Section III of the ASME Boiler and Pressure Vessel Code.

The HPCS diesel generator cooling water system is Seismic Category I. Each diesel generator set, with its attendant cooling water system, is located in a separate Seismic Category I structure. No non-Seismic Category I structures or components are located close enough to impair diesel generator cooling. The system is classified Safety Class 3, as detailed in <Section 3.2>.

9.5.9.2.4 Inspection and Testing Requirements

To ensure the availability of the HPCS diesel generator cooling water system, scheduled inspection and testing of the equipment are performed as part of the overall engine performance checks. Instrumentation is provided to monitor cooling water temperatures, pressure and head tank level. These instruments will receive periodic calibration and inspection to verify their accuracy.

During standby periods, the keepwarm feature of the engine jacket water cooling closed loop system is checked at scheduled intervals. This will ensure that the water jackets are warm enough to assist quick starting of the engine.

The HPCS diesel generator cooling water system is designed to permit periodic testing and inspection of all components. Periodic testing is described in <Section 8.3.1>.

The HPCS diesel generator cooling water system operability is demonstrated during the regularly scheduled tests of the diesel generators. The frequency of these tests is given in Technical Specifications. The system was hydrostatically tested prior to initial startup. The cooling water is sampled and analyzed periodically to verify that its quality meets the diesel manufacturer's recommendations.

9.5.9.2.5 Instrumentation Requirements

Instrumentation for each HPCS diesel generator cooling water system consists of two locally mounted temperature switches in the engine outlet line. The first switch is used to alarm on the local control panel in the event of high coolant temperature. The second switch is used to automatically shut down the engine in the event of high-high coolant temperature. This trip is bypassed on a LOCA start signal. A diesel generator trouble alarm actuates in the main control room if any of the alarms on the panel annunciate. A list of alarms used in the HPCS diesel generator water cooling system is provided in <Section 8.3.1.1.3.3>.

9.5.9.3 HPCS Diesel Generator Air Starting System

A functional block diagram which shows the relationships between the HPCS diesel generator air starting system and the other parts of the HPCS diesel generator is found in <Figure 9.5-24>.

9.5.9.3.1 Design Bases

a. The diesel generator air starting system for the HPCS diesel engine is provided with independent and redundant starting trains, with each train capable of starting its respective engine five times without recharging the associated air receiver.

b. The starting system initiates an engine start so that within 13 seconds after receipt of the start signal the diesel generator is operating at rated speed, voltage and frequency.

c. The portions of the starting system essential to the starting of a diesel engine are of Seismic Category I design. The entire HPCS diesel generator air starting system is housed within a Seismic Category I structure capable of protecting the system from extreme natural phenomena, missiles and the effects of pipe whip, jet impingement and water spray from high- and moderate energy pipe breaks <Section 3.5> and <Section 3.6>. The HPCS diesel generator air starting system is a Safety Class 3 and quality group as described in <Section 3.2> and detailed in <Table 3.2-1>.

d. The HPCS diesel generator air starting system meets IEEE 323 and IEEE 344 as described in <Section 3.11> and <Section 3.10>. Detailed summaries of qualification data are provided in the tables in <Section 3.11> and <Section 3.10>.

e. Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with applicable regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have been considered in the design of this system as described in <Chapter 8>.

9.5.9.3.2 System Description

A separate diesel generator air starting system is provided for the HPCS diesel generator. Each division of the ECCS has its own separate diesel generator air starting system, each of which is independent and physically separated from other divisions.

The starting system for the diesel generator is shown in <Figure 9.5-24> and consists of the following components and associated piping, valves, and controls:

a. Starting air compressors

b. Starting air receivers

c. Starting air motors

d. Starting air dryers

<Table 9.5-5> contains the applicable data for these components. A starting system consisting of two redundant trains is provided. Each train contains one air receiver connected to one starting air motor system. The two air receivers are charged by an individual compressor associated with that particular air receiver. The Division 3 compressors have 10 horsepower, 460V ac, 3 phase, 60 Hertz electric motor drives. These motors are non-Class 1E. Each compressor is fed from its associated Class 1E motor control center. The power supply to these motor control centers is provided from the Class 1E HPCS bus. The air is delivered to the air receiver by the air compressors where it is stored above 210 psig until it is needed to start the diesel engine. Upon leaving the compressor, the air enters an air dryer, which removes moisture from the air, reducing the starting air dewpoint to at least 20°F below the coldest anticipated room temperature. The air dryer operates only when the related compressor is operating. Each air dryer has a high dewpoint alarm which annunciates on the local panel and on the common diesel trouble alarm in the control room. To minimize the problems of particle carry over, wye strainers are provided in the start

system piping. Inspection and cleaning of the system components will be made after the initial runs during the installation period. It is expected that after the initial trial runs, all loose particles will either collect at the strainer or get blown out. Both compressors operate in response to system pressure switches and start automatically before the respective receiver pressure drops to 210 psig, and shut off before the air pressure reaches 250 psig. The non-Class 1E motors are removed from the circuit during accident/abnormal conditions, (LOCA, LOOP) by undervoltage and LOCA auxiliary relay contacts.

On receipt of the engine start signal (whether in normal or emergency start), a normally closed solenoid valve is opened and air flows to the piston for the pinion gear of the lower motor. The entry of air moves the pinion gear forward to engage with the engine ring gear. Movement of the pinion gear uncovers a port, allowing air pressure to be released to the upper motor pinion gear piston which in turn engages its pinion gear with the engine ring gear. Full engagement of the upper pinion gear permits air flow to the air valve which in turn opens the air starting valve and releases the main starting air supply. Starting air passes through the air line lubricator, releasing an oil air mist into the starting motors. The motors drive the pinion gears, rotating the ring gear and cranking the engine. Only two of the air motor pinions need to be engaged to the flywheel ring gear of each diesel engine to start the engine. However, all four of the air motor pinions are normally engaged to the flywheel simultaneously to improve starting reliability, and to further ensure positive starting. Both solenoids are energized simultaneously and both banks of dual starting motors crank the engine to start in the required time.

The following measures have been taken in the design of the HPCS diesel generator air starting system to preclude the fouling of the air start valve or filter with moisture and contaminants such as oil carry-over and rust.

a. The air for the diesel is delivered to the air receiver by the air compressors where it is stored above minimum standby pressure until required to start the diesel engine. Upon leaving the compressor, the air enters an air dryer, which removes moisture from the air. Each air dryer has four prefilters to remove moisture and particulate contamination in the air flow.

b. The HPCS diesel generator air start system has redundant trains. Failure of one train will not prevent the other train from starting.

c. Wye strainers are provided in the air start system piping to minimize particulate carry-over. Inspection and cleaning of the system components is performed periodically in accordance with manufactures requirements.

d. Fouling of the air start valve by oil carry-over is precluded by the air lubricator being located downstream of the air start valve.

9.5.9.3.3 Safety Evaluation

The diesel generator air starting system has two redundant air start component trains.

Essential components of the HPCS diesel generator air starting system are designed in accordance with the requirements of Section III of the ASME Boiler and Pressure Vessel Code. The system is classified Safety Class 3 and Seismic Category I from the check valve upstream of the receiver tanks. The components located on the HPCS diesel generator skid are manufactured to DEMA standards.

The HPCS diesel generator set, with its attendant air starting system, is located in a Seismic Category I structure. No non-Seismic Category I structures or components are located close enough to impair diesel generator air starting system operation. The system is classified Safety Class 3 as detailed in <Section 3.2>.

The air starting facilities for the diesel engine are completely redundant with each redundant section capable of supplying enough air for a minimum of five engine starts. The capacity of the air starting system will provide cranking capacity for five cranking cycles per train, each with a duration sufficient to start the diesel generator without operation of the compressors. The system can be recharged from minimum starting air pressure to maximum starting air pressure within 30 minutes.

The control panel for the HPCS diesel generator has an indicator light to signal low starting air pressure in the system <Section 8.3.1.1.3.3.b.10>.

There are no cross connections between the air starting systems of the diesel generator units - the loss of one diesel generator and its associated load group will not prevent safe shutdown of the reactor.

Air dryers ensure high reliability of the critical components of the HPCS diesel generator air starting system by eliminating the introduction of moisture and particulate contamination of the starting air supply.

The HPCS diesel generator air starting system air receivers (storage tanks) are provided with drains which may be opened periodically to remove moisture. This minimizes formation of rust within the system. In addition, the system piping for the HPCS diesel generator is provided with an air strainer installed before the starting air solenoid valve at an elevation lower than the engine inlet, and has a drip leg to provide for removal of any water which may be present in the lines. The HPCS diesel generator air starting system piping is provided with a strainer before the starting air solenoid valve, which removes particulates that might be present in the lines.

9.5.9.3.4 Inspection and Testing Requirements

The HPCS diesel generator air starting system is designed to permit periodic testing and inspection of all components.

The system operability is demonstrated during the regularly scheduled tests of the diesel generators. The frequency of these tests is given in Technical Specifications. The system was pressure tested prior to initial startup. Further discussion of the periodic testing requirements is provided in <Section 8.3.1>.

Proper operation of the air compressors, aftercoolers, dryers, system low pressure alarms, and the engine air admission valves will be checked at scheduled intervals to assure their availability. The following will be checked:

a. System pressure control pressure switches automatically start and stop the compressors, as required, to maintain the desired pressure range in their respective receiver tanks.

b. Low pressure alarm signals for low receiver tank pressure.

c. Engine air admission valves function properly in response to the engine start control.

d. Pressure gauges on the receiver tanks indicate accurately.

e. Air dryer high dewpoint alarms.

9.5.9.3.5 Instrumentation Requirements

Instrumentation for each HPCS diesel generator air starting system consists of four locally mounted pressure switches which monitor the air pressure in the air receiver tanks. Two air pressure switches, one per air receiver tank, automatically start the associated air compressor before system pressure drops to 210 psig, and stops the compressor before pressure rises to 250 psig. Another pressure switch on each air receiver tank is used to give a low pressure alarm on the local control panel, and input to the common trouble alarm in the main control room. If this alarm annunciates and the compressors have not automatically started at the required pressure, they will be manually started from the local control panel. Additionally, there is a high dewpoint alarm for each air dryer which annunciates at each local panel and on the common diesel trouble alarm in the control room.

9.5.9.4 HPCS Diesel Generator Lubrication System

A functional block diagram which shows the relationships between the HPCS diesel generator lubrication system and other parts of the HPCS diesel generator is found in <Figure 9.5-25>.

9.5.9.4.1 Design Bases

a. The HPCS diesel generator lubrication system is designed to supply lube oil to the engine bearings and moving parts at controlled pressure, temperature and cleanliness conditions.

b. The HPCS diesel generator lubrication system includes a keepwarm feature, and a soakback oil subsystem. The keepwarm feature maintains a steady lube oil temperature and maintains oil levels in the oil galleries for adequate upper engine lubrication upon startup. The soakback oil subsystem pre-lubricates the turbocharger bearings.

c. Each HPCS diesel generator lubrication system is of Seismic Category I design and is housed within a separate Seismic Category I structure capable of protecting the system from extreme natural phenomena, missiles and the effects of pipe whip or jet impingement from high and moderate energy pipe breaks.

d. Conformance with applicable GDCs is discussed in <Section 3.1>. Conformance with applicable regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. Conformance with Branch Technical Position APCSB 9.5-1 is detailed in <Appendix 9A>.

e. The HPCS diesel generator lubrication system is Seismic Category I, Safety Class 3 as described in <Section 3.2> and is detailed in <Table 3.2-1>.

9.5.9.4.2 System Description

A separate diesel generator lubrication system is provided for the HPCS diesel generator. The diesel generator lubrication system consists of lube oil pumps, lube oil sump pan and lube oil cooler, together with associated piping, valves, filters, strainer, and controls. The lube oil sump for the HPCS diesel engine is integral with the engine. The lube oil is warmed through the lube oil cooler as described in <Section 9.5.9.2.2> while in standby. The detailed arrangement is shown in <Figure 9.5-25>. <Table 9.5-6> contains applicable data for the above components.

The system provides lubricating oil to all moving parts of the diesel engine and rejects the heat picked up during circulation to the diesel jacket water cooling system via the lube oil cooler. The diesel engine jacket water cooling system is designed to absorb all the heat carried from the engine by the lube oil system. The thermal characteristics and design margin of the cooling water system are shown in <Table 9.5-4>. No external cooling is needed for the lube oil system.

The lube oil circulating system is comprised of two primary circulation loops. The first loop is for the turbocharger soakback function, which provides oil for cooling and lubrication to the turbocharger during standby. The turbocharger soakback loop is comprised of an ac driven pump with a dc driven backup pump, a soakback filter and associated strainers, valves and piping.

The ac motor driven soakback pump has a 3/4 horsepower, 460 volts, 3 phase, 60 Hz motor powered from a nonsafety-related motor control center. This pump normally operates continuously with the diesel engine in standby and also when the engine is operating. This pump is controlled by a manual control switch in the HPCS diesel generator room.

The dc motor driven soakback pump has a 3/4 horsepower 125 Vdc motor fed from its respective Class 1E dc power source. The dc motor-driven soakback pump normally operates automatically upon loss of discharge pressure from the ac motor-driven soakback pump during engine operation or during the soakback period following an engine run.

Either soakback pump takes suction from the engine sump and discharges to the soakback filter, followed by the turbocharger, and then drains to the engine sump.

The secondary loop circulates oil from the sump, through the main lube oil filter and cooler and returns oil to the sump. This loop is for the keepwarm function and also maintains oil levels in the oil galleries to provide for adequate engine lubrication upon startup. The circulating loop is comprised of an ac driven pump, strainers, valves and interconnecting piping to the other engine skid mounted equipment.

The lube oil circulating pump motor is a 1 horsepower, 440 volts, 3 phase, 60 Hz and is powered from a safety-related Class 1E, 480 volt motor control center. This pump normally operates continuously when the HPCS diesel engine is in standby, and de-energizes upon engine start up. This lube oil circulating pump is controlled by a manual switch on the local engine control panel.

The primary lubrication system which supports HPCS diesel engine operation is comprised of three independent circulation loops. These are the main lubricating loop, the piston cooling loop and the scavenging oil loop. Each loop has its own engine driven pump. The main lube oil pump and the piston cooling oil pump, although individual pumps, are both contained in one housing and driven from a common drive shaft. The scavenging oil pump is a separate pump.

The main lubricating loop supplies oil under pressure to most of the moving parts of the engine. The main lube oil pump takes oil from the oil strainer housing and pumps it into the main oil manifold. Maximum oil pressure in this loop is limited by a relief valve in the passage between the pump and the main oil manifold which relieves pressure by discharging oil to the engine sump. Oil from the main oil manifold is supplied to the crankshaft bearings, connecting rod bearings and crankshaft vibration damper. Oil from the manifold is then supplied to the engine’s rear gear train, the camshafts and finally to the turbocharger via the turbocharger oil filter. Oil from the camshafts lubricates the camshaft bearings and also supplies the rocker arm assemblies. Leak off from lubricated components drains to the engine sump.

The piston cooling loop consists of the piston cooling oil pump and the piston cooling oil manifolds. The piston cooling oil pump has a common suction line with the main lube oil pump. The piston cooling oil pump discharges oil to the two piston cooling oil manifolds, which extend the length of the engine, one on each side. A piston cooling oil pipe at each cylinder directs a stream of oil to the underside of each piston to provide cooling to the piston and lubrication to the piston pin bearing.

The scavenging oil loop consists of the scavenging oil strainer, the scavenging oil pump, the lube oil filter, and the lube oil cooler. The scavenging oil pump takes oil through the scavenging oil strainer from the engine oil sump and discharges to the oil filter and then to the oil cooler. The oil is returned to the oil strainer housing to supply the main lube oil and piston cooling oil loops with cooled and filtered oil. Excess oil supplied to the strainer housing spills over a dam in the strainer housing and returns to the engine oil sump.

9.5.9.4.3 Safety Evaluation

The HPCS diesel generator lubrication system is an integral part of the diesel generator. There are no shared systems or piping interconnections between systems. The HPCS diesel generator lubrication system is cooled by the HPCS diesel generator cooling water system <Section 9.5.9.2>.

Components of the HPCS diesel generator lubrication system are entirely located on the diesel generator skids and are designed to DEMA standards, NFPA 37 and Seismic Category I requirements. The lubrication system piping is also designed, fabricated and tested in accordance with standards noted in <Table 3.2-1>. No protective interlocks in the lubrication system will preclude HPCS diesel generator operation during emergency operations.

The lubrication system is designed to Seismic Category I requirements and is housed inside a Seismic Category I Structure.

During the standby condition of the diesel generator, the lubricating oil is warmed by the jacket water as described in <Section 9.5.9.2.2> and circulated by the lube oil circulating and soakback pumps to facilitate a quick engine start. The pre-lube system circulates oil to the turbocharger bearings and also maintains levels in the oil galleries to ensure adequate lubrication upon startup, therefore ensuring higher reliability. Failure of the warming system is annunciated by a lube oil low-temperature alarm in the diesel generator room and by a trouble alarm in the control room. Failure of the soakback system is annunciated by a low pressure lube oil local alarm and a common diesel trouble alarm in the control room.

9.5.9.4.4 Inspection and Testing Requirements

The HPCS diesel generator lubrication system is tested and inspected along with the overall engine during scheduled testing of the engine. Instrumentation is provided to ensure proper operation of the system by monitoring the lube oil temperature and pressure.

During standby periods, the keepwarm feature of the system is checked at scheduled intervals. This will ensure that the oil is warm enough for quick starting of the engine.

Leakage from the HPCS diesel generator lubrication system will be detected by lube oil pressure instrumentation or visual inspection of the system.

The HPCS diesel generator lubrication system is designed to permit testing and inspection of all components. System operability will be demonstrated during the regularly scheduled tests of the diesel generator. The frequency of these tests is given in Technical Specifications. The system was hydrostatically tested prior to initial startup. The lube oil is sampled and analyzed once every 3 months to verify that it can adequately perform its function (i.e., that it meets the specification for diesel engine lube oil specified by the manufacturer). Methods of periodic testing are described in <Section 8.3.1>.

9.5.9.4.5 Instrumentation Application

The following instrumentation is provided to monitor the lubrication system for the HPCS diesel engine. The outlet from the turbocharger oil filter has a pressure switch which is used to shut down the engine in the event of low-low lube oil pressure, except if a LOCA signal is present. Another pressure switch, which also monitors turbocharger pressure, is used as a cranking lock out to prevent the starting motors from engaging the fly wheel while the engine is still rotating. A third pressure switch is used to alarm low lube oil pressure on the local control panel and input to the common trouble alarm in the main Control Room. This switch monitors lube oil pressure of the turbocharger during engine operation and the soakback system pressure during standby.

The engine sump is monitored by a crankcase switch. This switch is used for the high crankcase pressure alarm which alarms on the local control panel and the common diesel trouble alarm in the main control room. The engine sump level will be monitored by use of the sump dipstick.

The lube oil filter is equipped with a differential pressure switch. This switch is used for alarm of a clogged oil filter. This alarm is on the local control panel and also has input to the common trouble alarm in the main control room.

Oil from the oil cooler is monitored by two temperature switches. The first switch is used to give an alarm for low lube oil temperature on the local control panel and input to the common trouble alarm in the main control room. The second switch is used for alarm of high lube oil temperature on the local control panel and input to the common trouble alarm in the main control room.

Alarm indicators are described in <Section 8.3.1.1.3.3.b.10>.

9.5.9.5 HPCS Diesel Generator Combustion Air Intake and Exhaust System

The relationship of the HPCS diesel generator combustion air intake and exhaust system to other parts of the diesel generator is shown in <Figure 9.5-26>.

9.5.9.5.1 Design Bases

a. The HPCS diesel generator combustion air intake and exhaust system is capable of supplying reliable quality air to the diesel engine and exhausting the products of combustion to the atmosphere.

b. The HPCS diesel generator combustion air intake and exhaust system is of Seismic Category I design. The safety-related portions of the system are housed within a separate Seismic Category I structure capable of protecting the system from extreme natural phenomena, missiles and the effects of pipe whip or jet impingement from high and moderate energy pipe breaks. The piping is classified as Safety Class 3.

c. The HPCS diesel generator combustion air intake and exhaust system is classified as Safety Class 3, Seismic Category I, except for the exhaust silencers which are nonsafety-related. The system is designed in accordance with NFPA-37. Further compliance is described in <Section 3.2> and <Table 3.2.1>.

d. The HPCS diesel generator combustion air intake and exhaust system is safety-related from the inlet filter to the missile barrier discharge. The exhaust silencer is nonsafety grade since any blockage of the silencer would be automatically bypassed through the missile barrier discharge. The system design conforms with the requirements of GDCs 1, 2, 4, 5, and 17 <Section 3.1>. Guidance presented in <Regulatory Guide 1.26>, <Regulatory Guide 1.29> and <Regulatory Guide 1.68> has been considered in the design of the system. The degree of conformance with these regulatory guides is discussed in <Section 1.8>. Conformance with Branch Technical Positions ASB 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment, is discussed in <Section 3.6.1> and <Section 3.6.2>. The guidelines presented in Branch Technical Position ICSB-17 (PSB) have also been considered in the design of this system as discussed in <Chapter 8>.

9.5.9.5.2 System Description

The HPCS diesel generator combustion air intake and exhaust system consists of an air intake filter with an integral silencer, expansion joints, exhaust silencer, and associated piping connecting the equipment.

An independent combustion air intake and exhaust system is provided for each HPCS diesel generator. The system components are sized and physically arranged such that no degradation of the operation of the engine will occur when the diesel is required to continuously operate at rated output. <Table 9.5-7> contains the applicable data for the above components.

The combustion air intake and exhaust system provides filtered ambient air to the diesel engine for combustion and exhausts the products of combustion to the atmosphere. Air for the combustion is taken from a missile protected air intake cubicle separate from the diesel generator room. All of the air intake and exhaust components, except the exhaust silencer, are located inside the diesel generator building which provides protection from extreme environmental phenomena. The exhaust silencer is not required for diesel operation and is therefore located on the roof of the diesel generator building with respect to other site components.

The HPCS diesel intake and exhaust system is shown in <Figure 9.5-13> and <Figure 9.5-14>, the layout arrangement is shown in <Figure 1.2-6> and <Figure 1.2-13>.

9.5.9.5.3 Safety Evaluation

The HPCS diesel generator combustion air intake and exhaust system is designed to Seismic Category I requirements and is housed inside a Seismic Category I structure.

Arrangement and location of combustion air intake and exhaust, as shown in <Figure 1.2-6> and <Figure 1.2-13>, are such that the dilution or contamination of intake air by exhaust products will not preclude the operation of the HPCS diesel generator. Recirculation of HPCS diesel engine combustion products to the air intakes is prevented by locating the exhaust stacks at a higher elevation away from the intakes. Since hot exhaust gases rise and disperse, significant recirculation into the intakes cannot occur. Additionally, the storage of gases in the vicinity of air intakes could not reduce oxygen levels below the minimum quantity and oxygen content requirements for intake combustion air if accidentally released. The only plant carbon dioxide fire extinguishing systems in the vicinity of the emergency diesel generator air intakes are located within the diesel generator rooms and in the control complex. If the carbon dioxide fire extinguishing system is activated for the HPCS diesel generator room, the fire dampers for the respective room are automatically closed and the area isolated to prevent air, smoke or carbon dioxide from being exhausted. The isolated area will be cleared of these gases using strict administrative controls to ensure that no possibility exists for large concentrations of gases to be ejected into the atmosphere and be drawn into the diesel generator air intakes. In this way essentially ambient quality air will be available at all times at the diesel generator air intakes.

If a postulated fire occurred in the fuel oil storage tank located above ground and over 650 ft from the intakes, it would be controlled using a foam extinguishing system discussed in <Section 9.5.1>. Foam is composed of water, foam concentrate and air. The concentrate is proportioned with water at a 3 to 4 percent concentration and air is induced into the resulting solution to form foam bubbles. The foam bubbles form an extinguishing blanket which excludes oxygen from the seat of the fire and extinguishes it. No carbon dioxide is involved or generated in the extinguishing process.

An analysis made of the actual burning process, assuming ideal combustion, results in a carbon dioxide generation rate of 4,270 lb/min. The total combustion gases would be approximately 20,900 lb/min. Very high flame temperature, in the vicinity of 3,000°F, would exist during such a fire. The large temperature difference between the fire and the atmosphere would cause a significant stack effect. Under low wind conditions, the stack effect could be several thousand feet and would not drop below several hundred feet with higher winds over 39.6 ft/sec. The results of assuming the minimum stack effect and a 12 m/sec wind speed indicates a minimum gas concentration at the intakes of 5.45×10^{-22} lb/min of combustion products. Slower wind speeds would result in lower concentration due to the higher stack effect.

The essential system components exposed to atmospheric conditions such as ice and snow are protected from possible clogging during standby or operation of the system. The essential portions of the system are housed within Seismic Category I structures provided with louvers. The standby and HPCS diesel generator combustion air intake and exhaust system components and piping are protected from missiles, pipe whip and jet impingement that might result from piping cracks or breaks. Refer to <Section 3.5> and <Section 3.6> for a discussion of missile and pipe whip protection. The system components and piping are designed or protected from the effects of earthquakes, floods, tornadoes, and internally and externally generated missiles.

The first part of the exhaust pipe and the missile barrier discharge on the exhaust system are tornado missile protected. A horizontal barrier and a vertical barrier protect the missile barrier discharge from a tornado missile.

Additional evaluation of the diesel generator combustion air intake and exhaust system with respect to the effects of fire extinguishing media, recirculation of diesel combustion products or sudden release of stored gases onsite, which is also applicable to the HPCS diesel generator, can be found in <Section 9.5.8.3>.

9.5.9.5.4 Inspection and Testing Requirements

The system is tested in accordance with the manufacturer's recommendations during initial tests and operation. The HPCS diesel generator is operated every month for periodic testing. Operation of air intake and exhaust system components is verified during this testing. Additional inspection, checkout and maintenance are performed as required. For a more detailed discussion of periodic testing, see <Section 8.3.1>.

9.5.10 AUXILIARY STEAM SYSTEM

9.5.10.1 Design Bases

When extraction steam from the nuclear

steam supply system is not available, the auxiliary steam system also supplies steam for building heating and various startup and test functions. The system is designed to supply steam demand requirements during normal plant operation, plant startup, and plant shutdown.

The auxiliary boiler and deaerator in this system are designed in accordance with Section I and Section VIII, respectively, of the ASME Boiler and Pressure Vessel Code. The connecting piping is designed to ASME Section I or ANSI B31.1 for 150 pound, 300 pound and 900 pound pressure classes.

9.5.10.2 System Description

The auxiliary steam system is shown schematically by <Figure 9.5-17>, <Figure 9.5-18>, <Figure 9.5-19>, and <Figure 9.5-20>. Auxiliary steam is supplied by two packaged boilers fired with No. 2 fuel oil from the auxiliary boiler fuel oil system. Each boiler is capable of discharging 100,000 lb/hr of steam, at a drum pressure of 175 psig, through the auxiliary steam distribution header. Condensate from the auxiliary steam hot water heat exchangers and the drain pots on the distribution headers are returned to the common deaerator.

Makeup water is supplied to the deaerator from the mixed bed demineralizer and distribution system. Boiler water quality is maintained by the auxiliary boiler chemical treatment system.

9.5.10.3 Safety Evaluation

The entire auxiliary steam system is nonsafety-class; therefore, seismic analyses and NSSS evaluations are not required.

9.5.10.4 Inspection and Testing Requirements

The auxiliary steam system will be hydrostatically tested in accordance with the ASME Boiler and Pressure Vessel Code or ANSI B31.1, as applicable. The system will be scheduled for periodic inspection and maintenance to ensure proper operation of all components.

9.5.11 REFERENCES FOR SECTION 9.5

1. (Deleted)

2. (Deleted)

3. Licensing Topical Report, NEDO-10905, "High Pressure Core Spray System Power Supply Unit." May 1973.

4. Calculation SSC-001, "Appendix R Evaluation: Safe Shutdown Capabilities Report."

TABLE 9.5-1

FAILURE MODE AND EFFECTS ANALYSIS FOR THE FIRE PROTECTION AND DETECTION SYSTEM

Component or System	Failure Mode	Effect
1. Internal fire protection water distribution system	1. Pipe line failure	1. A limited quantity of fixed systems or hose reels would be without a water supply.(1) 2. Water would be discharged into the area where the break occurs until isolation valves would be closed.(2)
	2. Hose failure when in use	1. No effect on total system or plant safety. 2. Water would discharge until hose valve would be closed.
2. External fire protection water distribution header.	1. Pipe line failure	1. No effect on total system. 2. Fire hydrants or building connections would be without a water supply.(1) 3. Water would discharge where the break occurs until isolated.
	2. Hydrant failure	1. Water would discharge until isolation valve would be closed. No effect on total system.
3. Electric driven fire pump (primary supply)	1. Power failure	1. No effect during non-use period, trouble alarm.

TABLE 9.5-1 (Continued)

Component or System	Failure Mode	Effect
3. Electric driven fire pump (primary supply) (Continued)		2. During use periods: pressure would drop and diesel pump would start, trouble alarm.
4. Diesel driven fire pump	1. Fuel supply failure	
	a. Line block	No effect; electric pump would provide adequate supply of water.
	b. Leak and fire	Automatic sprinklers would extinguish the fire.
	2. Battery failure	No effect; dual batteries provided.
5. Pressure maintenance system (jockey pump)	1. Pump failure	Electric driven fire pump would start on pressure drop.
6. Charcoal filter water spray system	1. Detection failure	No effect; fire or trouble alarm.
	2. System fail to operate	No effect; system is semi-automatic if remote-manual fails. Manual operation is possible.
	3. System trip no fire	No effect on plant safety.(3)
7. Outdoor oil-filled transformer spray system	1. Detection failure	
	a. False detection	Deluge valve would open and water would discharge through the nozzles except for manually actuated systems (Isolation valve normally closed), fire alarm.
	b. Electric fault	Trouble alarm.

TABLE 9.5-1 (Continued)

Component or System	Failure Mode	Effect
7. Outdoor oil-filled transformer spray system (Continued)	2. System failure	Deluge valve would not open automatically but could be opened manually. Hose streams could be used; fire alarm.
8. Turbine bearing protection	1. Line break	No effect; trouble alarm.
	2. Detection failure	
	a. Electrical fault	No effect; trouble alarm.
	b. False detection	No effect; deluge valve trip and water would fill piping. No water would flow from closed nozzles; fire alarm.
	3. Air supply failure	No effect; trouble alarm.
	4. System fail to trip	No effect; manual attack.(4)
	5. Nozzle failure	Air pressure would be lost; trouble alarm.
9. Hydrogen seal oil spray system	1. Detection failure	
	a. False detection	Deluge valve would trip and water would flow from nozzles; fire alarm.
	b. Electrical fault	No effect; trouble alarm.
	2. System fail to trip	No effect; manual attack.(4)

TABLE 9.5-1 (Continued)

Component or System	Failure Mode	Effect
10. Automatic wet pipe sprinkler systems	1. Pipe failure	No effect; water would discharge at the break; fire alarm.(2)(4)
11. Carbon dioxide hose reels	1. Electrical failure	
	a. False operation	No effect; CO_2 would fill piping; fire alarm.
	b. Fail to operate	No effect; hand extinguisher back up available.(4)
	2. Pipe failure within protected area	
	a. Normal condition	No effect.(5)
	b. During operation	1. No effect on plant safety; limited effect on CO_2 distribution.
		2. CO_2 would be discharged from the failure point until manually shut off at the tank.
		3. Fire would be attacked by alternate method.(3)
	3. Pipe failure outside protected area	
	a. Normal condition	No effect.(5)

TABLE 9.5-1 (Continued)

Component or System	Failure Mode	Effect
11. Carbon Dioxide hose reels (Continued)	b. During operation	1. CO_2 would be discharged from the leak until manually shut off at the tank.
		2. Fire would be attacked with hose lines and extinguishers.(4)
12. Total flooding carbon dioxide systems	1. Detection failure	
	a. Electrical fault	No effect; trouble alarm.
	b. False operation	No effect; CO_2 would discharge into protected area; fire alarm.(5)
	2. Pipe failure within the protected area	
	a. Normal condition	No effect.(5)
	b. During operation	1. No effect on plant safety; limited effect on CO_2 distribution.
		2. CO_2 would be discharged from the failure point.
		3. Extinguishment would be slowed but would occur.

TABLE 9.5-1 (Continued)

Component or System	Failure Mode	Effect
12. Total flooding carbon dioxide systems (Continued)	3. Pipe failure outside the protected area	
	a. Normal operation	No effect.(5)
	b. During operation	1. CO_2 would be discharged from the leak until manually shut off at the tank. 2. Fire would be attacked with hose lines and extinguishers.(4)
13. Carbon dioxide supply system	Power failure to the compressor	No effect; CO_2 is self-refrigerating due to the effect of vapor release through a bleeder valve at the rate of 6 to 21 lbs per hour.
14. Portable fire extinguishers	Fail to discharge	1. No effect on plant safety. 2. Speed of attack on fire would be slowed until another nearby extinguisher could be obtained.

TABLE 9.5-1 (Continued)

NOTES:

(1) The fire protection water distribution system is provided with an adequate supply of manually operated sectionalizing valves to limit the number of systems affected by a single failure. Areas affected by the loss of their section of the fire protection water distribution system would continue to have hand fire extinguisher protection, as well as hose stream protection from adjacent areas.

(2) Each area provided with fixed water type fire protection systems, hose reels or fire protection water distribution headers are provided with floor drains. The floor drains are adequately sized to remove water from fire protection systems, hose streams and foreseeable distribution system leaks. Additional safety from water damage is achieved for safety-related pumps and equipment by positioning them on 6 inch concrete pads. Alarms are provided in the control room to indicate when a fixed system has operated and when a fire pump is running. Such alarms will alert the plant operators that water is flowing and initiate a search for the exact location and cause of the alarm. Where the cause is from a piping or valve leak failure, the proper sectionalizing valves would be closed. All water piping is sized and routed in a way that their exposure to safety class equipment is minimized.

(3) False operation of the fire protection system protecting a safety class system will not affect the safety of the redundant safety system, because each safety system will have its own independent fire detection and protection system.

(4) Every part of the fire protection system has some redundancy in the form of hand fire extinguishers, hose streams, fire rated partitions, and walls, etc.

(5) In the event that false detection or operation of the CO_2 system were to occur, the area would be flooded with CO_2. All protected areas are provided with pressure relief, where relief is required to prevent overpressure. The CO_2 system piping is normally empty.

TABLE 9.5-2

(DELETED)

TABLE 9.5-2 (Continued)

(DELETED)

TABLE 9.5-3

DIESEL GENERATOR FUEL OIL SYSTEM COMPONENT DATA
DIVISION 3 (HPCS)

Diesel Generator Fuel Oil Storage Tank

Type	Horizontal
Quantity	1 per diesel generator
Capacity, gallons	39,375
Design pressure	Atmospheric

Diesel Generator Fuel Oil Transfer Pumps

Type	Horizontal centrifugal
Quantity	2 per diesel generator
Capacity, gpm	90
TDH, ft	200
Driver, hp	15.0

Diesel Generator Fuel Oil Day Tank

Type	Vertical
Quantity	1 per diesel generator
Capacity, gallons	555
Design pressure	Atmospheric

Diesel Generator Fuel Oil Pumps

a. Engine Driven Pump (Booster)

Type	Gear
Quantity	1
Capacity, gpm	4.0
TDH, ft	150

b. Motor Driven Pump (Priming)

Type	Gear
Quantity	1
Capacity, gpm	3.6
TDH, ft	150
Driver hp	0.25

TABLE 9.5-4

DIESEL GENERATOR COOLING WATER SYSTEM
DIVISION 3 (HPCS) COMPONENT DATA

a.	Cooling Water Pumps	
	Quantity	2 per engine, engine driven
	Capacity, gpm	550 each
	Head, ft	100
b.	Cooling Water Heat Exchanger (Jacket Water Cooler)	
	Quantity	1 per engine
	Type	TEMA AEW
	Duty, Btu/hr[(1)]	8.58×10^6
	Design Conditions[(1)]	
	Tube Side-ESW Cooling Water	
	a. Inlet temp, °F	95
	b. Outlet temp, °F	116.5
	c. Flow, gpm	800
c.	Jacket Water Expansion Tank	
	Quantity	1 per engine
	Type	Horizontal
	Capacity, gal	100
d.	Jacket Water Immersion Heater	
	Quantity	1 per engine
	Output, kW	15

NOTES:

(1) The jacket water cooler heat removal duty of 8.58×10^6 Btu/hr is based on the original design conditions as stated above. A minimum ESW Flow of 526 gpm will remove this heat load at an inlet temperature of 85°F and an outlet temperature of 117.8°F.

TABLE 9.5-5

DIESEL GENERATOR AIR START SYSTEM
DIVISION 3 (HPCS) COMPONENT DATA

a.	Air Receivers	
	Quantity	2
	Type	Vertical
	Capacity, ft^3 (each)	64
b.	Air Compressors	
	Quantity	2 (motor driven)
	Capacity, scfm (each)	20
	Discharge pressure, psi	250
c.	Air Motors	
	Quantity	2 dual, air starting motors
	Type	Rotary multivane
d.	Air Dryers	
	Quantity	1 Membrane
	Type	Type -40°F
	Capacity - Dewpoint at 20 scfm, 250 psig	

TABLE 9.5-6

DIESEL GENERATOR LUBRICATING OIL SYSTEM
DIVISION 3 (HPCS) COMPONENT DATA

a. Lube Oil Piston Cooling Pump	
Quantity	1
Capacity, gpm	109
Head, ft	125
b. Main Lube Oil Pressure Pump	
Quantity	1
Capacity, gpm	229
Head, ft	125
c. Lube Oil Scavenging Pump	
Quantity	1
Capacity, gpm	390
Head, ft	100
d. Lube Oil Soak Back Pump (dc)	
Quantity	1
Capacity, gpm	3
Head, psi	35
e. Lube Oil Soakback Pump (ac)	
Quantity	1
Capacity, gpm	3
Head, psi	35
f. Lube Oil Circulating Pump (ac)	
Quantity	1
Capacity, gpm	5 - 7
Head, psi	35
g. Lube Oil Heat Exchanger (Cooler)	
Quantity	1
Type	Tank type
Duty, Btu/hr	1.744×10^6
h. Lube Oil Sump	
Quantity	1
Capacity, gal.	
Total/usable	349/257
i. Maximum Lube Oil Consumption	
@ rated load, gal/hr	0.98

TABLE 9.5-7

DIESEL GENERATOR COMBUSTION AIR INTAKE AND EXHAUST
DIVISION 3 (HPCS) COMPONENT DATA

a.	Intake Air Filter	
	Quantity	1
	Type	Dry Type
	Capacity, cfm (nominal)	10,700 at 100°F
b.	Intake Air Silencer (Part of air intake filter)	
	Quantity	1
	Type	Residential
	Capacity, cfm (nominal)	10,700 at 100°F
c.	Exhaust Silencer	
	Quantity	1
	Type	Residential
	Capacity, cfm (nominal)	23,000 at 735°F

TABLE 9.5-8

STANDBY DIESEL GENERATOR COOLING WATER SYSTEM

Jacket Water Heat Exchanger	
Quantity	1 per diesel engine
Duty, Btu/hr[(1)]	24,500,000
Design Conditions: [(1)]	
Tube Side - Emergency Service Water:	
a. Inlet temp, °F	80.0
b. Outlet temp, °F	129.0
c. Flow, gpm	1,000
Shell Side - Jacket Cooling Water:	
a. Inlet temp, °F	175.0
b. Outlet, temp, °F	147.8
c. Flow, gpm	1,800

NOTES:

[(1)] The jacket water heat exchanger heat removal duty of 24,500,000 Btu/hr is based on the original design conditions as stated above. A minimum ESW Flow of 787 gpm at an inlet temperature of 85°F and an outlet temperature of 137.7°F will remove the current design basis heat load of 20,650,000 Btu/hr.

APPENDIX 9A

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

GAI Report No. 1958

<APPENDIX 9A>

FIRE PROTECTION EVALUATION REPORT

PERRY NUCLEAR POWER PLANT UNIT 1 AND UNIT 2

CLEVELAND ELECTRIC ILLUMINATING CO.

Identical to:
GAI Report No. 1958
Rev. 5

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

PERRY NUCLEAR POWER PLANT
UNIT 1 AND UNIT 2

FIRE PROTECTION EVALUATION REPORT

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THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

PERRY NUCLEAR POWER PLANT

UNIT 1 AND UNIT 2

<APPENDIX 9A>

FIRE PROTECTION EVALUATION REPORT

9A.1 INTRODUCTION

9A.1.1 BACKGROUND AND PURPOSE

The Nuclear Regulatory Commission (NRC), in a letter dated May 3, 1976, transmitted to the Cleveland Electric Illuminating Company (CEI) a copy of revised Standard Review Plan (SRP) 9.5.1, "Fire Protection," dated May 1, 1976, which included Branch Technical Position APCSB 9.5-1. This revision of SRP 9.5.1 contained new guidelines for NRC staff evaluations of fire protection in their review of nuclear power plant construction permit applications docketed after July 1, 1976. The letter stated (1) that to the extent reasonable and practical, the revised SRP will be used by the NRC staff in evaluating fire protection provisions of operating plants, applications currently under review for construction permits and operating licenses and future applications for operating licenses for plants now under construction; and (2) that the NRC would provide more definitive criteria or acceptable alternatives for the application of SRP 9.5.1 when available.

In a letter dated September 30, 1976, the NRC transmitted Appendix A to APCSB 9.5-1 which provides for plants docketed prior to July 1, 1976, certain acceptable alternatives to the positions given in SRP 9.5.1. This letter also directed CEI to conduct an evaluation of the fire protection provisions for the Perry Nuclear Power Plant (PNPP), Unit 1 and Unit 2. The evaluation must include a fire hazards analysis conducted under the technical direction of a qualified fire protection engineer and performed to the level of detail indicated by Enclosure 2 to NRC's letter "Supplementary Guidance on Information Needed for Fire Protection Program Evaluation." In addition, the evaluation must provide a detailed comparison of the fire protection provisions proposed for PNPP Unit 1 and Unit 2 with the appropriate guidelines in Appendix A, which for PNPP are those designated as "Application Docketed But Construction Permit Not Received as of 7/1/76."

In a subsequent letter dated October 15, 1981, the NRC directed CEI to submit a comparison of the PNPP fire protection program to <10 CFR 50, Appendix R>, identifying and justifying deviations. CEI responded with the requested comparison in a letter dated April 29, 1982.

As described in USAR Section 1.0, the request for extension of the construction permit for PNPP Unit 2 was formally withdrawn in 1994. Therefore, a documented fire hazards and safe shutdown analysis for Unit 2 is not required.

The purpose of this report is to present the results of the fire protection evaluation for PNPP Unit 1. The methodology employed and a description of the safe shutdown systems are presented in <Appendix 9A.2.0> and <Appendix 9A.3.0>, respectively. The fire hazards analysis is presented in <Appendix 9A.4.0>, and point-by-point comparisons with Appendix A and <10 CFR 50, Appendix R> are provided in <Appendix 9A.5.0> and <Appendix 9A.6.0>, respectively.

As part of the CEI on-going verification program, a reanalysis of the plant safe shutdown analysis was performed by a third party consultant, Tenera Corp. The results of this study have been factored into the plant design and operating procedures to ensure safe shutdown capability per <10 CFR 50, Appendix R>. The summary of the results of this analysis was incorporated in the revised <Appendix 9A.2> and <Appendix 9A.3>, which was subsequently incorporated in <Section 9.5>.

The initial evaluation was prepared by Gilbert Commonwealth, Inc., Reading Pennsylvania, under the technical direction of a qualified fire protection engineer, and included input from CEI’s engineering staff and Tenera Corp. consultants. The evaluation is updated to reflect ongoing plant conditions which affect fire protection by CEI engineering under the direction of a qualified fire protection engineer. The fire protection engineers either hold or are qualified to hold full membership status in the Society of Fire Protection Engineers.

9A.2 METHODOLOGY - FIRE HAZARDS ANALYSIS

9A.2.1 INTRODUCTION

A major task within the fire protection evaluation program was the fire hazards analysis. The fire hazards analysis was performed based on the final plant design as of April 1985. The objective of the analysis was to determine the potential effects of a fire at any location within the plant which could adversely affect the ability to safely shut down the plant or could result in an uncontrolled release of radioactivity. Where it was determined that a single fire might jeopardize safe plant shutdown or cause uncontrolled release of radioactivity, a design change was implemented to prevent the loss of safe shutdown capability. The detailed fire hazards analysis concentrated on those buildings which house Unit 1 safe shutdown equipment. This includes analysis for Unit 2 fire areas which contain Unit 1 safe shutdown components and/or cables, or that present a potential fire hazard to Unit 1 fire areas (e.g., in the Control Complex).

Buildings not containing equipment required for safe shutdown were evaluated to determine if, and to what extent, plant design changes need to be implemented in order for a fire in these buildings not to affect buildings containing safe shutdown equipment.

The fire hazards analysis was performed in two phases: the first was an information collection process; the second was the actual analysis and effects evaluation.

9A.2.2 INFORMATION COLLECTION

Before the fire hazards analysis could be performed, information about PNPP had to be compiled. This effort involved determining equipment required for safe shutdown, preparing an inventory of combustibles, investigating fire barriers, reviewing existing fire detection/protection equipment, and then presenting this information on fire protection layout drawings.

9A.2.2.1 Safe Shutdown Equipment

The shutdown operation, for purposes of this fire protection evaluation, is considered to start at full power and terminate with the plant at atmospheric pressure and refueling temperature with shutdown cooling in operation. Safe shutdown equipment is defined as mechanical, electrical, ventilation equipment, and includes instrumentation, control and power cables required for the shutdown operation. It was assumed that the shutdown procedure would be essentially conducted from either the control room or the remote shutdown panel in the control complex.

Additional information concerning the shutdown sequence is presented in <Appendix 9A.3>.

9A.2.2.2 Inventory of Combustibles

For this section the term "Combustible" is used to refer to any material or structure that can burn (Reference 6).

The types of combustibles considered include petroleum products, electrical insulation, charcoal filters, and maintenance and operating supplies.

Petroleum products are defined, for the purposes of this report, as lubricants and fuel oil utilized at PNPP. Lubrication of equipment requiring small quantities (less than one gallon) of oil or grease is normally accomplished through use of sealed bearings or oil/grease cup arrangements which require very small quantities of lubricant. These small quantities were not considered significant for the fire hazards analysis and were not included in specific fire area/zone fire loads. Fuel oil storage is discussed in the individual area analyses.

All transformers inside plant buildings are of dry type construction, except the main generator neutral grounding transformer (in the Turbine Building) which is filled with nonflammable epoxy. No oil filled transformers are located inside the plant buildings.

For purposes of the fire hazards analysis, the electrical cable insulation was assumed to be combustible with a heat content of 10,000 Btu/lb (Reference 1). The insulation for electrical cables routed through the plant are fire retardant types. Those cable types that are acceptable for routing in cable trays were tested in accordance with the flame test specified in IEEE-383 (Reference 2). Other cable types were tested in accordance with those fire resistance tests that were applicable to their specific installation and usage. Cables are installed in steel trays (ladder type or solid bottom type) or in steel conduits. Control, instrument and small power cables are randomly installed in trays and lay in multiple layers. Large power cables are installed in a single layer.

At the time this analysis was performed, the cable tray system layout had been established. Routing of cables and the number and size of cables in each tray is considered complete. A method used to determine the cable insulation inventory yields very conservative results to account for eventual cable routing modifications.

Cable insulation weights were estimated using the following procedure:

a. An average cable size was established for each tray class, based upon tray classification (power, control, instrument, etc.)

b. The number of cables per tray was determined based on 50 percent cable tray fill criteria.

c. The insulation quantity was obtained by multiplying the number of cables, tray length and weight of insulation of an average cable size representative of the tray loading.

d. The total insulation weight was obtained through summation of all trays in the area.

Since most circuits do not run the full length of a tray and maximum allowable tray fill was assumed, item d, above, yielded a conservative (high) estimate of total insulation weight. The insulation of cables installed in conduit was accounted for by the conservative procedure used for estimating cable insulation weight in cable trays. In areas of the plant where no cable trays exist, a conservative amount of cable insulation was determined using conduit sizes, conduit layout, allowable conduit fill, and the average cable size.

Insulation in motors less than 40 horsepower was a small quantity in comparison to the quantity of cable insulation and, therefore, was not considered.

Combustible materials inside instrumentation, control and relay cabinets consist of cable insulation, circuit card materials and bakelite in relay housings.

The Btu content of instrument cabinets was determined based upon a detailed investigation of combustibles within a representative cabinet. These combustibles consisted of cable insulation and printed circuit cards. The following procedure was used:

a. Cable length is estimated from physical wiring diagrams available at the time of this analysis.

b. The quantity, weight and dimensions of printed circuit cards was determined from design drawings.

c. The number of circuits contained in the control cabinets was calculated using elementary wiring diagrams.

d. The average wire length of a circuit was established and the total wire length was calculated.

e. The total weight of cable insulation was calculated, knowing the type of wire and its weight.

f. The total Btu content for the entire instrument cabinet was determined; the Btu per linear foot of cabinet width was obtained by dividing the total Btu content of the cabinet by the width of the cabinet.

g. The total footage of instrument cabinets was determined from layout drawings; the total Btu content for instrument cabinets in a given fire area/zone was then calculated.

Electrical insulation in motor control centers and switchgear was estimated using a procedure similar to that outlined above for cable insulation in cabinets.

Charcoal filter combustibles were determined from filter manufacturer data.

Maintenance and operating supplies consist of paper, cloth, flammable and combustible liquids, plastics, and other material items required for normal plant operations. In contrast to the first three categories of combustibles which are permanent and part of the plant design, these combustibles are transient, may vary with time, and can be moved throughout the plant. Because of these characteristics, they are subject to administrative controls. Certain areas of the plant, however, require a periodic supply of these combustibles. The Radiologically Restricted Area dressing area, for example, will always contain clothing and associated supplies.

There are also maintenance shops and designated storage areas within the Radiologically Restricted Areas required for ALARA concerns. Although the actual amounts and types of materials may vary, these will present a permanent combustible loading in the Fire Areas and have been referred to as “in situ” combustibles.

For the fire hazards analysis, an assumed Btu content of these materials and a maximum loading was determined based on design and occupancy changes reviewed by fire protection. These assumed Btu levels are presented in Section 4.0 for applicable areas/zones. The existing fire suppression and detection for the area as well as the potential exposure to redundant trains of safe shutdown trains was considered. For designated areas protected by sprinkler systems, acceptable storage of ordinary combustibles is based on commodities and arrangements within the scope of NFPA 13 for Ordinary Hazard Group 2. Any “in situ” flammable liquid storages are limited by the requirements of NFPA 30.

In other plant areas, administrative controls limit nonpermanent combustibles to low levels or require a review of the transient loading to determine if fire protection is required.

9A.2.2.3 Review of Fire Barriers

The review of fire barriers consisted of examining the construction of existing fire barriers which separate fire areas, fire zones and redundant equipment within the plant. Included in this review was an evaluation of doors, HVAC and cable penetrations between fire areas.

Walls adjacent to grade (underground) and to the exterior unless adjacent to outdoor transformers are not rated fire barriers.

Walls are assigned fire resistance ratings based upon their construction. Gypsum board wall assemblies are used as rated fire barriers, both for separation of safe shutdown equipment and as internal partitions within designated Fire Areas/Zones. In locations where the gypsum board barrier assemblies are used to provide separation of redundant trains of safe shutdown components and circuits, there are three basic configurations:

a. Vertical gypsum walls, formed by three layers of drywall mechanically attached to both sides of steel studs and the assembly seismically installed by mechanical fastening. These walls are designed to have a 3 hour fire resistance rating.

b. Bullet resistant walls/ceilings formed by bonding of three layers of drywall to each outside surface of bullet resistant steel plates. These walls have been tested and demonstrate a 1-3/4 hour fire resistance rating.

c. Horizontal ceiling configurations which utilized drywall and gypsum plank in type (1) construction. These configurations have been analyzed and are comparable to U.L. listed designs with a 2 hour fire resistance rating.

The configurations categorize the main construction features which could affect the fire resistance of the assembly such as fire resistive material used, means of attachment of the material and orientation of the barrier. Within each configuration, there are variations of features such as joint spacing, size and gauge and fastener arrangement.

The use of these configurations as part of Fire Area/Zone boundaries as described in this appendix occur mainly in the control complex. Other uses are for stairway enclosures in the intermediate building and fuel handling building.

In the Fire Hazards Analysis <Appendix 9A.4>, where gypsum barrier assemblies are described, vertical wall configurations (Item “a”, above), are utilized unless otherwise noted.

Insulated steel deck roofing conforms to Factory Mutual Class I construction requirements. Door ratings are determined by a test conducted by a recognized national laboratory. Penetrations through rated fire walls, floors or ceilings are sealed to provide a barrier equal to that of the surrounding structure. All cable tray penetrations through floors are sealed to prevent fire propagation along the cables between floors. In addition, penetrations in fire barriers between redundant equipment within a given fire area are sealed to prevent fire propagation through the barrier. Fire dampers throughout the plant will have a fire rating consistent with the rating of the wall or floor being penetrated.

9A.2.2.3.1 Conduit Sealing

The criteria for sealing inside conduit passing through fire barriers for preventing the passage of hot gases and smoke are based on actual fire test data. These criteria are as follows:

a. Openings inside conduit larger than 4 inches in nominal diameter are sealed at the fire barrier penetration, with a seal of the same rating as the barrier.

b. Openings inside conduit 4 inches or less in nominal size do not require sealing under either of the following conditions:

   1. Automatic fire suppression provided on both sides of the barrier.

   2. All safe shutdown equipment in the areas on both sides of the barrier is of the same division or not required for safe shutdown. The area on a side of a barrier will be considered to have one division of safe shutdown in cases where the conduit of the redundant division is protected by a one hour rated wrap throughout the area.

c. For barriers where a potential for exposure of redundant safe shutdown trains exist:

   1. Openings in conduits 3 inches to 4 inches in diameter will be sealed at the barrier or first opening on both sides of the barrier.

   2. Openings in conduits less than 3 inches in diameter will be sealed on one or both sides of the barrier where both of the following conditions exist:

      (a) The conduit terminates in a panel or enclosure containing equipment within a 10 foot lineal run from the point it enters the area.

      (b) The panel or equipment in which the conduit terminates is required for safe shutdown or contains safe shutdown equipment.

      If both of the above conditions (2a and 2b), exist on a side of the barrier, the conduit will be sealed on that side of the barrier to prevent the passage of smoke generated in the conduit on the other side (fire side) of the barrier. Each side of a barrier will be evaluated to the above two conditions to determine which conduits less than 3 inches in diameter must be sealed.

9A.2.2.4 Existing Fire Detection/Protection Equipment

The following information was collected concerning existing fire detection and protection equipment:

a. Fire detector type and location

b. Fire protection system configuration

c. Valving type and location

d. Fire pump type, capacity and location

e. Hose station type and location

f. Fire extinguisher type and location

g. Location and configuration of permanently installed water sprinkler or deluge systems

h. Location and configuration of permanently installed gaseous fire suppression systems

i. Type of actuation for fire protection systems

9A.2.2.5 Fire Protection Layout Drawings

Fire protection layout drawings <Figure 9A-1>, <Figure 9A-2>, <Figure 9A-3>, <Figure 9A-5>, <Figure 9A-6>, <Figure 9A-7>, <Figure 9A-8>, <Figure 9A-10>, <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-14>, <Figure 9A-15>, <Figure 9A-16>, <Figure 9A-18>, <Figure 9A-19>, <Figure 9A-20>, <Figure 9A-22>, <Figure 9A-23>, <Figure 9A-24>, <Figure 9A-25>, <Figure 9A-26>, <Figure 9A-27>, <Figure 9A-28>, <Figure 9A-29>, <Figure 9A-30>, <Figure 9A-31>, <Figure 9A-32>, <Figure 9A-33>, and <Figure 9A-34> were developed to present much of the information gathered in the first phase of the fire hazards analysis. These drawings show each building containing safe shutdown equipment, fire barriers within each building, required safe shutdown equipment found within each building, and existing fire suppression equipment. These drawings form the basic reference for the fire hazards analysis.

9A.2.2.6 References

1. American National Standards Institute, 1976. Draft-Generic Requirements for Nuclear Power Plant Fire Protection, ANSI N18.10.

2. Institute of Electrical and Electronics Engineers, “Standard for Type Test of Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations,” IEEE-383, 1974.

3. GE Document No. 22A7193 (MPL A62-4350), Mechanical Equipment Separation for Engineered Safety Feature, Design Specification.

4. Branch Technical Position APCSB 9.5-1.

5. <10 CFR 50, Appendix R>

6. National Fire Protection Association Handbook, 14th Edition, page A39.

9A.2.3 FIRE HAZARDS ANALYSIS

Following the information collection and drawing preparation phase, the fire hazards analysis was performed. The steps used in this analysis and general considerations are discussed below. The detailed analysis, with results, is presented in <Appendix 9A.4.1>

9A.2.3.1 Identification of Fire Areas/Zones

As part of the plant design for Unit 1, each building was designated as a major fire area. In some cases, buildings were further subdivided into individual fire areas. A fire area is defined as an area completely separated from adjacent areas by rated fire barriers. These designated fire areas were then used in the fire hazards analysis. In some instances a single fire area consisting of several rooms or floors within a building was analyzed in its entirety, while in other cases the fire area was further subdivided into fire zones to facilitate manageable and logical analysis. Divisions between zones do not necessarily occur at existing design features, such as floors or walls. Each fire area/zone is presented in <Appendix 9A.4> on a building by building basis.

The analysis for each fire area and fire zone within a building is treated similarly since differences between a fire area and a fire zone are often very slight. The location under consideration is identified in the analysis as a fire area or fire zone. The larger fire areas, composed of two or more zones have been further analyzed for adequate separation and protection throughout the area.

For purposes of this fire protection evaluation, stairtowers were not considered as part of the fire area/zone breakdown, except for one area in the control complex. The stairtower enclosures are adequate subdivisions between floors to provide an area boundary.

Unit 2 buildings that are not designated as fire areas and are not subdivided into fire areas/zones are discussed in Section 9A.4.23.

9A.2.3.2 Review of Safe Shutdown Equipment Within Fire Areas/Zones

Safe shutdown equipment located within each building is shown on the fire protection layout drawings, is listed in <Table 9A.3-1>, and is discussed in <Appendix 9A.4>. The fire protection layout drawings also show relative position of mechanical equipment, control and power centers and trays carrying safety-related cables. Valves and other smaller equipment are indicated in the fire area/zone, where they are located by a representative symbol.

An important aspect of this review was the consideration of equipment function and the location of all other equipment capable of performing the required functions, as part of the redundant shutdown method. In some cases, redundant equipment is located in the same fire area/zone. When this occurred, it was necessary to evaluate actual separation, (defined as the distance between components and/or circuits, without intervening combustibles), combustibles in the immediate vicinity of the equipment, ignition sources and fire detection and suppression equipment in the fire area/zone. In cases where other equipment capable of performing the safe shutdown function is located in different fire area/zones, it was determined that the equipment in the fire area/zone under consideration could be damaged by fire without adversely affecting safe plant shutdown by the method indicated for that zone.

Since equipment required for safe plant shutdown following a fire is also safety-related equipment, existing separation of redundant safety-related electrical systems provides protection against potential fires caused by internal cable failure in one division adversely affecting circuits of the redundant division. The separation required for cables and cable trays to provide this protection is set forth in the separation design criteria for PNPP. This criteria is in accordance with IEEE 384-1974.

Basically, two redundant channels of equipment for power and control exist throughout the plant. These are referred to as Division 1 and Division 2. There is also a Division 3 train of power and control. For the reactor protection system (RPS), four channels of sensors and cable exist for the purpose of dual trip alarm and actuation of reactor scram. These are referred to as Division 1, Division 2, Division 3, and Division 4. Separation for each of these four divisions of sensors is maintained by routing the cables in separate raceways for each division. In accordance with the dual trip logic, Division 1 and Division 4 are redundant to Division 2 and Division 3. Division 1 and Division 4 RPS sensor cables are routed through the same areas as Division 1 power and control cables. Division 2 and Division 3 RPS sensor cables are routed through the same areas as Division 2 power and control cables. Also, some non-divisional (X), nonsafety circuits have been included in the protection of the shutdown method due to their potential effect on these circuits due to hot shorts or open circuits caused by a fire.

9A.2.3.3 Calculation of Fire Load

Combustible materials located within each fire area/zone were listed and the fire loading, in Btu/ft^2, was calculated. The amounts of each type and totals for the fire zones and areas are documented in Calculation P54-24. This number was then used to verify the adequacy of existing fire barriers <Table 9A.2-1>. For fire areas/zones containing both sets of redundant equipment, the combustibles were further evaluated; their location, confinement, ignitability, and fire spread were considered with respect to the redundant equipment. Based on the above considerations, maximum allowable Btu/ft2 was established for each fire area/zone.

9A.2.3.4 Review of Ventilation Systems

Ventilation equipment required for safe plant shutdown, such as the residual heat removal pump room coolers, was treated as safe shutdown equipment.

All ventilation systems were then evaluated to ensure that fire would not be spread beyond the area/zone of origin as a result of the ventilation system itself. This was accomplished using detectors, fan interlocks and fire rated dampers.

In addition, smoke removal or venting systems have been provided as required where manual fire fighting would be very difficult due to the inaccessibility of the location or the nature (heavy smoke) of the fires anticipated.

9A.2.3.5 Evaluation/Conclusions

Finally, an evaluation was made to determine whether or not the plant was adequately protected in the event of a fire within a fire area/zone. This evaluation was based upon all the previously noted information. The primary consideration was to determine if a fire would jeopardize safe plant shutdown, given both the proper functioning of fire protection equipment and automatic systems and also assuming fire suppression systems failed.

The questions addressed in the evaluation of a fire area/zone were the following:

a. Is there equipment within the fire area/zone which is essential to safe plant shutdown, the function of which cannot be fulfilled by other equipment in other fire area/zones?

b. How would a fire in the fire area/zone be detected?

c. How would a fire in the fire area/zone be extinguished?

d. Does the ventilation system contribute to the spread of the fire and/or products of combustion to other fire areas/zones which would be otherwise unaffected?

e. Will a fire cause equipment damage resulting in spillage or leakage of radioactivity? Where the potential for a release of radioactivity was postulated, the analysis included any special consideration required.

f. Does this analysis show that the plant can be safely shut down and that radioactive releases to the environment are minimized despite any fire hazards identified within the fire area/zone?

If the answer to question f, above, was YES after all the other questions above had been addressed, then it was concluded that the individual fire area/zone was adequately protected against fire from the standpoint of safe plant shutdown.

If the answer to question f, above, based upon preceding analyses, was NO, design changes were implemented to ensure that adequate protection would be available.

9A.2.3.6 Review of Redundant Shutdown Systems

In accordance with Section 9.5.1 of Branch Technical Position (BTP) APCSB 9.5-1, position C.5.a (1) of NRC Standard Review Plan BTP CMEB 9.5-1 and <10 CFR 50, Appendix R> Section III.G, it is the NRC staff's position that equipment trains for redundant safe shutdown systems should be separated by walls having a three-hour fire rating or equivalent protection <10 CFR 50, Appendix R> Section III.G.2. That is, equipment and cabling required for or associated with the primary method of shutdown, should be physically separated by the equivalent of a three-hour rated fire barrier from equipment and cabling required for or associated with the redundant or alternate method of shutdown.

To ensure that redundant shutdown systems and all circuits, equipment and instrumentation that are associated with the shutdown systems are separated from each other, so that both are not subject to damage from a single fire, a safe shutdown analysis/evaluation was performed. The details of this study are contained in the safe shutdown analysis. The results are summarized here.

<Appendix 9A.3.1> defines the shutdown sequence that would be followed upon detection of a fire of such magnitude that shutdown of the plant is required. <Appendix 9A.3.2> identifies the systems required for the shutdown, and <Table 9A.3-1> identifies the equipment within these systems required for the shutdown.

The equipment, including instrumentation and vital support system equipment, required for the primary method of achieving shutdown was reviewed and the following items were identified:

a. Equipment required to achieve and maintain hot shutdown and equipment required to achieve and maintain cold shutdown

b. Location by fire area

c. The redundant counterpart, where applicable

d. All circuits (power, instrumentation and control) serving the equipment, including non-essential, nonsafety circuits associated with the equipment

e. Cable routing (by fire area) of essential circuits for the equipment

The essential circuits were also shown on circuit drawings by system and by color-coded circuit division. Nonsafety, non-essential circuits associated with the equipment were reviewed to verify that properly coordinated isolation devices exist, such that failures caused by open circuit, ground fault or short connection of conductors will not affect their associated shutdown system.

The circuit routing drawings were reviewed to determine if circuits serving redundant equipment are routed through a common fire area.

The factors considered in determining solutions were:

a. Present separation between redundant cables and/or equipment

b. Combustible loading for the area involved

c. Fire protection features already provided for the problem area

In performing the evaluation/analysis, no credit was taken for an alternate method of shutdown, except for a fire in the control room. That is, a fire in the control room will not affect the circuits required to shut down from the alternate shutdown panel.

Also included in the evaluation/analysis was a review of low pressure systems that interface with the high pressure primary coolant system and that are isolated by redundant electrically controlled devices. Circuits to redundant electrically controlled devices providing such isolation at high-low pressure interfaces were analyzed in the same method as safe shutdown circuits.

9A.2.3.7 REFERENCES

1. Calculation SSC-001, "Appendix R Evaluation: Safe Shutdown Capabilities Report."

TABLE 9A.2-1

REQUIRED BARRIER RATINGS FOR FIRE LOADINGS(1)

Fire Loading Btu/ft^2	Required Barrier Rating
40,000	30 minutes
80,000	1 hour
120,000	1-1/2 hours
160,000	2 hours
200,000	2-1/2 hours
240,000	3 hours

NOTE:

(1) From National Fire Protection Association Handbook, 14th Edition, page 6-81.

9A.3 SAFE PLANT SHUTDOWN

The primary consideration of the fire hazard analysis was the evaluation of the ability to safely shut down the reactor in the event of a fire. The safe shutdown procedure was assumed to start at normal full power and to end with the reactor in the cold shutdown condition with long term cooling, using the residual heat removal (RHR) system, in progress.

<Appendix 9A.3.1> outlines the shutdown sequence upon which the fire hazards analysis was based. <Appendix 9A.3.2> lists the systems required to accomplish safe plant shutdown. <Table 9A.3-1> is a list of equipment required for safe plant shutdown.

Emergency lights with 8-hour battery packs are provided to illuminate areas containing equipment which is manually operated outside of the control room to achieve safe shutdown and the access and egress to those locations. These emergency lights illuminate the following equipment:

- Emergency Service Water Screen Control Panel
- Diesel Generator, Generator Control Panel
- Diesel Generator, Engine Control Panel
- Motor Control Centers, Division 1
- 480 V Switchgear, Division 2
- 4.16 kV Switchgear, Division 1
- Remote Shutdown Panel
- Emergency Closed Cooling Temperature Gage
- Emergency Closed Cooling Valves
- Control Complex Chiller Water Control Panel
- Emergency Service Water Screen Wash Pump Discharge Strainer

9A.3.1 SHUTDOWN SEQUENCE

The Perry plant design utilizes two main divisions of power supplied from offsite sources or two independent diesel generators supplying two redundant Class 1E onsite power sources. It is not considered probable that a single fire would prevent the use of offsite power; however, for the purpose of this fire hazards analysis, only the Class 1E power sources have been analyzed. For the fire hazard analysis, the two redundant safe shutdown trains are Method A, which utilizes systems powered from Division I power sources and the redundant train, Method B, which utilizes systems powered from Division II power sources.

For the fire hazards analysis, the shutdown sequence starts with the detection of a fire of such a magnitude that shutdown of the plant is required. Depending upon the location and magnitude of the fire, the plant may be quickly brought to hot shutdown or tripped by the plant operator. It is assumed that plant shutdown is initiated with an automatic or manual scram of the reactor. The RPS is a normally energized, deenergized to trip, one out of two taken twice logic system. The required portions of the RPS may be denergized from a number of locations including the Main Control Room and RPS distribution cabinets. Once a scram is initiated, no further control rod motion is required. It was also determined that, although fire damage might cause the plant to trip, no fire could negate the ability to manually trip the reactor.

It was assumed, for analytical purposes, that the function of the main turbine pressure regulators to control reactor pressure via the bypass valves to the main condenser was lost. In the event that the reactor vessel is isolated, and feedwater supply is unavailable, Safety Relief Valves are provided to automatically (or remote-manually) maintain vessel pressure within desirable limits.

For depressurization and initial core cooling, Method A will utilize a combination of Automatic Depressurization System/Safety Relief Valves (ADS/SRV), with either Reactor Core Isolation Cooling (RCIC) or the Low Pressure Core Spray System (LPCS) or Low Pressure Coolant Injection (LPCI) A.

The water level in the reactor will drop due to continued steam generation by decay heat. Upon reaching a predetermined low level, the Reactor Core Isolation Cooling (RCIC) system will be activated automatically. Reactor coolant inventory will be controlled by the RCIC. Depressurization is provided initially by steam discharge to the RCIC system. As the level is restored, shutdown will proceed by operation of the relief valves to reduce reactor system pressure and temperature until RCIC cut-off. Manual operation of the relief valves reduces the reactor system pressure and temperature at a controlled rate until the RCIC system discontinues operation. This condition is reached at approximately 135 psig.

The RCIC system utilizes inboard containment isolation valves, powered from Division 2 sources. In areas where a fire could impact power and associated control circuits for both RCIC components and the redundant Method B systems, reactor inventory control can be provided by the Low Pressure Core Spray system. Depressurization is provided initially by the Automatic Depressurization System/Safety Relief Valves. The ADS/SRVs will be manually controlled by the operator, if automatic functioning has not yet taken place, to depressurize the reactor coolant system to LPCS or LPCI A cut in.

For depressurization and initial core cooling, Method B will utilize a combination of the Automatic Depressurization System/Safety Relief Valves, and the Low-Pressure Coolant Injection (LPCI) B or C system. The ADS/SRVs can be manually initiated by the operator, if automatic functioning has not yet taken place, to depressurize the reactor coolant system to LPCI B or C cut in. Generally, Train “C” of RHR will be utilized in the LPCI mode to restore reactor water level. However, for some fire scenarios, the Train “B” of RHR is utilized for reactor inventory control and suppression pool cooling.

During the depressurization process, the suppression pool cooling mode of RHR A or RHR B could be initiated to control suppression pool temperature. At approximately 135 psig, the shutdown cooling mode of RHR A or RHR B would be initiated, at which time reactor water is pumped from one of the recirculation loops, through the RHR heat exchangers, then back to the reactor vessel by way of the feedwater system. In the event that this shutdown cooling path is not available, there is an alternate shutdown cooling path, in which reactor water flows through the ADS/SRV valves to the suppression pool and is pumped from the suppression pool, through the RHR heat exchangers, then back to the reactor vessel.

9A.3.2 SYSTEMS FOR SAFE SHUTDOWN

The following is a list of systems required, or partially required, for safe plant shutdown:

1. Reactor system

2. Nuclear boiler system

3. Control rod drive hydraulic system

4. Reactor protection system

5. Residual heat removal system

   NOTE: All modes required except for containment spray.

6. Reactor core isolation cooling system

7. Automatic depressurization system

8. Remote shutdown system

9. Motor control centers, switchgear and miscellaneous electrical equipment area HVAC systems

10. Battery room exhaust system

11. Control room HVAC system

12. Emergency closed cooling pump area cooling system

13. Emergency service water pump house ventilation system

14. Emergency core cooling system pump room cooling system

15. Diesel generator building ventilation system

16. Condensate transfer and storage system

17. Emergency closed cooling system

18. Emergency service water system

19. Control complex chilled water system

20. Emergency service water screen wash system

21. Safety-related instrument air system

22. 125 Vdc system

23. Standby diesel generator power system

24. Standby diesel generator starting air system

25. Diesel generator fuel oil system

26. Standby diesel generator exhaust, intake and crankcase system

27. Standby diesel generator jacket water cooling system

28. Standby diesel generator lube oil system

29. Low pressure core spray system

This listing is based upon the shutdown sequence and assumptions given in <Appendix 9A.3.1>. Additional systems included in this list are used for normal reactor shutdown and, if available, would be put into service in the event of a fire.

TABLE 9A.3-1

LIST OF SAFE SHUTDOWN EQUIPMENT[1]

Equipment	Layout Drawing Location
a. Diesel Generator Building	
Diesel Generator, A (Including skid mounted equipment)	1DG-1c
Diesel Generator, B (Included skid mounted equipment)	1DG-1a
Diesel Generator High Voltage Exciter Cabinet, A	1DG-1c
Diesel Generator High Voltage Exciter Cabinet, B	1DG-1a
Diesel Generator, Generator Control Panel, A	1DG-1c
Diesel Generator, Generator Control Panel, B	1DG-1a
Diesel Generator Engine Control Panel, A	1DG-1c
Diesel Generator Engine Control Panel, B	1DG-1a
Starting Air Receiver Tanks, 1A/2A	1DG-1c
Starting Air Receiver Tanks, 1B/2B	1DG-1a
Fuel Oil Day Tank, A	1DG-1c
Fuel Oil Day Tank, B	1DG-1a
Fuel Oil Transfer Pumps, 1A	1DG-1c
Fuel Oil Transfer Pumps, 1B	1DG-1a
Ventilation Fans, 1A	1DG-1c
Ventilation Fans, 1B	1DG-1a
Air Intake Filter, 2A/3A	1DG-1c
Air Intake Filter, 2B/3B	1DG-1a
b. Control Complex, Floor 1 (Elevation 574'-10")	
Equipment	
Emergency Closed Cooling Pump, A	CC-1b
Emergency Closed Cooling Pump, B	CC-1a
Emergency Closed Cooling Heat Exchangers, A	CC-1b
Emergency Closed Cooling Heat Exchangers, B	CC-1a

TABLE 9A.3-1 (Continued)

	Equipment	Layout Drawing Location
b.	Control Complex, Floor 1 (Continued)	
	Control Complex Water Chiller, A	CC-1c
	Control Complex Water Chiller, B	CC-1c
	Control Complex Chilled Water Pump, A	CC-1c
	Control Complex Chilled Water Pump, B	CC-1c
	Emergency Closed Cooling Pump Area Air Handling Panel, A	CC-1b
	Emergency Closed Cooling Pump Area Air Handling Panel, B	CC-1a
	Emergency Closed Cooling/Chilled Water Inst. Rack, A	CC-1c
	Emergency Closed Cooling/Chilled Water Inst. Rack, B	CC-1c
	Control Complex Chilled Water Control Panel, A	CC-1c
	Control Complex Chilled Water Control Panel, B	CC-1c
	Emergency Pump Area Cooling System Air Handling Unit, A	CC-1b
	Emergency Pump Area Cooling System Air Handling Unit, B	CC-1a
c.	Control Complex, Floor 3 (Elevation 620’-6”)	
	Equipment	
	4.16 kV Switchgear Bus, Division 1	1CC-3c
	4.16 kV Switchgear Bus, Division 2	1CC-3a
	480V Switchgear Bus, Division 1	1CC-3c
	480V Switchgear Bus, Division 2	1CC-3a
	Motor Control Centers, Division 1	1CC-3c
	Motor Control Centers, Division 2	1CC-3a
	Remote Shutdown Panel	1CC-3d
d.	Control Complex, Floor 4 (Elevation 638’-6”)	
	Batteries, Division 1	1CC-4h
	Batteries, Division 2	1CC-4d

TABLE 9A.3-1 (Continued)

Equipment	Layout Drawing Location
d. Control Complex, Floor 4 (Continued)	
Battery Chargers, A	1CC-4g
Battery Chargers, B	1CC-4c
125 Vdc Switchgear Bus, Division 1	1CC-4g
125 Vdc Switchgear Bus, Division 2	1CC-4c
125 Vdc MCC, Division 1	1CC-4g
125 Vdc MCC, Division 2	1CC-4c
125 Vdc Distribution Panel, Division 1	1CC-4g
125 Vdc Distribution Panel, Division 2	1CC-4c
e. Control Complex, Floor 5 (Elevation 654'-6")	
Equipment	
ECCS Bench Board, P-601	1CC-5a
Auxiliary Relay Panels, P-618, 629	1CC-5a
Unit Control Console, P-680	1CC-5a
RPS Instrumentation and Auxiliary Relay Panel, P-691, 692, 693, 694	1CC-5a
HVAC Control Panel, P-800	1CC-5a
Analog Loop Instrument Panel, P-868,	1CC-5a
Diesel Generator Bench Board, P-877	1CC-5a
Containment/Drywell Isolation Valve Panel, P-881	1CC-5a
Common HVAC Control Panel, P-904	1CC-5a
f. Control Complex, Floor 6 (Elevation 679'-6")	
Control Room HVAC Supply Plenum, A	2CC-6
Control Room HVAC Supply Plenum, B	1CC-6
Control Room HVAC Supply Fan, A	2CC-6
Control Room HVAC Supply Fan, B	1CC-6

TABLE 9A.3-1 (Continued)

	Equipment	Layout Drawing Location
f.	Control Complex, Floor 6 (Continued)	
	Control Room HVAC Recirculation Fan, A	2CC-6
	Control Room HVAC Recirculation Fan, B	1CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area HVAC Plenum, A	2CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area HVAC Plenum, B	1CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area Supply Fan, A	2CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area Supply Fan, B	1CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area Return Fan, A	2CC-6
	MCC, Switchgear & Misc. Electrical Equipment Area Return Fan, B	1CC-6
	Battery Room Exhaust Fan, A	2CC-6
	Battery Room Exhaust Fan, B	1CC-6
	MCC, Switchgear, and Misc. Electric Equipment Area HVAC, and Battery Room Exhaust System Instrument Rack, P-164, 166	2CC-6
	MCC, Switchgear, and Misc. Electric Equipment Area HVAC, and Battery Room Exhaust System Instrument Rack, P-165, 167	1CC-6
	Control Room HVAC and Emergency Recirculation Instrument Rack, P-152	2CC-6
	Control Room HVAC and Emergency Recirculation Instrument Rack, P-153	1CC-6
	HVAC System Control Panel, A	2CC-6
	HVAC System Control Panel, B	1CC-6
g.	Intermediate Building	
	Instrument Air Receiver Tank, A, and Isolation Valve	IB-2

TABLE 9A.3-1 (Continued)

Equipment	Layout Drawing Location
h. Auxiliary Building	
Equipment	
Residual Heat Removal Heat Exchangers, A/C	1AB-1b
Residual Heat Removal Heat Exchangers, B/D	1AB-1e
Residual Heat Removal Pump, A	1AB-1b
Residual Heat Removal Pump, B	1AB-1e
Residual Heat Removal Pump, C	1AB-1d
Residual Heat Removal Valves, A	1AB-1b
Residual Heat Removal Valves, B	1AB-1e
Residual Heat Removal Valves, C	1AB-1d
RHR Pump Room Cooling Air Handling Unit, A	1AB-1b
RHR Pump Room Cooling Air Handling Unit, B	1AB-1e
RHR Pump Room Cooling Air Handling Unit, C	1AB-1d
Reactor Core Isolation Cooling Lube Oil Cooler	1AB-1c
RCIC Turbine Drive	1AB-1c
RCIC Pump	1AB-1c
RCIC Valves	1AB-1b,c
RCIC Pump Room Cooling Air Handling Unit	1AB-1c
Instrument Air Receiver Tank, B and Isolation Valve	1AB-3a
RCIC Instrument Panel	1AB-1g
Low Pressure Core Spray Pump	1AB-1a
Low Pressure Core Spray Valves	1AB-1a,c
Low Pressure Core Spray Air Handling Unit	1AB-1a
RHR Instrument Panel, A	1AB-1g
RHR Instrument Panel, B	1AB-1g
RHR Instrument Panel, C	1AB-1g
HVAC Pump Room Cooling Control Panels, Division 1 and 2	1AB-2
ESW Valves	1AB-1b,e

TABLE 9A.3-1 (Continued)

Equipment	Layout Drawing Location
i. Reactor Building	
Control Rod Drive Mechanisms	1RB-1d
Control Rod Drive Hydraulic Control Units	1RB-1b
Automatic Depressurization System (ADS) Valves	1RB-1c
Safety-related Instrument Air Isolation Valves	1RB-1b
Safety/Relief ADS Valve Air Accumulators	1RB-1c
Reactor Level & Pressure Instrumentation Rack, A	1RB-1b
Reactor Level & Pressure Instrumentation Rack, B	1RB-1b
Reactor Level & Pressure Instrumentation Rack, C	1RB-1b
Reactor Level & Pressure Instrumentation Rack, D	1RB-1b
Main Steam Line Isolation Valves	1RB-1c
RCIC Isolation Valve	1RB-1c
RHR Valves	1RB-1b
RHR Shutdown Valve	1RB-1c
j. Emergency Service Water Pumphouse	
Equipment	
Emergency Service Water Pump, A	ESW-1a
Emergency Service Water Pump, B	ESW-1a
Emergency Service Water Screen Wash Pump, A	ESW-1a
Emergency Service Water Screen Wash Pump, B	ESW-1a
Emergency Service Water Pumphouse Intake Screen, A	ESW-1a
Emergency Service Water Pumphouse Intake Screen, B	ESW-1a
Emergency Service Water Screen Wash Pump Discharge Strainer, A	ESW-1a
Emergency Service Water Screen Wash Pump Discharge Strainer, B	ESW-1a
Emergency Service Water Ventilation Fan, A	ESW-1a
Emergency Service Water Ventilation Fan, B	ESW-1a

TABLE 9A.3-1 (Continued)

	Equipment	Layout Drawing Location
j.	Emergency Service Water Pumphouse (Continued)	
	Equipment	
	Motor Control Centers, Division 1	ESW-1a
	Motor Control Centers, Division 2	ESW-1a
k.	Steam Tunnel	
	Main Steam Line Isolation Valves	Steam Tunnel
	RHR Shutdown Valve (including interfacing system isolation valves B21-F065A/B)	Steam Tunnel
	RCIC Valve	Steam Tunnel
l.	Yard Area	
	Diesel Generator Fuel Oil Storage Tank, A	Yard
	Diesel Generator Fuel Oil Storage Tank, B	Yard
	Condensate Storage Tank	Yard

NOTE:

(1) Only major equipment is listed.

9A.4 FIRE HAZARDS ANALYSIS

9A.4.1 UNIT 1 REACTOR BUILDING

The Unit 1 reactor building is the structure that houses the reactor vessel. The reactor building is comprised of the shield building and the primary steel containment vessel and extends from Elevation 574’-10” to Elevation 767’-5”. In addition to containing the reactor vessel and associated support systems, the reactor building contains the control rod drive (CRD) hydraulic units, refueling auxiliaries, reactor water cleanup (RWCU) equipment, recirculation flow control hydraulic power units, and miscellaneous HVAC equipment, and also maintains the primary radiological boundary and pressure containment for the plant. The reactor building is adjacent to the auxiliary building, intermediate building and fuel handling building.

The reactor building ventilation system is comprised of two subsystems: drywell cooling and containment vessel cooling. The drywell cooling system consists of three fan cooler assemblies, each with one 100 percent capacity supply plenum and two 100 percent capacity supply fans. The containment vessel cooling system consists of six 25 percent capacity air handling units.

The reactor building purge system is comprised of three subsystems: containment purge supply (2) and containment purge exhaust. The containment purge supply system consists of two 50 percent capacity plenums and supply fans to provide filtered and heated outside air to the containment vessel. The containment purge exhaust system consists of two 50 percent capacity exhaust fans and charcoal filter trains. This system exhausts air from the containment vessel through charcoal filters and to the plant vent. Supply air to and exhaust air from the drywell is purged by this system during refueling operations only. The

42 inch purge supply and exhaust system penetrations consist of 0.375 inch thick pipe and two Class 2 valves in series. These valves are normally closed except for purge operation (intermittent). They are capable of being closed remote-manually from the control room.

Air handling for the annulus is accomplished by an exhaust gas treatment system consisting of two 100 percent capacity exhaust fans and charcoal filter trains. This system maintains a negative pressure relative to the outside so that exfiltration and ground level release of airborne radioactivity is minimized. All ventilation ducts penetrating the shield building wall are provided with 3 hour rated fire dampers with standard 160°F fusible links.

For purposes of this fire hazards analysis, the entire reactor building is considered a single fire area. This fire area is divided into four fire zones: Fire Zone 1RB-1a is the annulus outside of the steel containment vessel; Fire Zone 1RB-1b is the zone located inside the containment vessel and outside the drywell wall; Fire Zone 1RB-1c is the zone inside the drywell and includes the reactor vessel; Fire Zone 1RB-1d is the zone directly underneath the reactor vessel within the reactor pedestal wall.

The low overall combustible loading, along with the high ceilings, would limit the potential of a postulated fire to cross the zone boundaries described. Therefore, the zone boundaries provide adequate separation of redundant trains in adjacent zones. The fire hazard analysis for this area addresses the separation of redundant shutdown methods within each zone.

A complement of fire extinguishers is located at the entrance to containment in a cabinet. These extinguishers are to be carried in during emergency fire situations. During shutdown, a supply of fire extinguishers will be taken into and kept in containment during maintenance operations.

9A.4.1.1 Unit 1 Reactor Building Fire Zones

9A.4.1.1.1 Fire Zone 1RB-1a

9A.4.1.1.1.1 Description

Fire Zone 1RB-1a is shown on <Figure 9A-2>, <Figure 9A-5>, <Figure 9A-10>, <Figure 9A-14>, <Figure 9A-18>, <Figure 9A-22>, <Figure 9A-25>, <Figure 9A-27>, <Figure 9A-28>, and <Figure 9A-29>. This zone, referred to as the annulus, is located between the shield building wall and the containment vessel wall. It serves as a secondary barrier for maintaining the radiation doses within the limits specified by <10 CFR 50.67>.

The outside wall and ceiling (dome) of this fire zone are constructed of reinforced concrete. The inside wall and ceiling (dome) are the steel containment vessel. The outer concrete wall has a 3 hour fire resistance rating. The wall provides separation of redundant trains of safe shutdown equipment. The floor is constructed of reinforced concrete. The annulus at 574’-10” has been filled with concrete from Elevation 574’-10” to Elevation 598’-4”. Wall and ceiling penetrations have 3 hour fire rated seals. Access to this zone is through a Class A fire door from the auxiliary building.

The ventilation system for this fire zone operates to maintain a negative pressure in the annulus relative to the outside to minimize exfiltration and ground level release of airborne activity. This system consists of two 100 percent capacity charcoal filter trains with exhaust fans located in the intermediate building. Smoke detectors are located in the discharge ducts of each fan to actuate an alarm in the control room if smoke is detected. Duct penetrations through the shield building wall are provided with 3 hour rated fire dampers with 160°F fusible links.

Safe shutdown equipment in this fire zone consists of:

a. Reactor protection system (RPS) cables, Division 1, Division 2, Division 3, and Division 4.

b. Power and control cables, Division 1 and Division 2.

Fire detection is provided by the duct smoke detectors.

9A.4.1.1.1.2 Analysis

Both divisions of redundant circuits required for safe shutdown are located in this fire zone. Electrical penetration assemblies for all divisions are located in the southwest portion (Quadrant 3) of the annulus. Penetrations are arranged in vertical and horizontal rows such that Division 1 and Division 4 penetrations are separated from Division 2 and Division 3 penetrations by a minimum of 12 feet.

Combustibles contained within this fire zone consist of cable insulation and lubricating oil. Total fire loading contained in the 1,963 ft^2 floor area of this fire zone is less than 15,000 Btu/ft^2.

Since electrical penetration assemblies are located in a 35 foot segment of Quadrant 3, special consideration was given to the concentrated fire loading of 104,000 Btu/ft^2 in this region. The penetration cables are installed in enclosed raceways in the annulus. These enclosed raceways, consisting of stainless steel tubes, act as radiant energy shields surrounding the cables. Each electrical penetration assembly provides at least 3 hour fire protection for the cable penetration. No additional protection is required.

9A.4.1.1.1.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging both redundant divisions of safe shutdown cable is achieved. This is accomplished by spatial separation and cable encasement, and fire detection provided by the duct smoke detectors. In the event of a fire in this zone, Division 1 or Division 2 will be available for shutdown, depending upon the location of the fire.

9A.4.1.1.2 Fire Zone 1RB-1b

9A.4.1.1.2.1 Description

Fire Zone 1RB-1b is shown on <Figure 9A-2>, <Figure 9A-5>, <Figure 9A-10>, <Figure 9A-14>, <Figure 9A-18>, <Figure 9A-22>, <Figure 9A-25>, <Figure 9A-27>, and <Figure 9A-29>. It comprises the region from the steel containment vessel to the concrete drywell wall.

The outside wall and ceiling (dome) of this fire zone are constructed of steel. The inside wall and floor are constructed of reinforced concrete. Doors consist of double-doored steel/concrete personnel access hatches and equipment hatches. Wall and ceiling penetrations have 3 hour fire rated seals, (including the 3” rattle space at the hatch areas) except for the suppression pool vents on the inside wall which are under water. The drywell wall is rated 3 hours above the suppression pool to the reactor head cover.

The cooling system for this zone operates primarily to provide cooling only for the containment vessel. This system uses six 25 percent capacity air handling units, located in the containment vessel, which supply cooled, recirculated air to various areas of the containment vessel through distribution ductwork. Temperature detectors mounted in the ducts, and area temperature detectors are provided to actuate alarms in the control room if the ambient temperature is too high.

The purge supply system provides filtered and heated outside air to the containment vessel. This system consists of two 50 percent capacity supply plenums and two 50 percent capacity supply fans. Smoke detectors are provided in the discharge duct of the supply fans to actuate an alarm in the control room and trip the fans if smoke is detected.

The purge exhaust system draws air from the containment vessel and drywell area (refueling operations only), exhausting it through the plant vent after it passes through the charcoal filters. Two 50 percent capacity charcoal filter trains with exhaust fans are provided for this system. A smoke detector is provided at the common discharge duct for the fan and will actuate an alarm in the control room if smoke is detected.

The above equipment, except drywell purge supply fans, is located in the intermediate building. The drywell purge supply fans are located in the containment vessel.

Safe shutdown equipment for this fire zone consists of:

a. Control rod drive hydraulic control units (HCU)

b. Reactor vessel level and pressure instrument racks, A, B, C, and D

c. RPS cables, Division 1, Division 2, Division 3, and Division 4

d. Power and control cables, Division 1 and Division 2

e. Residual heat removal (RHR) valves

Fire detection equipment in this zone consists of smoke and heat detectors above floor Elevations 599’-0”, 620’-6”, 654’-6”, and 664’-7”. In addition, smoke will be drawn to the duct smoke detectors. Fire suppression equipment consists of manual water type hose stations.

9A.4.1.1.2.2 Analysis

Both divisions of redundant components and circuits required for safe shutdown are located in this fire zone. The control rod drive mechanisms are located in Fire Zone 1RB-1d <Appendix 9A.4.1.1.4>. RPS sensors are located in this zone.

The two groups of the HCUs are physically separated at 90° and 270° azimuths.

In those locations where redundant circuits needed for safe shutdown are located in close proximity (less than 20 feet), radiant energy shields are installed to prevent a fire from damaging both divisions. Manual action will compensate for the effects of fire on the remaining circuits needed for cold shutdown.

The RPS sensors in this zone are located in a series of instrument panels. Each primary parameter is measured by a set of four independent RPS sensors. Sensors in a set are assigned different divisions and are located in different panels that are spatially separated from each other (90° apart around the Reactor Building).

Redundant RHR valves required for safe shutdown are also provided with adequate separation (approximately 90° apart around the reactor building).

Combustibles contained within this fire zone consist of cable insulation, lubricating oil, electrical panels, motor windings, hydraulic fluid, grease and component insulation. Total fire loading contained in the 6,382 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2. Combustible loading on the refueling floor elevation is limited to less than 6,500 Btu/ft^2.

This combustible loading is distributed over the five levels of the area. The fire loading exposing safe shutdown equipment in any part of the area would be less than 1/2 hour.

9A.4.1.1.2.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging both divisions of redundant cables or equipment required for safe shutdown is achieved. This is accomplished by providing radiant energy shields or adequate spacial separation between the redundant components and circuits. In addition an early warning fire detection system is provided at locations where fire could jeopardize redundant equipment. In the event of a fire in this zone, Division 1 or Division 2 will be available for shutdown, depending upon the location of the fire.

9A.4.1.1.3 Fire Zone 1RB-1c

9A.4.1.1.3.1 Description

Fire Zone 1RB-1c is shown on <Figure 9A-2>, <Figure 9A-5>, <Figure 9A-10>, <Figure 9A-14>, <Figure 9A-18>, <Figure 9A-22>, and <Figure 9A-23>. It comprises the region inside the drywell including the reactor vessel but excluding the area directly beneath the reactor. This zone serves as the structure that channels steam releases to the suppression pool, as well as housing the reactor vessel, reactor recirculation system and other auxiliary systems.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Wall doors consist of double-doored steel/concrete personnel access hatches and an equipment hatch. Wall penetrations have 3 hour fire rated seals, except for the suppression pool vents which are under water. The drywell wall is rated 3 hours above the suppression pool to the reactor head cover.

The drywell cooling system operates primarily to provide cooling only for the drywell area. This system uses three 100 percent capacity fan cooler assemblies, each with a supply plenum and two supply fans located in the drywell. The fan cooler units supply recirculated, cooled air to the drywell area through distribution ductwork. Temperature detectors mounted in the ducts, and area temperature detectors are provided to actuate alarms in the control room if the ambient temperature is too high.

During the drywell purge mode (refueling operations only), the two 50 percent capacity drywell purge supply fans (located within the containment vessel) direct supply air from the containment vessel into the drywell area. This supply air is then circulated by the drywell cooling system.

The purge exhaust system for this fire zone is the same as for Fire Zone 1RB-1b <Appendix 9A.4.1.1.2>.

Safe shutdown equipment for this fire zone consists of:

a. Automatic depressurization system (ADS) valves

b. ADS valve air accumulators

c. Residual heat removal (RHR) valves

d. Reactor core isolation cooling valves

e. Main steam line isolation valves

f. Power and control cables, Division 1 and Division 2

g. RPS cables, Division 1, Division 2, Division 3, and Division 4

Heat detection, for fire warning and suppression system activation, is provided at the reactor recirculation pumps. Fire suppression equipment for this zone consists of a local application type carbon dioxide system for the reactor recirculation pumps. Additional lengths of hose are staged at hose stations in the adjacent Fire Zone 1RB-1b for use in drywell.

9A.4.1.1.3.2 Analysis

Both divisions of redundant components and circuits required for safe shutdown are located in this fire zone. The ADS valves provide a redundant means for transferring the reactor vessel water to the RHR system (via the suppression pool cooling mode of the RHR system) should the RHR shutdown suction valves become inoperative. The physical separation between the ADS valves and the RHR shutdown suction valves is adequate (approximately 90° apart around the reactor building). Structural features function as radiant energy shields to prevent a fire from damaging both trains, where redundant circuits needed for safe shutdown are located less than 20 feet apart. Manual action will compensate for the effects of fire on the remaining circuits needed for cold shutdown.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil, hydraulic fluids, grease, electrical panels, lead blankets with herculite covering, and motor windings. Total fire loading contained in the 2,603 ft^2 floor area of this fire zone is less than 52,000 Btu/ft^2.

Since combustibles are concentrated in the area of the recirculation pump, special consideration was given to the potential for a fire in this region. However, fire detection and suppression systems are provided to minimize any damage in this fire zone.

9A.4.1.1.3.3 Conclusions

The results of the analysis for this fire zone indicates that the objective of preventing a fire from damaging redundant equipment required for safe shutdown is achieved. This is accomplished by physical separation of redundant equipment and fire detection and suppression systems provided for the reactor recirculation pumps. Also, redundant raceways are adequately separated. In the event of a fire in this zone, Division 1 or Division 2 will be available for shutdown, depending upon the location of the fire.

9A.4.1.1.4 Fire Zone 1RB-1d

9A.4.1.1.4.1 Description

Fire Zone 1RB-1d is shown on <Figure 9A-2>, <Figure 9A-5> and <Figure 9A-29>. It is the region directly below the reactor vessel and inside the vessel pedestal. This zone contains the control rod drives, neutron monitoring equipment and other under-vessel servicing equipment.

Walls and floor of this fire zone are constructed of reinforced concrete. Ventilation air is circulated through this zone by vents in the pedestal wall.

Safe shutdown equipment for this fire zone consists of the control rod drive mechanism.

Heat detectors are located beneath the reactor vessel to provide a fire signal to annunciate in the control room.

9A.4.1.1.4.2 Analysis

Redundancy for the control rod drive mechanism is not required.

The only combustible in this fire zone consists of cable insulation. This material, contained in the 301 ft^2 floor area, yields a fire loading of less than 90,000 Btu/ft^2 for this fire area.

9A.4.1.1.4.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire in this zone from damaging equipment required for safe shutdown in another zone is achieved. This is accomplished by separation of equipment and provision of a fire detection system.

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9A.4.2 UNIT 1 AUXILIARY BUILDING

The Unit 1 auxiliary building is a three story building constructed of reinforced concrete. Floor 1 is located at Elevations 568’-4” and 574’-10”, Floor 2 is at Elevation 599’-0” and Floor 3 is at Elevation 620’-6” (grade). This building houses auxiliary equipment for plant operation such as the residual heat removal (RHR) system, reactor core isolation cooling (RCIC) system, high and low pressure core spray (HPCS, and LPCS, respectively), reactor water cleanup (RWCU) system, instrument air systems, and ventilation systems. The third floor is divided by the portion of the steam tunnel that passes through the auxiliary building from the reactor building to the turbine power complex enroute to the turbine building. The auxiliary building is adjacent to the reactor building, intermediate building, the turbine power complex, and the radwaste building; the remainder of the building is exposed.

The ventilation system for the auxiliary building consists of a 100 percent capacity supply plenum, two 100 percent capacity supply fans, a 100 percent capacity charcoal exhaust plenum, two 100 percent capacity exhaust fans, and distribution ductwork. Fans and plenums are at Elevation 620’-6”. The supply fans draw outside air through filters and heating coils and distribute the air as follows: to the corridors at Elevations 574’-10”, 599’-0” and 620’-6”, and to each of the pump rooms (RHR “A”, “B”, “C”; RCIC, LPCS, HPCS; etc.). Air supplied to the corridor and pump rooms at Elevation 574’-10” is exhausted through ductwork at that level. Part of the air is used to ventilate the room before being exhausted. Part of the air supplied to the equipment area at Elevation 620’-6” is drawn into the RHR “A” and “B” pump rooms and then it is exhausted. Exhaust air passes through the charcoal exhaust plenum prior to discharge to the atmosphere through the unit vent. Air from the steam tunnel is partially exhausted by the auxiliary building exhaust. The rest of the air supplied to the steam tunnel (by a separate steam tunnel cooling system) is relieved to the turbine building.

Ventilation duct penetrations in the auxiliary building (except for ductwork and openings in the walls of RHR “A” and “B” pump rooms at Elevation 620’-6” and the floor above the RCIC pump room) are provided with 3 hour rated fire dampers with standard 160°F fusible links.

Smoke detectors are provided in the common duct of the supply fans and on the common ductwork on the discharge of the exhaust fans. Upon detection of smoke, these detectors will actuate an alarm in the control room and illuminate the alarm light on the local HVAC control panel. In addition, if the smoke is in the supply ductwork, the smoke detector on the discharge side of the supply fans will send a signal to trip both supply fans, thereby cutting off the flow of supply air.

For purposes of this fire hazards analysis, the auxiliary building has been divided, by floors, into numerous fire areas and fire zones. These zones are shown on <Figure 9A-2>, <Figure 9A-5> and <Figure 9A-10>.

9A.4.2.1 Unit 1 Auxiliary Building Fire Areas and Zones

9A.4.2.1.1 Fire Area 1AB-1a

9A.4.2.1.1.1 Description

Fire Area 1AB-1a, shown on <Figure 9A-2>, is located in the eastern section of Floor 1 of the auxiliary building (Elevation 568'-4") and contains the process and auxiliary components for the LPCS system. It is bounded on the north and east by Fire Area 1AB-1g, on the south by the Unit 1 reactor building and on the west by Fire Zone 1AB-1b.

Walls, floor and ceiling for this fire area are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings. Wall and ceiling penetrations have 3 hour fire rated seals. Floor drains for this area are routed to a sump located within the area. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the area.

The ventilation system for this fire area is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the area when the LPCS pump is operating.

Safe shutdown equipment in this area consists of:

a. LPCS pump

b. LPCS suction valve

c. LPCS air handling unit

Fire suppression equipment for this area consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.1.2 Analysis

Only Division 1 safe shutdown equipment is located in this fire area. Redundant equipment is located in other areas and zones.

Combustibles contained within this fire area consist of cable insulation, lubricating oil, and motor winding. Total fire loading contained in the 1,588 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

9A.4.2.1.1.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from spreading to adjacent areas or zones containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and low fire loading. For a fire in this area, shutdown could be accomplished using Division 2.

9A.4.2.1.2 Fire Zone 1AB-1b

9A.4.2.1.2.1 Description

Fire Zone 1AB-1b is shown on <Figure 9A-2>, <Figure 9A-5> and <Figure 9A-10>. It includes, in addition to the Floor 1 location, identical regions directly above on Floor 2 (Elevation 599'-0") and Floor 3 (Elevation 620'-6"). This composite zone contains the process and auxiliary components for the RHR "A" system on each respective floor. It is bounded on the north by Fire Area 1AB-1g (Elevation 568'-4"), Fire Zone 1AB-2 (Elevation 599'-0") and Fire Zone 1AB-3a (Elevation 620'-6"); on the east by Fire Area 1AB-1a, Fire Zone 1AB-2 (Elevation 599'-0") and Fire Zone 1AB-3a (Elevation 620'-6"); on the south by the Unit 1 reactor building; on the west by Fire Zone 1AB-1c, Fire Zone 1AB-2 (Elevation 599'-0") and the steam tunnel (Elevation 620'-6").

Walls, floor and ceiling (roof) for this fire zone are constructed of reinforced concrete. Doorways are equipped with a Class A fire door at Elevation 568’-4”, a Class A fire door at Elevation 599’-0” and a Class A door at Elevation 620’-6”. Walls have 3 hour fire resistance ratings, except for the wall containing the pressure relief opening from Elevation 620’-6” to 652’-0” (roof). Wall penetrations have 3 hour fire rated seals, except for the wall from 620’-6” to 652’-6” where an unsealed pressure relief opening exists in the wall to Fire Zone 1AB-3a. Zones 1AB-1b and 1AB-3a form a larger fire area due to this unprotected opening. The north and east walls provide separation of redundant trains of safe shutdown equipment. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone.

The ventilation system for this fire zone is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the zone when the RHR “A” pump is operating.

Safe shutdown equipment in this fire zone consists of:

a. RHR heat exchangers, A and C

b. RHR pump, A

c. RHR pump room cooling air handling unit, A

d. Power and control cables, Division 1 and Division 2, Unit 1

e. RHR valves, A

f. RCIC valves

g. ESW valves

h. LPCS valves

Fire detection for this zone consists of smoke detectors that actuate alarms in the control room. Fire suppression equipment consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.2.2 Analysis

Only Division 1 safe shutdown components and both divisions of safe shutdown circuits are located in this fire zone. Redundant components are located in other zones and areas. Manual action will compensate for the effects of fire on most of the Division 2 equipment required for cold shutdown.

Zone 1AB-3a, which forms a fire area with Zone 1AB-1b, also contains redundant components and circuits of Division 2. There is more than 20 ft separation between the redundant equipment and the unprotected opening, with no continuity of combustibles.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil and grease, raceway fire barrier material and motor windings. Total fire loading contained in the 1,298 ft^2 floor area of this fire zone is less than 25,000 Btu/ft^2.

9A.4.2.1.2.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging redundant equipment required for safe shutdown is achieved. This is accomplished by spatial separation and barrier design, low fire loading, and early warning fire detection. Also, a fire in Zone 1AB-1b would not affect safe shutdown components in Zone 1AB-3a. In the event of a fire in Zone 1AB-1b, safe shutdown could be accomplished using Division 2.

9A.4.2.1.3 Fire Zone 1AB-1c

9A.4.2.1.3.1 Description

Fire Zone 1AB-1c, shown on <Figure 9A-2>, is located in the right center portion of Floor 1 of the auxiliary building. It contains process and auxiliary equipment for the RCIC system. This zone is bounded on the north by Fire Area 1AB-1g, on the east by Fire Zone 1AB-1b, on the south by the Unit 1 reactor building, and on the west by Fire Area 1AB-1d.

Walls, floor and ceiling for this fire zone are constructed of reinforced concrete. The doorway has a Class A fire door. Walls have 3 hour fire resistance ratings. Wall penetrations have 3 hour fire rated seals. A portion of the ceiling has grating for pressure relief. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone. A larger fire area is formed by the addition of Fire Zone 1AB-2, located directly above <Figure 9A-5> due to the unprotected opening in the floor/ceiling separating the two zones. The north and west walls provide separation of redundant trains of safe shutdown equipment.

The ventilation system for this fire zone is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the zone when the RCIC pump is operating.

Safe shutdown equipment in this fire zone consists of:

a. RCIC pump room air handling unit

b. RCIC pump

c. RCIC turbine lubricating oil cooler

d. RCIC turbine drive

e. Power and control cables, Division 1, Unit 1

f. RCIC valves

Fire detection is provided for this zone by smoke detectors that activate alarms in the control room.

Fire suppression equipment for this zone consists of an automatic sprinkler system, manual type water hose stations and fire extinguishers.

9A.4.2.1.3.2 Analysis

Only Division 1 safe shutdown equipment is located in this fire zone. If the high pressure injection capabilities of the RCIC system become inoperative, the automatic depressurization system (ADS) can be used to decrease the reactor vessel pressure so the low pressure injection systems can be activated for reactor vessel water level control.

The larger fire area, including Zone 1AB-2, contains components and circuits for Division 1 and circuits for Division 2. Division 2 circuits within the larger area are separated from this zone by concrete barriers or are enclosed in a 1 hour wrap.

Special attention was given to the case of lubricating oil spillage. Should the lubricating oil system rupture, the oil will drain to a sump located within the room and not allow it to spread to adjacent zones. The sump is discharged through a line that is valve operated from outside the zone.

The motor-operators on the RCIC valves will not be affected by an inadvertent actuation of the sprinkler system. These motor-operators are enclosed to prevent water spray from rendering them inoperative. The motor associated with the water leg pump could be rendered inoperative, but this would have no impact on main process equipment operation.

Combustibles contained within this fire zone consist of cable insulation, motor windings, lubricating oil and grease. Total fire loading contained in the 560 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

9A.4.2.1.3.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing safe shutdown equipment is achieved. This is accomplished by barrier design, low fire loading and early warning fire detection. The automatic sprinkler system provided for this zone adds further depth in preventing a fire from spreading. For a fire in this zone, safe shutdown could be accomplished using Division 2.

9A.4.2.1.4 Fire Area 1AB-1d

9A.4.2.1.4.1 Description

Fire Area 1AB-1d, shown on <Figure 9A-2>, is located in the left center portion of Floor 1 of the auxiliary building. It contains process and auxiliary equipment for the RHR “C” system. This area is bounded on the north by Fire Area 1AB-1g, on the east by Fire Zone 1AB-1c, on the south by the Unit 1 reactor building, and on the west by Fire Zone 1AB-1e.

Walls, floor and ceiling for this fire area are constructed of reinforced concrete. The doorway has a Class A fire door. Walls and ceiling have 3 hour fire resistance ratings. Wall and ceiling penetrations have 3 hour fire rated seals. The north and east walls provide separation of redundant trains of safe shutdown equipment. Floor drains for this area are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the area.

The ventilation system for this fire area is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the area when the RHR "C" pump is operating.

Safe shutdown equipment in this fire area consists of:

a. RHR C pump

b. RHR C pump room air handling unit

c. RHR valves, C

d. Power and control cables, Division 2, Unit 1

Fire suppression equipment for this area consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.4.2 Analysis

Only Division 2 safe shutdown equipment is located in this fire area. Redundant equipment is located in other areas and zones.

Combustibles contained within this fire area consist of cable insulation, lubricating oil and grease, and motor windings. Total fire loading contained in the 560 ft^2 floor area of this fire zone is less than 30,000 Btu/ft^2.

9A.4.2.1.4.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and low fire loading. For a fire in this area, shutdown could be accomplished using Division 1.

9A.4.2.1.5 Fire Zone 1AB-1e

9A.4.2.1.5.1 Description

Fire Zone 1AB-1e is shown on <Figure 9A-2>, <Figure 9A-5> and <Figure 9A-10>. It includes, in addition to the Floor 1 location, identical regions directly above on Floor 2 (Elevation 599′-0″) and Floor 3 (Elevation 620′-6″). This composite zone contains the process and auxiliary components for the RHR "B" system on each respective floor. It is bounded on the north by Fire Area 1AB-1g (Elevation 568′-4″), Fire Zone 1AB-2 (Elevation 599′-0″) and Fire Zone 1AB-3b (Elevation 620′-6″); on the east by Fire Area 1AB-1d, Fire Zone 1AB-2 (Elevation 599′-0″) and the steam tunnel (Elevation 620′-6″); on the south by the Unit 1 reactor building; on the west by Fire Area 1AB-1f, Fire Zone 1AB-2 (Elevation 599′-0″) and Fire Zone 1AB-3b (Elevation 620′-6″).

Walls, floor and ceiling (roof) for this fire zone are constructed of reinforced concrete. Doorways are equipped with a Class A fire door at Elevation 568′-4″, a Class A fire door at Elevation 599′-0″ and a Class A door at Elevation 620′-6″. Walls have 3 hour fire resistance ratings, except for the walls containing pressure relief openings from Elevation 620′-6″ to 652′-0″ (roof). Wall penetrations have 3 hour fire rated seals, except for the walls from 620′-6″ to 652′-0″ where unsealed pressure relief openings exist in the wall to Fire Zone 1AB-3b. Zones 1AB-1e and 1AB-3b form a larger fire area due to this unprotected opening. The north and west walls provide separation of redundant trains of safe shutdown equipment. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone.

The ventilation system for this fire zone is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the zone when the RHR "B" pump is operating.

Safe shutdown equipment in this fire zone consists of:

a. RHR heat exchangers, B and D

b. RHR pump, B

c. RHR pump room cooling air handling unit, B

d. Power and control cables, Division 1 and Division 2, Unit 1

e. RHR valves, B

f. ESW valves

Fire detection for this area consists of smoke detectors that actuate alarms in the control room.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.5.2 Analysis

Only Division 2 safe shutdown components and both divisions of safe shutdown circuits are located in this fire zone. Redundant components are located in other zones and areas. Manual action will compensate for the effects of fire on most of the Division 1 equipment required for cold shutdown. Remaining Division 1 equipment, consisting of MSIV circuits, can be lost since redundant equipment is available in other zones and areas. Zone 1AB-3b, which forms the larger fire area with Zone 1AB-1e, also contains circuits for RCIC but these circuits are not needed for safe shutdown. Components and circuits for the LPCS system (Division 1) are not located in this fire area and LPCS would be available to provide Reactor Inventory Control.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil and grease, and motor windings. Total fire loading contained in the 1,298 ft^2 floor area of this fire zone is less than 50,000 Btu/ft^2.

9A.4.2.1.5.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging redundant equipment required for safe shutdown is achieved. This is accomplished by barrier design, low fire loading and early warning fire detection. Also, a fire in 1AB-1e will not prevent safe shutdown using equipment required in 1AB-3b. In the event of a fire in Fire Zone 1AB-1e, safe shutdown could be accomplished using Division 1.

9A.4.2.1.6 Fire Area 1AB-1f

9A.4.2.1.6.1 Description

Fire Area 1AB-1f is shown on <Figure 9A-2>, <Figure 9A-5> and <Figure 9A-10>. It is located in the western portion of Floor 1 of the auxiliary building. It has a vertical pipe chase extending to Elevation 620’-6”. This area contains the process and auxiliary components for the HPCS system. It is bounded on the north and west by Fire Area 1AB-1g, on the south by the Unit 1 reactor building and on the east by Fire Zone 1AB-1e.

Walls, floor and ceiling for this fire area are constructed of reinforced concrete. Doorways are equipped with a Class A fire door at Elevation 574'-10" and a Class A fire door at Elevation 620'-6". Walls and ceiling to adjacent areas have 3 hour fire resistance ratings. Wall and ceiling penetrations have 3 hour fire rated seals. Floor drains for this area are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the area.

The ventilation system for this fire area is described in <Appendix 9A.4.2>. In addition, a fan coil unit is provided to cool and circulate air within the area when the HPCS pump is operating.

Safe shutdown equipment in this fire area consists of:

a. RHR valve, A and B

b. Power and control cables, Division 1 and Division 2, Unit 1

Fire suppression equipment for this area consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.6.2 Analysis

Both divisions of safe shutdown components and circuits are located in this area. Manual action will compensate for the effects of fire on equipment required for cold shutdown.

Combustibles contained within this fire area consists of grease, cable insulation, lubricating oil, and motor windings. Total fire loading contained in the 1,588 ft^2 floor area of this fire zone is less than 30,000 Btu/ft^2.

9A.4.2.1.6.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from damaging both divisions of components or circuits needed for safe shutdown is achieved. This is accomplished by barrier design and low fire loading. Division 1 could be used for shutdown in the event of a fire in this area.

9A.4.2.1.7 Fire Area 1AB-1g

9A.4.2.1.7.1 Description

Fire Area 1AB-1g, shown on <Figure 9A-2>, is the common corridor for Floor 1 of the auxiliary building. It provides access to Fire Areas and Zones 1AB-1a through 1AB-1f, and to the intermediate building. It also contains instrument and control panels required for safe shutdown. This area connects on the north to the turbine power complex, on the south to the intermediate building and on the west to the radwaste building; the east side is an outside wall. The turbine power complex pipe tunnel runs beneath the floor on the west side of the area, and opens to the pipe chase in the southwest corner.

Walls, floor and ceiling for this fire area are constructed of reinforced concrete. The doorway to the intermediate building and the doorways to the other Floor 1 zones and fire areas are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings. Wall and ceiling penetrations have 3 hour fire rated seals. The ceiling and parts of the east, west and south walls provide separation of redundant trains of safe shutdown equipment.

The ventilation system for this fire area is described in <Appendix 9A.4.2>.

Safe shutdown equipment in this fire area consists of:

a. RCIC instrument panel

b. RHR “A” instrument panel

c. RHR “B” instrument panel

d. RHR “C” instrument panel

e. RCIC suppression pool level instrumentation

f. Power and control cables, Division 1 and Division 2, Unit 1

g. LPCS instrument panel.

Fire detection equipment for this area consists of smoke detectors that actuate alarms in the control room. Fire suppression equipment consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.7.2 Analysis

Both divisions of redundant components and circuits required for safe shutdown are located in this area. Safe shutdown related panels and control cables of redundant divisions are spatially separated by distances of approximately 25 feet. There is Division 2 instrumentation associated with the operation of the RCIC (Division 1) located on the Division 2 RHR instrument rack. However, instrumentation for LPCS (Division 1) are located in a panel 60 feet from the Division 2 instrumentation.

Combustibles contained within this fire area consist primarily of cable insulation, fire barrier material and electrical panels. Total fire loading contained in the 4,856 ft^2 floor area of this fire zone is less than 15,000 Btu/ft^2.

9A.4.2.1.7.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from damaging both divisions of redundant safe shutdown equipment is achieved. This is accomplished by spatial separation of redundant equipment within the area, cable wrap, low fire loading, an early warning fire detection system, and good separation from other zones and areas containing safe shutdown equipment. In the event of a fire in this area, Division 1 or Division 2 will be available for shutdown, depending upon the location of the fire.

9A.4.2.1.8 Fire Zone 1AB-2

9A.4.2.1.8.1 Description

Fire Zone 1AB-2, shown on <Figure 9A-5>, comprises the entire Floor 2 (Elevation 599'-0") of the auxiliary building, with the exception of portions of Fire Zones and Areas 1AB-1b, 1AB-1e and 1AB-1f which originate on Floor 1. This zone contains instrument and control panels, and process equipment for the RWCU system and turbine building cooling system. It is connected on the north to the turbine power complex, on the south to the Unit 1 reactor building and intermediate building, and on the west to the radwaste building; the east side is an outside wall.

Walls, floor and ceiling for this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings. Wall, floor and ceiling penetrations have 3 hour fire rated seals, except for the small floor area above the RCIC room on Floor 1 (Fire Zone 1AB-1c) which is provided with grating for pressure relief. A larger fire area is formed by the addition of Fire Zone 1AB-1c, located directly below, <Figure 9A-2>. The floor, ceiling and parts of the south and east walls provide separation of redundant trains of safe shutdown equipment.

The ventilation system for this fire zone is described in <Appendix 9A.4.2>.

Safe shutdown equipment in this fire zone consists of:

a. Control panels for HVAC pump room cooling units, Division 1 and Division 2

b. Power and control cables, Division 1 and Division 2, Unit 1

Fire detection equipment for this zone consist of smoke detectors that activate alarms in the control room. Fire suppression equipment consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.8.2 Analysis

Both divisions of redundant components and circuits required for safe shutdown are located in this zone. Manual action will compensate for the effects of fire on most of the Division 2 equipment required for cold shutdown. The redundant HVAC pump room cooling unit control panels are separated by more than 20 feet.

The larger fire area, which includes Zone 1AB-1c, contains Division 1 components and circuits and Division 2 circuits. Division 2 circuits within Zone 1AB-2 are separated from Division 1 equipment in Zone 1AB-1c by concrete barriers.

Combustibles contained within this fire zone consist of cable insulation, hydraulic fluid, lubricating oil, electrical panels, raceway fire barrier material, component insulation lead blanket covers and motor windings. Total fire loading contained in the 9,685 ft^2 floor area of this fire zone is less than 60,000 Btu/ft^2.

9A.4.2.1.8.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging both divisions of redundant safe shutdown equipment or from spreading to an adjacent zone containing redundant safe shutdown equipment, and preventing safe shutdown, is achieved. The Division 2 circuits required for shutdown are provided with adequate spatial separation. The redundant HVAC control panels are also provided with adequate spatial separation within the zone. In addition, an early warning detection system is provided. In the event of a fire in this zone, Division 2 will be available for shutdown.

9A.4.2.1.9 Fire Zone 1AB-3a

9A.4.2.1.9.1 Description

Fire Zone 1AB-3a, shown on <Figure 9A-10>, comprises the eastern half of Floor 3 (Elevation 620’-6”) of the auxiliary building, with the exception of the upper portion of Fire Zone 1AB-1b and the steam tunnel. This zone contains instrument air compressors and air receiving tanks, auxiliary building and steam tunnel ventilation equipment, and provides access to the portion of Fire Zone 1AB-1b on this floor. It is bounded on the south by the Unit 1 reactor building, and on the west by the steam tunnel and Fire Zone 1AB-1b; the north and east walls are exposed to grade.

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and floor have 3 hour fire resistance ratings except for walls adjacent to Fire Zone 1AB-1b. The floor and part of the west wall provide separation of redundant trains of safe shutdown equipment. Wall and floor penetrations have 3 hour fire rated seals, except for pressure relief openings in the wall to Fire Zone 1AB-1b. A larger fire area is formed by the addition of Fire Zone 1AB-1b <Figure 9A-10>.

The ventilation system for this zone is described in <Appendix 9A.4.2>.

Safe shutdown equipment for this zone consists of the instrument air receiver tank, valves and cabling, for Division 2.

Fire detection for this zone consists of smoke detectors that activate alarms in the control room.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.2.1.9.2 Analysis

Only Division 2 equipment required for safe shutdown is located in this fire zone. Redundant equipment is located in other areas and zones.

Zone 1AB-1b, which forms a fire area with Zone 1AB-3a, contains components and circuits for Division 1 and Division 2. There is more than 20 ft separation between the redundant equipment within Zone 1AB-3a and the unprotected opening, with no continuity of combustibles.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil, electrical panels and motor windings. Total fire loading contained in the 3,334 ft^2 floor area of this fire zone is less than 6,500 Btu/ft^2.

9A.4.2.1.9.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent zones containing safe shutdown equipment is achieved. This is accomplished by locating redundant equipment in other fire areas and zones, low fire loading and early warning fire detection. Also, a fire in Zone 1AB-3a would not affect safe shutdown components in Zone 1AB-1b. In the event of a fire in Zone 1AB-3a, safe shutdown could be accomplished using Division 1.

9A.4.2.1.10 Fire Zone 1AB-3b

9A.4.2.1.10.1 Description

Fire Zone 1AB-3b, shown on <Figure 9A-10>, comprises the western half of Floor 3 (Elevation 620’-6”) of the auxiliary building, with the exception of the upper portions of Fire Zone 1AB-1e and Fire Area 1AB-1f, and the steam tunnel. This zone contains auxiliary vent exhaust system equipment and provides access to the portion of Fire Zone 1AB-1e on this floor. It is bounded on the south by the intermediate building and Fire Area 1AB-1f, on the east by the steam tunnel and Fire Zone 1AB-1e, on the north by the turbine power complex, and on the west by the radwaste building.

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and floor have 3 hour fire resistance ratings except for walls adjacent to Fire Zone 1AB-1e. Wall and floor penetrations have 3 hour fire rated seals, except for the pressure relief openings in the wall to Fire Zone 1AB-1e. A larger fire area is formed by the addition of Fire Zone 1AB-1e <Figure 9A-10>. The floor and parts of the south walls provide separation of redundant trains of safe shutdown equipment. The exterior wall at the northwest corner is 3 hour rated due to the adjacent transformer.

The ventilation system for this zone is described in <Appendix 9A.4.2>.

Safe shutdown equipment for this zone consists of Division 1 and Division 2, Unit 1 power and control cables.

Fire detection for this zone consists of smoke detectors that actuate alarms in the control room.

Fire suppression equipment for this zone consists of automatic sprinkler protection for the cable trays in the hallway area, manually operated deluge systems for the charcoal filters, manual water type hose stations, and fire extinguishers.

9A.4.2.1.10.2 Analysis

Both divisions of equipment required for safe shutdown are located in this fire zone. Manual action will compensate for the effects of fire on the Division 1 equipment required for cold shutdown. The remaining redundant equipment located in this fire area consists of circuits for the RCIC system. Components and circuits for the LPCS system (Division 1) are not located in this fire area and LPCS would be available to provide Reactor Inventory Control.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil and grease, electrical panels, charcoal, raceway fire barrier material, H_2 bottles, motor windings and combustible materials storage. Total fire loading contained in the 4,555 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Special consideration was given to charcoal as a fire hazard. The current design includes heat sensors that initiate signals in the control room so that a water deluge system can be manually actuated, if required.

9A.4.2.1.10.3 Conclusions

The results of the analysis of this fire zone indicate that the objective of preventing a fire from damaging both divisions of required redundant safe shutdown equipment or spreading to a zone containing redundant safe shutdown equipment, and preventing safe shutdown, is achieved. This is accomplished by protecting the required Division 1 circuits with spatial separation, fire rated barriers and the low fire loading in this zone. In addition, automatic suppression and early warning fire detection are provided. Also, a fire in 1AB-3b will not prevent safe shutdown using equipment required in 1AB-1e.

In the event of a fire in this zone, safe shutdown could be accomplished using Division 1.

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9A.4.3 INTERMEDIATE BUILDING

The intermediate building is a five story building constructed of reinforced concrete. The building is located between the Unit 1 and Unit 2 reactor buildings and houses safety-related systems that service the fuel handling building and the Unit 1 reactor building complex. It is bounded on the north and south by the Unit 1 and Unit 2 auxiliary and reactor buildings, on the east by the fuel handling building and Unit 1 and Unit 2 reactor buildings and on the west by the control complex, service building and radwaste building.

The ventilation system for the intermediate building consists of one 100 percent capacity supply plenum, a supply fan, an exhaust fan, and distribution ductwork. The supply plenum, supply fan and exhaust fan are located at Elevation 682'-6" of the intermediate building. The supply fan draws outside air through filters and heating coils and supplies it to various locations in the intermediate building. This supply air is drawn by the exhaust fan and discharged through the unit vent. Air from the spent fuel pool cooling and cleaning equipment rooms is exhausted by the fuel handling area exhaust system.

All ventilation ducts penetrating intermediate building floors, fire barriers and walls of the walkway to the control complex, are provided with 3 hour rated fire dampers with standard 160°F or 165°F fusible links. The reactor building purge system penetrations are discussed in <Appendix 9A.4.1>.

Smoke detectors are provided in the discharge ducts of the supply fans and exhaust fans. Upon detection of smoke, these detectors will signal in the control room and on the HVAC control panel. Also, if smoke is detected in the supply duct, the supply fan will trip.

For purposes of this fire hazards analysis, the entire five story intermediate building is considered a fire area since each floor communicates via a 3 inch rattle space covered by a steel plate at the reactor building. This fire area is divided into five fire zones: Fire Zone IB-1 is Elevation 574'-10"; Fire Zone IB-2 is Elevation 599'-0"; Fire Zone IB-3 is Elevation 620'-6"; Fire Zone IB-4 is Elevations 654'-6" and 665'-0"; Fire Zone IB-5 is Elevation 682'-6". The existing separation between zones is considered adequate for the fire hazard in each zone. A fire would not be expected to propagate through the 3-inch rattle space and breach the zone boundaries. Therefore, the existing separation provides a satisfactory level of protection for the Fire Zones. Therefore, each zone is treated as a fire area in the following analysis.

9A.4.3.1 Fire Zone IB-1

9A.4.3.1.1 Description

Fire Zone IB-1 is shown on <Figure 9A-3>. It is at Elevation 574'-10", comprising the entire first floor of the intermediate building, and Elevation 585'-0", the pipe chase along the west wall. This zone contains equipment for the service air, liquid radwaste, fuel pool cooling and cleanup, and reactor building chilled water systems. It is bounded on the north by the Unit 1 auxiliary building, on the east by the fuel handling building and Unit 1 and Unit 2 reactor buildings, on the south by the Unit 2 auxiliary building, and on the west by the control complex and radwaste building.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings. However, the 3 inch rattle space at each reactor building interface are unprotected openings. Penetrations have 3 hour fire rated seals, except for the rattle spaces. Also included in IB-1 is a pipe chase at 585'-0" running along the entire west end.

There is no safe shutdown equipment located in this fire zone.

Fire detection for this zone consists of smoke and heat detectors in the areas where safety-related equipment or cables are located. These detectors activate alarms in the control room.

Fire suppression equipment for this zone consists of manual water type hose stations, fire extinguishers, water spray system for the charcoal filter and wet pipe sprinkler system in the tool decontamination and storage areas.

9A.4.3.1.2 Analysis

Protection for equipment in this fire zone is not required since this equipment is not required for safe shutdown.

The combustibles contained within this fire zone consist of cable insulation, lubricating oil, grease, electrical panels, component insulation, motor windings and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

9A.4.3.1.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent areas or zones containing safe shutdown equipment is achieved. This is accomplished by the low fire loading, barrier design and the provision of an early warning fire detection system.

9A.4.3.2 <u>Fire Zone IB-2</u>

9A.4.3.2.1 Description

Fire Zone IB-2 is shown on <Figure 9A-8>. It is at Elevation 599’-0”, comprising the entire second floor of the intermediate building. This zone contains equipment for the spent fuel pool cooling and cleanup system. It is bounded on the north by the Unit 1 auxiliary building, on the east by the fuel handling building and Unit 1 and Unit 2 reactor buildings, on the south by the Unit 2 auxiliary building, and on the west by the control complex and radwaste building.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have 3 hour fire resistance ratings. The west wall provides separation of redundant trains of safe shutdown equipment. However, the 3 inch rattle space at each reactor building interface is an unprotected opening. Penetrations have 3 hour fire rated seals, except for the rattle spaces.

Safe shutdown equipment in this zone consists of:

a. Power and control cables for Division 1 and Division 2

b. Instrument air receiver tanks, A

c. Air system isolation valve, A

Fire detection equipment for this zone consists of smoke detectors that actuate alarms in the control room. Fire suppression equipment consists of an automatic sprinkler system, manual water type hose stations and fire extinguishers.

9A.4.3.2.2 Analysis

Division 1 components and both divisions of power and control cables for Unit 1 are located in Fire Zone IB-2. Manual action will compensate for the effects of fire on the Division 2 equipment required for cold shutdown.

Combustibles contained within this fire zone consist of cable insulation, electrical panels, power transformers, and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

9A.4.3.2.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging cables or components associated with both divisions of required safe shutdown equipment is achieved. This is accomplished by barrier design and low fire loading.

An automatic sprinkler system, early warning fire detection and manual type fire suppression equipment are also provided. In the event of a fire in this zone, Division 2 could be utilized for safe shutdown.

9A.4.3.3 Fire Zone IB-3

9A.4.3.3.1 Description

Fire Zone IB-3 is shown on <Figure 9A-12> and <Figure 9A-16>. It is at Elevation 620’-6”, consisting of two areas. The majority of Fire Zone IB-3 comprises the entire third floor of the Intermediate Building. This zone contains equipment for the annulus exhaust gas treatment system. It is bounded on the north by the Unit 1 Auxiliary Building, and on the west by the Control Complex and the Service Building. In addition, Fire Zone IB-3 extends west into a Service Building hall along the south side of the Control Complex.

The walls, floors, and ceiling of this Fire Zone within the Intermediate Building are constructed of reinforced concrete. The walls and ceiling of this Fire Zone within the service building hall area are constructed of drywall. The floor in this area is constructed of reinforced concrete. Doorways are protected by Class A fire doors. Walls, floor and ceiling have 3 hour fire resistance ratings. The north and west walls provide separation of redundant trains of safe shutdown equipment. However, the 3 inch rattle space at each reactor building interface is an unprotected opening. Penetrations have 3 hour fire rated seals, except for the rattle spaces.

Safe shutdown equipment in this zone consists of power and control cables for Division 1 and Division 2, and instrumentation for Division 1.

Fire detection for this zone consists of smoke detectors that activate alarms in the control room.

Fire suppression equipment for this zone consists of automatic sprinkler protection for the cable trays in the hallway area, manually actuated water deluge systems in the charcoal filter plenums, water type hose stations, and fire extinguishers.

9A.4.3.3.2 Analysis

Both divisions of power and control cables required for safe shutdown are located in this zone. There are also nonsafety circuits which are associated with Division 1 and Division 2 which could affect shutdown. Because of the spatial separation between the trays containing required Division 1 and Division 2 safe shutdown circuits, low fire exposure hazard presented by the intervening combustibles, and ceiling height in excess of 30 feet, a fire in the corridor area of Fire Zone IB-3 would not be expected to involve both trains of safe shutdown. It is judged that the existing fire detection system and automatic and manual fire protection features will provide adequate protection for the redundant trains of safe shutdown equipment in this area. Manual action will compensate for the effects of fire on the remaining Division 2 circuits required for cold shutdown.

Combustibles contained within this fire zone consist of cable insulation, electrical panels, transformers, raceway fire barrier material, charcoal, batteries (hydrogen), and combustible materials storage. Total fire loading contained in the 10,778 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Special consideration was given to charcoal as a fire hazard. The charcoal filter design includes heat sensors that actuate alarms in the control room so that the water deluge system can be manually actuated, if required.

9A.4.3.3.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging required cables or equipment associated with both divisions of equipment required for safe shutdown is achieved. This is accomplished with spatial separation, fire rated barriers, and the low fire loading in this zone. Automatic and manual suppression and early warning fire detection are also provided. In the event of a fire in this zone, Division 2 could be utilized for safe shutdown.

9A.4.3.4 Fire Zone IB-4

9A.4.3.4.1 Description

Fire Zone IB-4 is shown on <Figure 9A-16> and <Figure 9A-20>. It is at Elevations 654'-6" and 665'-0" and houses equipment for the reactor building and drywell purge system. This zone is bounded on the east by Unit 1 and Unit 2 reactor buildings and the fuel handling building, and on the west by the control complex. The north and south sides have no building interfaces.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are protected by Class A fire doors. Walls, floor and ceiling have 3 hour fire resistance ratings. However, the 3 inch rattle space at each reactor building interface is an unprotected opening. Penetrations have 3 hour fire rated seals, except for the rattle spaces.

Safe shutdown equipment in this zone consists of power and control cables for Division 1.

Fire detection equipment for this zone consists of smoke detectors that activate alarms in the control room.

Fire suppression equipment for this zone consists of manually actuated deluge systems in the charcoal filter plenums, water hose stations and fire extinguishers.

9A.4.3.4.2 Analysis

Only Division 1 circuits are located in this fire zone. Redundant equipment is located in other fire areas and zones.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil and grease, electrical panels, charcoal, H_2 bottles and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Special consideration was given to charcoal as a fire hazard. The present design includes heat sensors that actuate alarms in the control room so that the deluge system can be manually actuated, if required.

9A.4.3.4.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging safe shutdown equipment associated with both divisions is achieved. This is accomplished by the low fire loading, locating redundant equipment in other zones and early warning fire detection. Division 2 could be utilized to shut down the plant in the event of a fire in this zone.

9A.4.3.5 <u>Fire Zone IB-5</u>

9A.4.3.5.1 Description

Fire Zone IB-5 is shown on <Figure 9A-24>. It is at Elevation 682’-6”, comprising the entire top floor of the intermediate building. This zone contains the ventilation system equipment for the intermediate building and the fuel handling building. It is bounded on the east by Unit 1 and Unit 2 reactor buildings and on the west by the control complex. The north and south sides have no building interfaces.

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are protected by Class A fire doors. Walls and floor have 3 hour fire resistance ratings. However, the 3 inch rattle space at the reactor building interface is an unprotected opening. Penetrations have 3 hour fire rated seals, except for the rattle spaces.

There are no safe shutdown components located in this fire zone.

Fire detection for this zone consists of smoke and heat detectors in areas where safety-related equipment and cables are located. The detectors activate alarms in the control room.

Fire suppression equipment for this zone consists of manually actuated deluge systems in the charcoal filter plenums, water type hose stations and fire extinguishers.

9A.4.3.5.2 Analysis

Protection for equipment in this fire zone is not required since this equipment is not required for safe shutdown.

Combustibles contained within this fire zone consist of cable insulation, lubricating oil and grease, electrical panels, charcoal, and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Special consideration was given to charcoal as a fire hazard. The present design includes heat sensors that actuate alarms in the control room so that the deluge system can be manually actuated, if required.

9A.4.3.5.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent areas or zones containing safe shutdown equipment is achieved. This is accomplished by the low fire loading, barrier design and early warning fire detection.

9A.4.4 CONTROL COMPLEX

The control complex is a six story structure constructed of structural steel and reinforced concrete. Floors 1 and 2 are located below Elevation 620'-0" (grade) and house mechanical and HVAC equipment, general offices and meeting rooms common to both Unit 1 and Unit 2. Floors 3 through 6 are separated into two main sections. The control complex is bounded on the north by the radwaste building, on the east by the intermediate building, on the south by the service building, and on the west by the diesel generator building.

The ventilation systems that serve the various floors, areas and zones of the control complex are as follows:

a. Controlled access and miscellaneous equipment area HVAC system

   This system consists of redundant 100 percent capacity supply and return fans, supply plenums, charcoal filter trains, and exhaust fans. A common duct connects the redundant fans and the distribution ductwork to other areas through the vertical cable chases.

b. MCC, switchgear and miscellaneous electrical equipment area HVAC system and battery room exhaust system

   This system consists of redundant 100 percent capacity supply fans, supply plenums and return fans. It serves Division 1 and Division 2 of the Unit 1 and Unit 2 electrical areas that contain switchgear, motor control centers, battery rooms, and the cable spreading rooms.

c. Control room HVAC system and control room emergency recirculation system

   The control room HVAC system consists of redundant 100 percent capacity supply fans, supply plenums and return fans. The emergency recirculation system consists of two 100 percent capacity charcoal filter trains and two 100 percent capacity recirculating fans. These systems serve the control rooms for Unit 1 and Unit 2.

d. Computer room HVAC system

   This system consists of two 100 percent capacity air handling units. During normal operation one air handling unit operates continuously to supply cooling air for the computer rooms.

e. Emergency pump area cooling system

   This system consists of two 100 percent capacity air handling units that serve the equipment at Elevation 574'-10". The system is interlocked with the emergency closed cooling water pumps so that it operates when these pumps start.

Ventilation system duct penetrations through fire rated walls and floors are provided with 3 hour rated fire dampers with standard 160°F fusible links. The ventilation systems listed above are discussed further in the applicable fire area/zone descriptions that follow.

For purposes of this fire hazards analysis, the control complex has been divided, by floors, into numerous fire areas and fire zones. These areas and zones are shown on <Figure 9A-6>, <Figure 9A-7>, <Figure 9A-11>, <Figure 9A-15>, <Figure 9A-16>, and <Figure 9A-19>. The floor at Elevation 599'-0" (which is the ceiling of Fire Area CC-1 and the floor of Fire Area CC-2) meets or exceeds the requirements of a three hour fire resistance rating with one exception: the bottom rebar concrete cover does not consistently maintain the minimum 1-1/4" depth requirement. However, this cover is never less than a 1" depth. Therefore, although the appropriate zones will address this floor as having a two hour fire resistance rating, CC-1 and CC-2 will be identified as separate fire areas.

9A.4.4.1 Unit 1 and Unit 2 Fire Areas, Floor 1 (CC-1)

Fire Area CC-1 is shown on <Figure 9A-6>. It is at Elevation 574'-10" and comprises the entire first floor of the control complex. This area houses mechanical and HVAC equipment.

This fire area is bounded on the north by the radwaste building, on the east by the intermediate building and is below grade on the west and south with no building interfaces. Boundary walls are constructed of reinforced concrete.

This fire area is divided into three fire zones. Fire Zones CC-1a and CC-1b contain redundant safe shutdown equipment associated with the emergency closed cooling system. These zones are separated by a non-continuous 3 hour rated fire wall and are open to Zone CC-1c at the north. Fire Zone CC-1c comprises the remainder of this fire area and houses the control complex water chillers and nonsafety-related service and instrument air system components. Each redundant control complex chiller is separated by a non-continuous 3 hour rated fire wall. The only doorway to an adjacent building is to the intermediate building from Fire Zone CC-1c, and is equipped with a Class A fire door. This wall provides separation of redundant trains of safe shutdown equipment.

Ventilation air for this fire area is supplied by one of the redundant HVAC units serving the controlled access area located in the HVAC equipment room. The ducts supplying the air penetrate the ceiling of Fire Zone CC-1c and are provided with 3 hour rated fire dampers. During an emergency, or whenever the emergency closed cooling pumps are actuated, the corresponding air handling unit at Elevation 587’-0” is automatically started and provides cooling by recirculating the air in the zone.

Deviations from <10 CFR 50, Appendix R> III G Requirements

Redundant safe shutdown components and circuits exist in the fire area and also within each zone composing the fire area. The following deviations from the requirements of <10 CFR 50, Appendix R> III G have been reviewed and accepted based on the conditions described in SSER 3 and SSER 7.

1. The fire rated barrier for raceway protection does not extend throughout the fire area - Cables of one or both divisions are wrapped so that exposed circuits of redundant divisions are separated by more than 20 ft with no intervening combustibles. Also, a partial gypsum board wall has been installed to achieve 20 ft separation between the Division 1 and Division 2 ECCW pumps. Automatic Suppression is installed in the intervening areas as described in each fire zone (SSER 7 Section 9.5.1.4.2.(3)).

2. Redundant safe shutdown components are closer than 20 ft without a fire rated barrier - For cases where components of one train of safe shutdown equipment cannot be separated from components and

circuits of the other division by the required 20 ft, special protection is provided in the form of fast response type sprinkler heads located within 6-8 ft of the components and covering the surrounding area. These heads supplement the overhead sprinklers for fires involving combustibles located close to these components that could result in temperatures that exceed what the component can tolerate before ceiling level sprinklers can operate. The equipment involved is not susceptible to water damage. The fast response heads will provide rapid extinguishment of a fire in close proximity of the equipment or cooling of the equipment for exposing fires (SSER 7 Section 9.5.1.4.2.(3)).

3. Partial suppression in fire zones/areas containing redundant safe shutdown trains - Automatic sprinklers are provided over the safe shutdown systems, approximately 45% of the total floor area of fire zones CC-1a, CC-1b and CC-1c. The total fire loading in these fire zones is less than 30 min (40,000 BTU/ft^2) and Fire zone CC-1c has less than 15 minutes combustible loading. The combustibles in the unprotected areas do not expose redundant trains of safe shutdown systems. The elimination of the requirement for automatic suppression is based on a fire loading of less than 20,000 Btu/ft^2 for fire zone CC-1c (SSER 3 Section 9.5.1.4.2).

9A.4.4.1.1 Fire Zone CC-1a

9A.4.4.1.1.1 Description

Fire Zone CC-1a is located in the southeast corner of the first floor and contains the B loop components of the Emergency Closed Cooling System. Emergency air handling equipment for this zone is located within this zone on a partial mezzanine floor at Elevation 587’-0”. This zone is bounded on the west by Fire Zone CC-1b, is open to Fire Zone CC-1c on the north and is bounded on the east by the Intermediate Building, with an outside wall on the south.

The east and south walls of this fire zone are constructed of reinforced concrete. The west wall, which separates Fire Zones CC-1a and CC-1b, is non-continuous and of drywall construction. The doorway in this wall is equipped with a Class A fire door. Floor construction is of reinforced concrete. Ceilings are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling provides separation of redundant trains of safe shutdown equipment. Walls and ceilings have 3 hour and 2 hour fire resistance rating, respectively. All penetrations are sealed to at least the fire rating of their respective wall or ceiling. Floor drains in this fire zone are routed to a sump in Fire Zone CC-1c.

Safe shutdown equipment located in this zone is as follows:

a. Emergency closed cooling pump B

b. Emergency closed cooling heat exchanger B

c. Emergency pump area cooling system air handling unit, B

d. Power and control cables for Division 1 and Division 2

e. Emergency closed cooling pump area air handling panel, B

Fire detection consists of smoke detectors that activate alarms in the control room. Fire suppression equipment for this zone consists of a wet pipe sprinkler system, water type hose stations, and fire extinguishers.

9A.4.4.1.1.2 Analysis

Division 2 components and both divisions of circuits, required for safe shutdown, are located in this zone. Functional redundancy for the components in this fire zone is provided by identical equipment located in Fire Zone CC-1b <Appendix 9A.4.4.1.2>. All Division 1 circuits are wrapped with a 1 hour fire rated barrier.

Combustibles within this fire zone consist of cable insulation, raceway fire barrier material, and pump motor winding insulation.

Most of the cable insulation is located in the middle of the zone. Total fire loading contained in the 3,082 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

Special consideration was given to the case of a fire in the region of the Division 2 emergency closed cooling pumps (B) which could result in exposing Division 1 cable serving the emergency closed cooling pumps (A) and Control Complex chiller "A" and the emergency pump area cooling system air handling unit. However, these situations are protected against by protecting the Division 1 cable with a 1 hour fire rated barrier, and by the detection and suppression systems.

The larger area, composed of Fire Zones CC-1a, CC-1b and CC-1c, contains both Division 1 and Division 2 components and circuits. The partial 3 hour wall, which divides Zones CC-1a from CC-1b, provides a separation distance of at least 40 feet between Division 1 and Division 2 components and cables within each zone. There is no continuity of combustibles between these zones. The suppression, detection and partial barrier provide adequate protection.

There are redundant components in Zones CC-1a and CC-1c. These are separated by more than 40 feet, with the exception of instrumentation along the east wall. The redundant instruments are separated by 10 feet. Cables to the Division 1 instrument are enclosed in a 1 hour wrap. There are no in situ combustibles in the area of these instruments. Additional protection in the form of fast response sprinklers is provided over each instrument for quick extinguishment of any fire in transient combustibles which could affect both instruments.

9A.4.4.1.1.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished by providing adequate separation between redundant safe shutdown components, and wrapping all Division 1 cables in a 1 hour fire rated barrier. In addition, an automatic sprinkler system, early warning fire detection and manual water type suppression equipment, have also been provided. In the event of a fire in this zone, Division 1 could be utilized for safe shutdown.

9A.4.4.1.2 Fire Zone CC-1b

9A.4.4.1.2.1 Description

Fire Zone CC-1b is located in the south central portion of the first floor and contains the A loop components of the emergency closed cooling system. The emergency air handling equipment for this zone is located within this zone on a partial mezzanine floor at Elevation 587’-0”. It is bounded on the east by Fire Zone CC-1a, is open to Zone CC-1c on the north and west, with an outside wall on the south.

The south wall of this fire zone is constructed of reinforced concrete. The east wall, which separates Fire Zones CC-1a and CC-1b, is non-continuous and is constructed of drywall. The doorway in this wall is equipped with a Class A fire door. Floor construction is of reinforced concrete. Ceilings are constructed of reinforced concrete over steel form decks and 3 hour protected framing. The ceiling provides separation of redundant trains of safe shutdown equipment.

Walls and ceilings have 3 hour and 2 hour fire resistance rating, respectively. All penetrations are sealed to at least the fire ratings of their respective wall or ceiling. Floor drains in this fire zone are routed to a sump in Fire Zone CC-1c.

Safe shutdown equipment located in this zone is as follows:

a. Emergency closed cooling pump A

b. Emergency closed cooling heat exchanger A

c. Emergency pump area cooling system air handling unit, A

d. Power and control cables for Division 1 and Division 2

e. Emergency closed cooling pump area air handling panel, A

f. Emergency closed cooling system isolation valves, A and B (Passive, De-Energized)

g. Emergency closed cooling system instrumentation, A and B

Fire detection for this zone consists of smoke detectors that activate alarms in the control room. A wet pipe sprinkler system, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.1.2.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this zone. Functional redundancy for most of the components in this fire zone is provided by identical equipment located in Fire Zone CC-1a <Appendix 9A.4.4.1.1>. This equipment is separated by a non-continuous 3 hour rated fire wall. An exception is the ECC System isolation valve and instrumentation (B), located in this zone.

Division 2 power and control cables to this equipment, and all other Division 2 safe shutdown cables in this zone, are protected with a 1 hour fire rated barrier. There is no concentration of in situ combustibles in the area of these components. Additional protection in the form of fast response sprinklers is provided over each component for quick extinguishment of any fire in transient combustibles which could affect components of both divisions. In addition, due to the proximity of Division 1 cables to redundant equipment in Fire Zone CC-1c, all required Division 1 cables in Fire Zone CC-1b between column lines CC-C and CC-D are also wrapped with a 1 hour fire rated barrier to achieve more than 20 foot separation from unprotected Division 2 circuits and equipment for the redundant safe shutdown train. This will provide adequate spatial separation between unprotected cables for Division 1 and Division 2.

The larger area, composed of Fire Zones CC-1a, CC-1b and CC-1c, contains both Division 1 and Division 2 components and circuits. The partial 3 hour wall, which divides Zones CC-1a from CC-1b, provides a separating distance of at least 40 ft between Division 1 and Division 2 components and cables. There is no continuity of combustibles between these zones. The suppression, detection and partial barrier provide adequate protection.

Combustibles within this fire zone consist of cable insulation, raceway fire barrier material, panel combustibles, motor winding insulation, and lubricating oil.

Total fire loading contained in the 2,192 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

9A.4.4.1.2.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished by providing adequate separation between redundant safe shutdown components, and wrapping all required Division 2 cables in a 1 hour fire rated barrier. In the area where Division 1 cables are in proximity to redundant equipment in Fire Zone CC-1c, these cables have also been protected with a fire rated barrier. In addition, an automatic wet pipe sprinkler system, early warning fire detection and manual suppression equipment are also provided. In the event of a fire in this zone, safe shutdown could be accomplished using Division 2.

9A.4.4.1.3 Fire Zone CC-1c

9A.4.4.1.3.1 Description

Fire Zone CC-1c is an L-shaped section in the west and north portions of the first floor. It contains the chilled water equipment for the control complex and the service and instrument air for use throughout the plant and an electric maintenance shop. This zone is open on the east to Fire Zone CC-1b, open on the south (internally) to Fire Zones CC-1a and CC-1b and is bounded on the north by the radwaste building, with outside walls on the west and south.

Outer walls and the floor of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Ceilings are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls and ceilings have 3 hour and 2 hour fire resistance ratings, respectively. All penetrations are sealed to at least the fire ratings of their respective wall or ceiling. Floor drains are routed to a sump in this fire zone. This zone is open to Fire Zones CC-1a and CC-1b, and is accessible by stairtowers and through a Class A fire door at the intermediate building.

Safe shutdown equipment located in this zone is as follows:

a. Control complex water chillers, A and B

b. Control complex chilled water pumps, A and B

c. Power and control cables, Division 1 and Division 2

d. Control complex chilled water control panels, A and B

e. Emergency closed cooling/chilled water instrument racks, A and B

f. Emergency closed cooling system valves (Passive, De-Energized)

Fire detection equipment for this zone consists of smoke detectors that activate alarms in the control room. A partial zone, automatic wet pipe sprinkler system is provided between column lines CC-2 and CC-3, and CC-B and CC-E. Water type hose stations and fire extinguishers are also provided for fire suppression.

9A.4.4.1.3.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this zone. The chillers are spatially separated and non-continuous 3 hour rated fire barriers are located between chiller cubicles. In addition to this separation, the drainage arrangement is such that a fire due to oil spillage from any of the 15 gallon capacity chillers will not spread from one cubicle to another. A partial zone sprinkler system is provided south of the fire barrier located along column line CC-C. The following safe shutdown circuits are wrapped with 1 hour fire rated barriers to provide adequate separation:

a. Required circuits of both divisions between column lines CC-C and CC-D to achieve more than 20 foot separation between redundant divisions.

b. Required Division 1 circuits north of column line CC-C.

c. Required Division 2 circuits south of column line CC-D.

The larger area, composed of Fire Zones CC-1a, CC-1b and CC-1c, contain both Division 1 and Division 2 components and circuits. There are redundant components in Zones CC-1a and CC-1c. These are separated by more than 40 feet, with the exception of instrumentation along the east wall. The redundant instruments are separated by 10 feet. Cables to the Division 1 instrument are enclosed in a 1 hour wrap. There are no in situ combustibles in the area of these instruments. Additional protection in the form of fast response sprinklers is provided over each instrument for quick extinguishment of any fire in transient combustibles which could affect both instruments.

The remainder of the Division 2 components and circuits within Zone CC-1c are separated from Division 1 components and circuits by at least 20 feet, with no intervening combustibles.

Combustibles within this zone consist of cable insulation, Thermo-Lag fire barrier material, motor winding insulation, lubricating oil, panel combustibles and combustible materials in maintenance shop and office area. (i.e., electrical equipment, supplies and tools).

Total fire loading contained in the 13,632 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Special consideration was given to required redundant valves located approximately 2 feet apart (1 location). Circuits for the redundant valves have been spared in place rendering the valves only capable of manual operation. As such, no additional protective measures are necessary.

9A.4.4.1.3.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging the cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished by spacial separation of components, and fire barrier design. Where required circuits are in proximity to redundant equipment, at least 1 division of circuits is protected with fire rated barriers. In addition, a partial zone sprinkler system, early warning fire detection and manual suppression equipment are provided. In the event of a fire in this area, Division 1 or Division 2 will be available for shutdown, depending on the location of the fire.

9A.4.4.2 Unit 1 and Unit 2 Fire Areas, Floor 2 (CC-2)

Fire Area CC-2 is shown on <Figure 9A-7>. It is at Elevation 599’-0” and comprises the entire second floor of the Control Complex. This area houses offices, meeting rooms and mechanical equipment common to Unit 1 and Unit 2.

This fire area is bounded on the north by the Radwaste Building, on the east by the Intermediate Building, on the south by the Service Building and is below grade on the west and south with no building interfaces. All walls are constructed of reinforced concrete.

The entire floor is divided into one fire area and three fire zones. Fire Zone CC-2a consists of the entire eastern part of this floor from column lines CC-4 to CC-6. Fire Zone CC-2b includes the northern part of this floor from column lines CC-A to CC-C (north to south) and column lines CC-1 to CC-4 (west to east). Fire Zone CC-2c includes the southern part of this floor from column lines CC-C to CC-E (north to south) and column lines CC-1 to CC-4 (west to east). Fire Area CC-STW is the stairwell in the northwest corner of the Control Complex. Zone partitions are 2 hour rated walls with Class B fire doors. The stairwell is 3 hour rated with Class A fire doors. The only doorways to an adjacent building are to the intermediate building from Fire Zone CC-2a and they are equipped with Class A fire doors.

The ventilation for Fire Area CC-2 is provided by the controlled access and miscellaneous equipment area HVAC system <Appendix 9A.4.4.a>.

9A.4.4.2.1 Fire Zone CC-2a

9A.4.4.2.1.1 Description

Fire Zone CC-2a is located in the eastern portion of the floor and houses miscellaneous mechanical equipment common to Unit 1 and Unit 2 and Division 1 and Division 2 power and control cables. It is bounded on the west by Fire Zones CC-2b and CC-2c, on the north by the radwaste building, on the east by the intermediate building, with an outside wall on the south.

The north, east and south walls of this fire zone are constructed of reinforced concrete. The west wall, which separates this zone from Fire Zones CC-2b and CC-2c, is constructed of drywall. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls and ceiling have a 3 hour fire resistance rating, except for the center corridor walls which are 2 hour rated. The floor has a 2 hour fire resistance rating. All penetrations are sealed to at least the fire rating of the wall, ceiling or floor respectively. The floor, ceiling and east wall provide separation of redundant trains of safe shutdown equipment. Floor drains are provided for this fire zone. Access to the zone is through Class A fire doors from the intermediate building and Class B fire doors from the center corridor.

Safe shutdown equipment in this zone consists of Division 1 and Division 2 power and control cables.

Fire detection for the zone consists of smoke detectors that alarm in the control room. Fire suppression equipment for this zone consists of an automatic sprinkler system, above and below the ceiling, water type hose stations and fire extinguishers.

9A.4.4.2.1.2 Analysis

Both divisions of required power and control cables are located in this zone. In order to provide separation between redundant divisions, most Division 2 circuits needed for safe shutdown are wrapped with a 1 hour rated fire barrier to provide 20 foot separation. Manual action will compensate for the effects of fire on the remaining Division 2 circuits needed for cold shutdown.

The combustibles contained in this fire zone consist of cable insulation, electrical panels, motor windings, raceway fire barrier material and combustible material storage. Total fire loading contained in the 6,072 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

9A.4.4.2.1.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging the cables associated with more than one division of safe shutdown equipment is achieved. This is accomplished by spatial separation, with the installation of adequate fire barriers on Division 2 cables needed for safe shutdown to achieve this separation. This arrangement is supplemented by an automatic sprinkler system, manual fire suppression equipment and early warning fire detection. In the event of fire in this Zone, Division 1 or Division 2 will be available for safe shutdown, depending upon the location of the fire.

9A.4.4.2.2 Fire Zone CC-2b

9A.4.4.2.2.1 Description

Fire Zone CC-2b is located in the northwestern portion of the floor and houses general offices and laboratories common to Unit 1 and Unit 2. It is bounded on the east by Fire Zone CC-2a, on the south by Fire Zone CC-2c, on the north by the radwaste building, with an outside wall on the west.

The north and west walls of this fire zone are constructed of reinforced concrete. The south and east walls are of drywall construction. Doorways are equipped with Class B fire doors. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor and ceiling provide separation of redundant trains of safe shutdown equipment. Walls and ceiling have a 3 hour fire resistance rating, except for the walls adjacent to Fire Zones CC-2a and CC-2c which are 2 hour rated. The floor has a 2 hour fire resistance rating. All penetrations in fire area boundaries are sealed to at least the fire rating of the respective wall, ceiling or floor. Floor drains are provided for this fire zone.

Safe shutdown equipment in this zone consists of Division 1 and Division 2 power and control cables.

Fire detection for this zone consists of smoke detectors (above the suspended ceiling) that activate alarms in the control room. Fire suppression equipment for this zone consists of an automatic sprinkler system (above and below the ceiling), water type hose stations and fire extinguishers.

9A.4.4.2.2.2 Analysis

Both divisions of required power and control cables are located in this zone. In order to provide separation between redundant divisions, Division 1 circuits needed for safe shutdown are wrapped with a 1 hour rated fire barrier to provide 20 foot separation.

Combustibles contained within this fire zone consist of cable insulation, raceway fire barrier material, and combustible material storage. Total fire loading contained in the 6,099 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

9A.4.4.2.2.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging the cables associated with more than one division of safe shutdown equipment is achieved. This is accomplished by spatial separation, with the installation of adequate fire barriers on Division 1 cables needed for safe shutdown to achieve this separation. This arrangement is supplemented by the automatic sprinkler system, manual fire suppression equipment and early warning fire detection. In the event of a fire in this zone, Division 1 or Division 2 will be available for safe shutdown, depending upon the location of the fire.

9A.4.4.2.3 Fire Zone CC-2c

9A.4.4.2.3.1 Description

Fire Zone CC-2c is located in the southwestern portion of the floor and houses general offices, radiological count rooms, conference rooms, etc., that are common to Unit 1 and Unit 2. It is bounded on the east by Fire Zone CC-2a, on the north by Fire Zone CC-2b on the south by the Service Building, with an outside wall on the west.

The west and south walls of this fire zone are constructed of reinforced concrete. The north and east walls are of drywall construction. Doorways are equipped with Class B fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The walls and ceiling have a 3 hour fire resistance rating, except for the walls adjacent to Fire Zones CC-2a and CC-2b which are 2 hour rated. The floor has a 2 hour fire resistance rating. The floor and ceiling provide separation of redundant trains of safe shutdown equipment. All penetrations in fire area boundaries are sealed to at least the fire rating of the respective wall, ceiling or floor. Floor drains are provided for this fire zone. Access to this zone is through Class B fire doors from the center corridor.

There is no safe shutdown equipment in this zone.

Fire detection for this zone consists of smoke detectors (above the suspended ceiling) that activate alarms in the control room. Fire suppression equipment for this zone consists of an automatic sprinkler system (above and below the ceiling), water type hose stations and fire extinguishers.

9A.4.4.2.3.2 Analysis

Combustibles contained within this fire zone consist of cable insulation, charcoal, miscellaneous combustibles, material storage and electrical panels. Total fire loading contained in the 6,370 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Consideration has been given to the case of inadvertent operation of the automatic sprinkler system. The sprinkler system for the area is not extended into rooms where it is possible that water damage to computer and counting equipment could result if such an event occurred.

9A.4.4.2.3.3 Conclusions

The results of the analysis for this zone indicate that the objective of preventing a fire from damaging the cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished by the automatic sprinkler system, manual fire suppression equipment and an early warning fire detection system.

9A.4.4.2.4 Fire Area CC-STW

9A.4.4.2.4.1 Description

This fire area consists of the northwest stairwell in the control complex. The north and west walls, and the floor and ceiling are constructed of 3 hour rated reinforced concrete. The south and east walls are constructed of drywall. Doorways are equipped with Class A fire doors. All penetrations are provided with 3 hour fire rated seals.

Safe shutdown equipment in this fire area consists of Division 2 cables.

Fire suppression consists of hose reels and cabinets located in or adjacent to the stairwell at each floor.

9A.4.4.2.4.2 Analysis

Only Division 2 cables are located in this area.

The combustibles contained within this fire zone consist of cables in conduits and lighting equipment. Total fire loading contained in the 271 ft^2 floor area of this fire zone is less than 6,500 Btu/ft^2.

9A.4.4.2.4.3 Conclusions

Analysis indicates that a fire in this area will not damage both redundant divisions. This is accomplished by locating redundant equipment in other fire areas. In the event of a fire in this area, safe shutdown could be accomplished using Division 1.

9A.4.4.3 <u>Fire Areas, Floor 3</u>

9A.4.4.3.1 Unit 1 Fire Areas, Floor 3 (1CC-3)

9A.4.4.3.1.1 Fire Area 1CC-3a

9A.4.4.3.1.1.1 Description

Fire Area 1CC-3a is shown on <Figure 9A-11>. It houses the 4.16 kV and 480V switchgear, the Division 2 redundant remote shutdown panel and 480V motor control centers for power distribution to Unit 1, Division 2 safety-related equipment. This area consists of the switchgear room located at Elevation 620'-6" along the north wall of the Unit 1 control complex, and the reactor protection system (RPS) motor generator set room. This area is bounded on the north by the radwaste building, on the east by Fire Area 1CC-4b (electrical cable chase), on the south by Fire Areas 1CC-3b and 1CC-3c, and on the west by Fire Area 1CC-3e.

The north wall of this area is constructed of reinforced concrete. East, south and west walls are of drywall construction. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, part of the ceiling, south and east walls provide separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

The ventilation system for this fire area consists of two 100 percent capacity air handling units located in the HVAC equipment room. Air is supplied to this area by ductwork that is routed through the electrical cable chase (Fire Area 1CC-4b) and penetrates the chase wall at the Fire Area 1CC-4b interface. This supply air is relieved to the fourth floor (Elevation 638'-6") cable spreading room (Fire Area 1CC-4a) through ceiling openings located on the west end of this area. All ventilation penetrations through fire rated walls and ceiling openings are provided with 3 hour rated fire dampers. If required, a manually activated smoke venting system is provided to purge smoke from this area. Water from fire suppression activities can be removed by opening doors to direct the water to adjacent rooms containing floor drains or to stairwells. This will prevent water from accumulating in the redundant switchgear rooms.

Safe shutdown equipment within this area is as follows:

a. 4.16 kV switchgear bus (Division 2)

b. 480V switchgear busses (Division 2)

c. 480V motor control centers (MCC's) (Division 2)

d. Power and control cables for Unit 1, (Division 1 and Division 2)

Fire detection equipment for this area consists of smoke detectors that activate alarms in the control room. Manual carbon dioxide hose reels, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.3.1.1.2 Analysis

Both divisions of safe shutdown equipment and cables are located in this fire area. Functional redundancy for the Division 2 switchgear, MCC's and cabling in this area is provided by the Division 1 switchgear, MCC's and cabling located in Fire Area 1CC-3c <Appendix 9A.4.4.3.1.3>. Manual action will compensate for the effects of fire on the Division 1 equipment required for cold shutdown. The remaining equipment, an RCIC circuit, is not required since the LPCS System (Division 1) would be available for reactor inventory control.

Combustibles contained within this fire area consist of cable insulation, electrical panels, and raceway fire barrier material. Total fire loading contained in the 3,655 ft^2 floor area of this fire zone is less than 60,000 Btu/ft^2.

9A.4.4.3.1.1.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers and is provided with early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Also, the presence of the carbon dioxide hose reels, water type hose stations and fire extinguishers provides ample fire suppression. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.3.1.2 Fire Area 1CC-3b

9A.4.4.3.1.2.1 Description

Fire Area 1CC-3b is shown on <Figure 9A-11>. It houses power distribution equipment for the Division 3 high pressure core spray system (HPCS). It is at Elevation 620'-6" and consists of the rectangular room located near the center of the Unit 1 control complex. This area is bounded on the north by Fire Area 1CC-3a, on the east and west by Fire Areas 1CC-3a and 1CC-3c and on the south by Fire Area 1CC-3c.

The east wall of this area is constructed of reinforced concrete. North, south and west walls are of drywall construction. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Floor drainage is provided for this area.

Ventilation air for this area is provided by two ducts branching off of the main duct that supplies air to Fire Areas 1CC-3a and 1CC-3c. Part of this supply air is relieved to these fire areas through wall openings. All penetrations through rated fire walls are provided with 3 hour rated fire dampers.

There is no safe shutdown equipment located in this area.

Fire detection equipment for this area consists of smoke detectors that activate alarms in the control room. Manual carbon dioxide hose reels, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.3.1.2.2 Analysis

Protection for equipment in this area is not required since this equipment is not required for safe shutdown.

Combustibles contained within this fire area consist of cable insulation, electrical panels, battery cell cases and chargers and raceway fire barrier material. Total fire loading contained in the 713 ft^2 floor area of this fire zone is less than 60,000 Btu/ft^2.

Special consideration was given to the case of overcharging the batteries resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

9A.4.4.3.1.2.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 3/4 hour. Since this area is designed with 3 hour rated fire barriers and is provided with early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing safe shutdown equipment is achieved. Also, the presence of the carbon dioxide and water hose stations and fire extinguishers provides sufficient fire suppression.

9A.4.4.3.1.3 Fire Area 1CC-3c

9A.4.4.3.1.3.1 Description

Fire Area 1CC-3c is shown on <Figure 9A-11>. It houses the 4.16 kV and 480V switchgear, and 480V motor control centers for power distribution to Unit 1, Division 1, safety-related equipment. This area consists of the switchgear room and access area at Elevation 620’-6” and is located on the north side of the wall separating the control complex and the reactor protection system (RPS) motor generator set room. This area is bounded on the north by Fire Areas 1CC-3a and 1CC-3b, on the east by Fire Area 1CC-4f (electrical cable chase), on the south by Fire Area 2CC-3, and on the west by Fire Area 1CC-3d and Fire Area 1CC-3e.

All walls of this area are constructed of drywall. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, north, east, and west walls provide separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units located in the HVAC equipment room. Air is supplied to this area by ductwork that is routed through the electrical cable chase (Fire Area 1CC-4f) and penetrates the chase wall at the Fire Area 1CC-4f interface. This supply air is relieved to the fourth floor (Elevation 638’-0”) cable spreading room (Fire Area 1CC-4e) through ceiling openings located at the west end of this area. All ventilation penetrations through rated fire walls and ceiling openings are provided with 3 hour rated fire dampers. If required, a manually activated smoke venting system is provided to purge smoke from this area. Water from fire suppression activities can be removed by opening doors to direct the water to adjacent rooms containing floor drains or to stairwells. This will prevent water from accumulating in the redundant switchgear rooms.

Safe shutdown equipment within this area is as follows:

a. 4.16 kV switchgear bus Division 1

b. 480V switchgear busses Division 1

c. 480V motor control centers (MCC's) Division 1

d. Power and control cables for Unit 1, Division 1 and Division 2

Fire detection equipment for this area consists of smoke area detectors that activate alarms in the control room. Manual carbon dioxide hose reels, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.3.1.3.2 Analysis

Both divisions of safe shutdown components and circuits are located in this fire area.

Functional redundancy for the Division 1 switchgear, MCC's and cabling in this area is provided by the Division 2 switchgear, MCC's and cabling located in Fire Area 1CC-3a <Appendix 9A.4.4.3.1.1>. In this fire area, manual action will compensate for the effects of fire on most of the Division 2 equipment required for cold shutdown.

Combustibles contained within this fire area consist of cable insulation, electrical panels and raceway fire barrier material. Total fire loading contained in the 3,472 ft^2 floor area of this fire zone is less than 60,000 Btu/ft^2.

9A.4.4.3.1.3.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers and provided with early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Also, the presence of the carbon dioxide hose reels, water type hose stations and fire extinguishers provides ample fire suppression. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.3.1.4 Fire Area 1CC-3d

9A.4.4.3.1.4.1 Description

Fire Area 1CC-3d is shown on <Figure 9A-11>. It is at Elevation 620’-6” and consists of a small rectangular room located in the southwest corner of the control complex that houses the remote shutdown panel. This area is bounded on the north and east by Fire Area 1CC-3c, on the south by Fire Area 2CC-3 and on the west by the control complex elevator shaft.

All walls of this area are constructed of drywall. The west wall is of bullet resistant construction. The doorway is equipped with a Class A fire door.

The floor and ceiling are constructed of reinforced concrete over steel form deck and three hour protected framing. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

Ventilation air for this fire area is provided by a duct branching off of the main duct that supplies air to Fire Area 1CC-3c. The supply air to this area is relieved to Fire Area 1CC-3c through a transfer grille located in the wall. All penetrations and openings are provided with 3 hour rated fire dampers. Should a fire occur in this area, or in Fire Area 1CC-3c, the fire dampers will close, thereby isolating the fire areas from one another.

The safe shutdown equipment within this area is as follows:

a. Remote shutdown panel, Unit 1, Division 1

b. Control cables, Division 1 and Division 2

Fire detection equipment for this area consists of smoke detectors that activate alarms in the control room. Manual carbon dioxide hose reels, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.3.1.4.2 Analysis

Division 1 components and both divisions of circuits are located in this fire area. Functional redundancy for the equipment in this area is provided since the control room has redundant component controls for all equipment which can be controlled from the remote shutdown panel. Separation is provided between Division 1 and Division 2 cabling and components on the panel in accordance with separation design criteria. In this fire area, manual action will compensate for the effects of fire on most of the Division 2 equipment required for cold shutdown. Remaining Division 2 equipment, consisting of MSIV circuits, can be lost since redundant equipment is available in other zones and areas.

The combustibles contained within this fire area consists of the panel and cable insulation, and in-situ stored material. This is contained within a 165 ft^2 floor area which yields a fire loading of less than 60,000 Btu/ft^2 for this fire area.

9A.4.4.3.1.4.3 Conclusions

The results of the analysis for this area indicate that with the fire loading calculated, and the provision of early warning fire detection, the objective of preventing a fire from damaging both divisions of equipment required for safe shutdown, or spreading to adjacent areas is achieved. This is accomplished by barrier design and the low fire loading. Although some Division 1 and Division 2 valve controls are located on the remote shutdown panel, the safe shutdown of the reactor can be achieved by using appropriate valve controls in the control room if a fire should occur in this fire area. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.3.1.5 Fire Area 1CC-3e

9A.4.4.3.1.5.1 Description

Fire Area 1CC-3e is shown on <Figure 9A-11> and consists of the access corridor at the west side of the Unit 1 control complex. This area is bounded on the east by Fire Areas 1CC-3a and 1CC-3c, on the north by the access stair, on the south by the control complex elevator shaft, and on the west by the diesel generator building.

All walls of this area are constructed of drywall except for the west wall which is reinforced concrete. Doors to the stair, elevator and rooms are Class A fire doors.

The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floor and ceiling have a 3 hour fire resistance rating. The floor, ceiling, east, and west walls provide separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals.

The safe shutdown equipment within this area consists of control cables, Division 1 and Division 2, Unit 1.

Fire detection equipment for this area consists of smoke detectors that activate alarms in the control room. Fire suppression equipment consists of manual carbon dioxide hose reels, water type hose stations and fire extinguishers.

9A.4.4.3.1.5.2 Analysis

This area contains both divisions of control cables required for safe shutdown. Division 1 cables needed for safe shutdown are enclosed in a 1 hour fire rated barrier.

The only combustible contained within this fire area consists of cable insulation. This is contained within a floor area of 320 ft^2, which yields a fire loading of less than 40,000 Btu/ft^2 for this fire area.

9A.4.4.3.1.5.3 Conclusions

The results of the analysis for this area indicate that with the fire loading calculated, the separation of redundant divisions with fire barriers, and the early warning fire detection provided, the objective of preventing the spread of fire to another area or fire from damaging more than one division of safe shutdown equipment is achieved. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.3.2 Unit 2 Fire Areas, Floor 3 (2CC-3)

9A.4.4.3.2.1 Fire Area 2CC-3

9A.4.4.3.2.1.1 Description

Fire Area 2CC-3 consists of three separate functional areas and is shown on <Figure 9A-11>. It houses 4.16kV and 480V switchgear, supporting Unit 1, that is located in a cut-off room bounded by gypsum walls. The central room houses the back-up power distribution equipment and batteries for the Division 3 High Pressure Core Spray (HPCS) system.

This room is provided with a 3 hour fire rated barrier. The remaining space is available as an RRA Access Control Point and Health Physics support facilities.

Fire Area 2CC-3 is located at elevation 620'-6". This area is bounded on the north by Fire Area 1CC-3c, on the east by Fire Area 2CC-4b and 2CC-4f, on the west by Fire Area 2CC-3e, and on the south by the Service Building. All walls surrounding Fire Area 2CC-3 are 3-hour fire rated.

All walls of this area are constructed of drywall, with the exception of the wall adjacent to the Service Building which is concrete. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck. The support steel has an adequate level of protection from fire exposure presented by the hazards in the area. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units located in the HVAC equipment room. Air is supplied to this area by ductwork that is routed through the electrical cable chase (Fire Area 2CC-4b) and penetrates the chase wall at the Fire Area 2CC-4b interface. This supply air is relieved to the fourth floor (Elevation 638'-6") cable spreading room (Fire Area 2CC-4a) through ceiling openings located at the west end of this area. All ventilation penetrations through rated fire walls and ceiling openings are provided with 3 hour rated fire dampers. The operation (closing) of all these dampers is initiated either by heat melting a fusible element or by a signal from the smoke detection system for this area. Water from fire suppression activities can be removed by opening doors to direct the water to adjacent rooms containing floor drains or to stairwells. This will prevent water from accumulating.

Safety Related equipment in this area includes the back-up power distribution equipment and batteries for the Division 3 High Pressure

Core Spray (HPCS) system as well as the 4160V and 480V switchgear. The central room (housing the Division 3 equipment) is separated from the remaining portion of the area by a 3 hour fire rated gypsum wall barrier. This Unit 2 equipment, located in this central room, is only required to support Unit 1 when the primary system, located in 1CC-3b is taken offline. Functional redundancy for the Division 3 power and control cabling in this Fire Area is provided by Division 1 and Division 2 power and control cabling located in Fire Area 1CC-3a and 1CC-3c.

In addition to the area ventilation, a separate RRA Access Area HVAC System is contained within this fire area. A portion of the exhaust from this area is routed through the floor, via a 3 hour rated fire damper, to the M21 HVAC System. The operation (closing) of this damper is initiated by heat melting a fusible element. In addition, the area includes office material combustibles associated with the RRA Access facilities.

Fire detection equipment for this area consists of smoke detectors. Manual carbon dioxide hose reels, water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.3.2.1.2 Analysis

The combustible loading within the fire area includes cabling and materials consistent with switchgear, motor control centers and batteries. Of the originally designed cable runs, only small portions were actually pulled and many of the cable trays are either empty or minimally filled. In addition, the area includes office material combustibles associated with the RRA Access facilities.

The 4160V and 480V switchgear is located in the southwest corner of this fire area and is separate from the remainder of the fire area by non-fire rated gypsum walls. This equipment is not required to achieve safe shutdown in the event of a fire.

The back-up Division 3 power and distribution equipment, located within a room provided with fire rated gypsum walls, is functionally redundant to the primary Division 3 equipment and is not required to accomplish safe shutdown.

Special consideration was given to the case of overcharging the batteries in the HPCS power distribution room resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

The boundary of Fire Area 2CC-3, as described in <Section 9A.4.4.3.2.1.1>, serves as the rated fire barrier that separates the Unit 2 equipment from the remainder of the facility thus ensuring a fire does not propagate and impact safe shutdown equipment.

9A.4.4.3.2.1.3 Conclusions

The objective of preventing a fire in Fire Area 2CC-3 from spreading to adjacent areas containing safe shutdown equipment is achieved. This is accomplished in part by the low and discontinuous combustible loading, the fire detection system, and the 3 hour fire rated walls protecting Unit 1 safety-related equipment. Also the presence of the carbon dioxide hose reels, water type hose stations, and fire extinguishers provide ample fire suppression.

9A.4.4.3.2.2 (Deleted)

9A.4.4.3.2.3 (Deleted)

9A.4.4.3.2.4 (Deleted)

9A.4.4.3.2.5 Fire Area 2CC-3e

9A.4.4.3.2.5.1 Description

Fire Area 2CC-3e is shown on <Figure 9A-11> and consists of the access corridor at the west side of the Unit 2 control complex. This area is bounded on the east by Fire Area 2CC-3, on the north by the elevator shaft, on the south by the access stair, and on the west by the diesel generator building.

All walls of this area are constructed of drywall except for the west wall which is reinforced concrete. Doors to the stair and rooms are Class A fire doors and the door to the elevator shaft is a Class B fire door.

The floor and ceiling are constructed of reinforced concrete over steel form deck and three hour protected framing. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

There are no Unit 1 safe shutdown components or cables located in this area.

Fire detection for this area consists of smoke detectors that activate alarms in the control room. Fire suppression equipment consists of manual carbon dioxide hose reels, water type hose stations and fire extinguishers.

9A.4.4.3.2.5.2 Analysis

The only combustible in this area consists of cable insulation. This is contained within a floor area of 500 ft^2 which yields a fire loading of 31,460 Btu/ft^2 for this fire area.

9A.4.4.3.2.5.3 Conclusions

The results of the analysis for this area indicate that with the fire loading calculated, and the early warning fire detection provided, the objective of preventing the spread of fire to another area is achieved.

9A.4.4.4 Fire Areas, Floor 4

9A.4.4.4.1 Unit 1 Fire Areas, Floor 4 (1CC-4)

9A.4.4.4.1.1 Fire Area 1CC-4a

9A.4.4.4.1.1.1 Description

Fire Area 1CC-4a is shown on <Figure 9A-15>. It is the cable spreading area for Unit 1, Division 2 and houses the Division 2 power and control cables, RPS instrumentation cables, Division 2 and Division 3, and nonsafety-related cables routed from the control room to other plant areas. This area is located at Elevation 638’-6” along the north wall of the Unit 1 control complex. The floor boundary includes the computer room ceiling. This area is bounded on the north by the radwaste building, on the east by Fire Area 1CC-4b, on the south by Fire Areas 1CC-4c, 1CC-4d, 1CC-4e, and 1CC-4i, and on the west by Fire Area 1CC-638/654.

The north wall of this area is constructed of reinforced concrete. East, south and west walls are of drywall construction. The west wall is of bullet resistant construction. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, ceiling, south, east, and west walls provide separation of redundant trains of safe shutdown equipment. The walls, floors and ceilings separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Floor drainage is provided throughout this area.

Ventilation air for this area is supplied through transfer grilles located in the walls and floor. Return air is removed by two 100 percent capacity fans and associated ductwork. All wall ventilation penetrations and floor openings for ventilation are provided with 3 hour rated fire dampers. A manually activated smoke venting system is also provided to purge the smoke from this area.

Safe shutdown equipment in this area consists of:

a. Power and control cables for Unit 1, Division 1 and Division 2

b. RPS cables for Unit 1, Division 2 and Division 3

Fire protection for this area consists of a preaction type sprinkler system equipped with heat detectors for system actuation. Water type hose stations and fire extinguishers are also provided to supplement this system. Additional fire detection equipment is also provided for this area by smoke detectors that activate alarms in the control room.

9A.4.4.4.1.1.2 Analysis

Both divisions of circuits required for safe shutdown are located in this area. Functional redundancy for the Division 2 power and control cabling and Division 2 and Division 3 RPS cabling in this fire area is provided by Division 1 control cabling and Divisions 1 and Division 4 RPS cabling located in Fire Area 1CC-4e <Appendix 9A.4.4.4.1.5>. The Division 1 circuits located in this fire area include control circuits for the RCIC system. Components and circuits for the LPCS system (Division 1) are not located in this fire area, and LPCS would be available to provide Reactor Inventory Control. Manual actions will compensate for the effects of fire on the Division 1 circuits needed for cold shutdown. The manual operation in recirculation mode would compensate for fire induced faults on non-safety circuits associated with the Control Room HVAC system.

Combustible material contained in this fire area consists of cable insulation, electrical panels, and raceway fire barrier material. Total fire loading contained in the 3,159 ft^2 floor area of this fire area is less than 120,000 Btu/ft^2.

9A.4.4.4.1.1.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1-1/2 hours. Since this area is designed with 3 hour rated fire walls, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further protection is provided since the area is equipped with a preaction type sprinkler system for fire suppression and an early warning fire detection system. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.4.1.2 Fire Area 1CC-4b

9A.4.4.4.1.2.1 Description

Fire Area 1CC-4b is shown on <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-15>, <Figure 9A-16>, and <Figure 9A-19>. It consists of a vertical cable chase along the east end of the Unit 1, Division 2 control complex extending from Elevation 620'-6" to Elevation 693'-2" and a horizontal cable chase extending from the vertical chase to the Unit 1 reactor building at Elevation 639'-6" of the intermediate building. This fire area houses Division 2 and Division 3 and nonsafety-related cables routed from the Unit 1 reactor building to the cable spreading room and other plant areas. It is bounded on the north by the radwaste building and the interior of the intermediate building, on the east by the Unit 1 reactor building, on the south by Fire Area 1CC-4f and the interior of the intermediate building, and on the west by Fire Area 1CC-4a.

The north and east walls of this area within the control complex, and all walls within the intermediate building and Unit 1 reactor building, are constructed of reinforced concrete. The west and south walls of this area within the control complex are constructed of drywall. Doorways are equipped with Class A fire doors. Floor construction in the control complex is of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling in the control complex (at Elevation 693’-2”) is constructed of drywall and gypsum plank. Floor and ceiling construction within the intermediate building is of reinforced concrete. Walls and floors have a 3 hour fire resistance rating. The floor, ceiling, parts of the north, south, east, and west walls provide separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals, including the 3” rattle space at the reactor building. Floor drainage is provided in the control complex and intermediate building.

There is no ventilation system provided for this area during normal plant operation. However, in case of a fire in this area, a manually actuated smoke venting system is provided to purge the smoke. This system consists of a 100 percent capacity fan, isolation dampers and ductwork. Three hour rated fire dampers are provided where the ductwork penetrates fire rated walls.

Safe shutdown equipment in this fire area consists of:

a. Power and control cables for Unit 1, Division 1 and Division 2

b. RPS cables for Unit 1, Division 2 and Division 3

Fire protection for this area consists of a preaction type sprinkler system equipped with heat detectors for system actuation. Closed directional spray nozzles are provided at each floor elevation to ensure protection of cable tray runs in the vertical chases. These nozzles are located as required for protection of multi-level cable tray configurations. Fire extinguishers and water type hose stations are also provided. Additional fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.1.2.2 Analysis

Both divisions of circuits required for safe shutdown are located in this area. Functional redundancy for the Division 2 power and control cabling and Division 2 and Division 3 RPS cabling in this fire area is provided by Division 1 power and control cabling and Division 1 and Division 4 RPS cabling located in Fire Area 1CC-4f <Appendix 9A.4.4.4.1.6>. The Division 1 circuits located in this fire area include control circuits for the RCIC system. Components and circuits for the LPCS system (Division 1) are not located in this fire area and LPCS would be available to provide Reactor Inventory Control. Manual action will compensate for the effects of fire on most of the Division 1 equipment required for cold shutdown.

Combustible material contained in this fire area consists of cable insulation, electrical panels, and raceway fire barrier material. Total fire loading contained in the 1,405 ft^2 floor area of this fire area is less than 280,000 Btu/ft^2.

9A.4.4.4.1.2.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from damaging the cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished by separation of redundant equipment by

3 hour rated fire barriers and wrapping required circuits with 1 hour fire rated barriers. Further protection is provided since the area is equipped with a preaction type sprinkler system for fire suppression and an early warning fire detection system. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.4.1.3 Fire Area 1CC-4c

9A.4.4.4.1.3.1 Description

Fire Area 1CC-4c is shown on <Figure 9A-15>. It is at Elevation 638'-6" and consists of a small square room within the Unit 1, Division 2 control complex that houses the 125 Vdc distribution equipment for Division 2. This area is bounded on the north and east by Fire Area 1CC-4a, on the south by Fire Area 1CC-4g, and on the west by Fire Area 1CC-4d.

Walls are constructed of drywall. The floor and ceiling construction is of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. The floor, ceiling, north, south, and east walls provide separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one air handling unit operates continuously to supply air to this area. This air is then relieved to the adjacent battery room (Fire Area 1CC-4d) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

a. 125 Vdc distribution panels

b. Battery chargers

c. 125 Vdc switchgear bus

d. Power and control cables for Unit 1, Division 1, Division 2 and Division 3

e. 125 Vdc MCC

Fire detection equipment for this area consists of smoke detectors that activate alarms in the control room. Manual fire extinguishers, water type hose stations and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.1.3.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this area.

Functional redundancy for most Division 2 equipment in this area is provided by Division 1 equipment located in Fire Area 1CC-4g <Appendix 9A.4.4.4.1.7>. RCIC system components and circuits are the only Division 1 equipment in this area. Components and circuits for the LPCS system (Division 1) are not located in this fire area and LPCS would be available to provide Reactor Inventory Control.

Combustibles within this area consist of cable insulation, lubricating oil and grease, electrical panels, and raceway fire barrier material. Total fire loading contained in the 256 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

9A.4.4.4.1.3.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers and is provided with early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. In order to prevent a fire from damaging both divisions and affecting safe shutdown, required circuits contained in this area are protected with adequate fire barriers. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.4.1.4 Fire Area 1CC-4d

9A.4.4.4.1.4.1 Description

Fire Area 1CC-4d is shown on <Figure 9A-15>. It is at Elevation 638'-6" and consists of a rectangular room within the Unit 1, Division 2 control complex that houses the Division 2 batteries. This area is bounded on the north and west by Fire Area 1CC-4a, on the east by Fire Area 1CC-4c and on the south by Fire Area 1CC-4h.

Walls are constructed of drywall. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. The south wall provides separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Also, floor drainage is provided for this area.

Ventilation air supplied to the adjacent dc switchgear room (Fire Area 1CC-4c) and the access corridor (Fire Area 1CC-4a) is routed to this area through transfer grilles located in the walls. This air is then exhausted to the atmosphere by two 100 percent capacity exhaust fans. All ventilation penetrations are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

a. 125 Vdc batteries

b. Power and control cables for Unit 1, Division 2

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.1.4.2 Analysis

Only Division 2 safe shutdown equipment is located in this area. Redundant equipment is located in other fire areas and zones. Functional redundancy for the Division 2 batteries in this fire area is provided by the Division 1 batteries located in Fire Area 1CC-4h <Appendix 9A.4.4.4.1.8>.

The only combustible material in this area consists of battery cases. This material, contained within a 416 ft^2 floor area, yields a fire loading of less than 20,000 Btu/ft^2 for this fire area.

Special consideration was given to the case of overcharging the batteries resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

9A.4.4.4.1.4.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers and early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.4.1.5 Fire Area 1CC-4e

9A.4.4.4.1.5.1 Description

Fire Area 1CC-4e is shown on <Figure 9A-15>. It is the cable spreading area for Unit 1, Division 1, and houses the Division 1 power and control cables, RPS instrumentation cables, Division 1 and Division 4, and nonsafety-related cables routed from the control room to other plant areas. This area is located at Elevation 638'-6" along the north side of the wall separating Unit 1 and Unit 2 control complex. The floor boundary includes the computer room ceiling. This area is bounded on the north by Fire Areas 1CC-4a, 1CC-4g, 1CC-4h, and 1CC-4i, on the east by Fire Area 1CC-4f, on the south by Fire Area 2CC-4a, and on the west by Fire Area 1CC-638/654.

The walls of this area are constructed of drywall with the west wall having bullet resistant construction. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, ceiling, north, south, east, and west walls provide separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Floor drainage is provided throughout this area.

Ventilation air for this area is supplied through transfer grilles located in the walls and floor. Return air is removed by two 100 percent capacity fans. All wall ventilation penetrations and floor openings for ventilation are provided with 3 hour rated fire dampers. A manually activated smoke venting system is also provided to purge the smoke from this area.

Safe shutdown equipment in this area consists of:

a. Power and control cables for Unit 1, Division 1 and Division 2

b. RPS cables for Unit 1, Division 1 and Division 4

c. Power and control cables for Unit 2, Division 1 and Division 2 utilized as backup for Unit 1 systems

Fire protection for this area consists of a preaction type sprinkler system equipped with heat detectors for system actuation. Water type hose stations and fire extinguishers are also provided to supplement this system. Additional fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.1.5.2 Analysis

Both divisions of circuits required for safe shutdown are located in this area. Functional redundancy for the Division 1 power and control cabling and Division 1 and Division 4 RPS cabling in this area is provided by the Division 2 control cabling and Division 2 and Division 3 RPS cabling located in Fire Area 1CC-4a <Appendix 9A.4.4.4.1.1>. The manual operation in recirculation mode would compensate for fire induced faults on non-safety circuits associated with the Control Room HVAC system. Circuits for the Unit 2 Division 2 batteries are required for safe shutdown when used as the Unit 1 Division 2 DC supply and are wrapped with 1 hour fire rated barriers. Manual action will compensate for the effects of fire on the remaining Division 2 equipment required for cold shutdown.

Combustible material in this area consists of a concentration of cable insulation and electrical panels. This material, contained within the 3,002 ft^2 floor area, yields a fire loading of less than 140,000 Btu/ft^2.

9A.4.4.4.1.5.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1-3/4 hours. Since this area is designed with 3 hour rated fire walls, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further assurance of limiting fire spread is achieved since the area is equipped with a preaction type sprinkler system and early warning fire detection. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.4.1.6 Fire Area 1CC-4f

9A.4.4.4.1.6.1 Description

Fire Area 1CC-4f is shown on <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-15>, <Figure 9A-16>, and <Figure 9A-19>. It consists of a vertical cable chase along the east end of the Unit 1, Division 1 control complex extending from Elevation 620’-6” to Elevation 693’-2”, and a horizontal cable chase extending from the vertical chase to the Unit 1 reactor building at Elevation 639’-6” of the intermediate building. This fire area houses Division 1 and Division 4, and nonsafety-related cables routed from the Unit 1 reactor building to the cable spreading room and other plant areas. It is bounded on the north by Fire Area 1CC-4b and the interior of the intermediate building, on the east by the Unit 1 reactor building and the interior of the intermediate building, on the south by Fire Area 2CC-4b and the interior of the intermediate building, and on the west by Fire Area 1CC-4e.

The east wall of this area within the control complex, and all walls of this area within the intermediate building and the Unit 1 reactor building, are constructed of reinforced concrete. The north, south and west walls of this area within the control complex are constructed of drywall. Doorways are equipped with Class A fire doors. Floor construction in the control complex is of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling in the control complex (at Elevation 693’-2”) is constructed of drywall and gypsum plank. Floor and ceiling construction within the intermediate building is of reinforced concrete. Walls and floor have a 3 hour fire resistance rating. The floor, ceiling, north, and parts of the south, east and west walls provide separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals, including the 3” rattle space at the reactor building. Floor drainage is provided in both the control complex and intermediate building.

There is no ventilation system provided for this area during normal plant operation. However, in case of a fire in this area, a manually actuated smoke venting system is provided. This consists of a 100 percent capacity fan, isolation dampers and ductwork. Three hour rated fire dampers are provided where ductwork penetrates fire walls.

Safe shutdown equipment in this fire area consists of:

a. Power and control cables for Unit 1, Division 1 and Division 2

b. RPS cables for Unit 1, Division 1 and Division 4

Fire protection for this area consists of a preaction type sprinkler system equipped with heat detectors for system actuation. Closed directional spray nozzles are provided at each floor elevation to ensure protection of cable tray runs in the vertical chases. These nozzles are located as required for protection of multi-level cable tray configurations. Fire extinguishers and water type hose stations are also provided. Additional fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.1.6.2 Analysis

Both divisions of circuits required for safe shutdown are located in this area. Functional redundancy for the Division 1 power and control cabling and Division 1 and Division 4 RPS cabling in this fire area is provided by Division 2 power and control cabling and Division 2 and Division 3 RPS cabling located in Fire Area 1CC-4b <Appendix 9A.4.4.4.1.2>. Manual action will compensate for the effects of fire on most of the Division 2 equipment required for cold shutdown. Remaining Division 2 circuits needed for safe shutdown, are wrapped with a 1 hour fire rated barrier.

Combustible material in this area consists of a concentration of cable insulation, electrical panels, and raceway fire barrier material. Total fire loading in the 2,286 ft^2 floor area of this fire area is less than 200,000 Btu/ft^2.

9A.4.4.4.1.6.3 Conclusions

The results of the analysis for this fire area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 2-1/2 hours. Since this area is designed with 3 hour rated fire walls, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further assurance of limiting fire spread is achieved since the area is equipped with a preaction type sprinkler system and early warning fire detection. In this area, required Division 2 circuits are enclosed in a 1 hour fire rated barrier. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.4.1.7 Fire Area 1CC-4g

9A.4.4.4.1.7.1 Description

Fire Area 1CC-4g is shown on <Figure 9A-15>. It is at Elevation 638'-6" and consists of a small square room within the Unit 1, Division 1 control complex that houses the 125 Vdc distribution equipment for Division 1. This area is bounded on the north by Fire Area 1CC-4c, on the east and south by Fire Area 1CC-4e, and on the west by Fire Area 1CC-4h.

Walls are constructed of drywall. The floor and ceiling construction is of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. The north wall provides separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one handling unit operates continuously to supply air to this area. This air is then relieved to the adjacent battery room (Fire Area 1CC-4h) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

a. 125 Vdc distribution panel

b. Battery chargers

c. 125 Vdc switchgear bus

d. 125 Vdc motor control center (MCC)

e. Power and control cables for Unit 1, Division 1

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.1.7.2 Analysis

Only Division 1 safe shutdown equipment is located in this area. Redundant equipment is located in other areas and zones. Functional redundancy for the Division 1 components in this area is provided by Division 2 equipment located in Fire Area 1CC-4c <Appendix 9A.4.4.4.1.3>, with the exception of the MCC for the reactor core isolation cooling system valves; the MCC has no redundancy.

Combustibles within this fire area consist of cable insulation, and electrical panels. Total fire loading contained in the 256 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

9A.4.4.4.1.7.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers and early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.4.1.8 Fire Area 1CC-4h

9A.4.4.4.1.8.1 Description

Fire Area 1CC-4h is shown on <Figure 9A-15>. It is at Elevation 638'-6" and consists of a rectangular room within the Unit 1, Division 1 control complex that houses the Division 1 batteries. This area is bounded on the north by Fire Area 1CC-4d, on the east by Fire Area 1CC-4g and on the west and south by Fire Area 1CC-4e.

Walls are constructed of drywall. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. The north wall provides separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Also, floor drainage is provided for this area.

Ventilation air supplied to the adjacent dc switchgear room (Fire Area 1CC-4g) and the access corridor (Fire Area 1CC-4e) is routed to this area through transfer grilles located in the walls. This air is then exhausted to the atmosphere by two 100 percent capacity exhaust fans. All ventilation penetrations are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

a. 125 Vdc batteries

b. Power and control cables for Unit 1, Division 1

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.1.8.2 Analysis

Only Division 1 safe shutdown equipment is located in this area. Redundant equipment is located in other fire areas and zones. Functional redundancy for the Division 1 batteries in this fire area is provided by the Division 2 batteries located in Fire Area 1CC-4d <Appendix 9A.4.4.4.1.4>.

The only combustible material in this area consists of battery cases. This material, contained within a 416 ft^2 floor area, yields a fire loading of less than 20,000 Btu/ft^2 for this fire area.

Special consideration was given to the case of overcharging the batteries resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

9A.4.4.4.1.8.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers and early warning fire detection, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.4.1.9 Fire Area 1CC-4i

9A.4.4.4.1.9.1 Description

Fire Area 1CC-4i is shown on <Figure 9A-15>. It is located at the center of the Unit 1 control complex at Elevation 638’-6” and consists of the computer room. This area is bounded on the north, east and west by Fire Area 1CC-4a and on the south, east and west by Fire Area 1CC-4e.

Walls are constructed of drywall with doorways equipped with Class A fire doors. The ceiling is constructed of drywall and gypsum plank. The computer room has a raised floor above the typical floor construction which is reinforced concrete over steel form deck and 3 hour protected framing. Parts of the north, south, east, and west walls provide separation of redundant trains of safe shutdown equipment. Walls and floor have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

The ventilation system for this fire area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one air handling unit operates continuously to supply air to this area. This supply air is relieved to the adjacent cable spreading areas (1CC-4a and 1CC-4e) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers.

There is no safe shutdown equipment located in this fire area.

Fire detection equipment for this area consists of smoke detectors in the computer room and in the subfloor. Fire suppression equipment includes a manual total flooding carbon dioxide system in the subfloor, manual fire extinguishers and carbon dioxide hose reels.

9A.4.4.4.1.9.2 Analysis

Protection for equipment in this fire area is not required since this equipment is not required for safe shutdown.

Combustibles in this fire area consist of cable insulation, electrical panels, and combustible supplies. Total fire loading contained in the 672 ft^2 floor area of this fire zone is less than 120,000 Btu/ft^2.

9A.4.4.4.1.9.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1-1/2 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to adjacent areas containing safe shutdown equipment is achieved. Also, the carbon dioxide system in the computer room subfloor, and the early warning fire detection, provide sufficient protection.

9A.4.4.4.1.10 Fire Area 1CC-638/654

9A.4.4.4.1.10.1 Description

Fire Area 1CC-638/654 is shown on <Figure 9A-15>. It consists of the elevator vestibule area at the 638'-6" elevation, adjacent to the northwest stairwell in the control complex. The west wall is reinforced concrete, and the remaining walls are drywall with the east wall of bullet resistant construction. The east wall provides separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling are 3 hour rated. Doors are Class A, except for the Class B elevator door.

Safe shutdown equipment consists of nonsafety circuits which can affect safe shutdown.

Fire detection equipment for this area consists of smoke detectors. Fire suppression equipment consists of water and CO_2 hose stations, and fire extinguishers.

9A.4.4.4.1.10.2 Analysis

Only one nonsafety circuit located in this area is required for safe shutdown. Redundant equipment is located in other fire areas and zones.

Combustibles in this fire area consist of cable insulation. This material, contained within a 320 ft^2 floor area, yields a fire loading of less than 60,000 Btu/ft^2 for this fire area.

9A.4.4.4.1.10.3 Conclusions

Analysis indicates that a fire in this area does not damage required circuits of both divisions; therefore, safe shutdown is not prevented. Manual suppression and early warning fire detection are provided. Division 2 could be utilized in the event of a fire in this area.

9A.4.4.4.2 Unit 2 Fire Areas, Floor 4 (2CC-4)

9A.4.4.4.2.1 Fire Area 2CC-4a

9A.4.4.4.2.1.1 Description

Fire Area 2CC-4a is shown on <Figure 9A-15>. It is the cable spreading area for Unit 2, Division 2 and houses the Unit 2 Division 1 and 2 battery cables. This area is located at Elevation 638’-6” along the south side of the wall separating the Unit 1 and Unit 2 control complex. The floor boundary includes the computer room ceiling. This area is bounded on the north by Fire Area 1CC-4e, on the east by Fire Area 2CC-4b, on the south by Fire Areas 2CC-4c, 2CC-4d, 2CC-4e, and 2CC-4i, and on the west by the diesel generator building.

The walls of this area are constructed of drywall with doorways equipped with Class A doors. Floor and ceiling construction is of reinforced concrete over steel form deck and 3 hour protected framing. The walls, floors and ceilings separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Also, floor drainage is provided throughout this area.

Ventilation air for this area is supplied through transfer grilles located in the walls and floor. Return air is removed by two 100 percent capacity fans and associated ductwork. All wall ventilation penetrations and floor openings for ventilation are provided with 3 hour rated fire dampers. In addition to operation (closing) of these dampers by melting of fusible links, the dampers to Fire Areas 2CC-3, 4b, and 4i will also operate upon a signal from the smoke detection system for this area.

Safe shutdown equipment in this area consists of:

a. Cables for Unit 2, Division 1 and Division 2 batteries utilized as backup power for Unit 1 systems

Fire protection for this area consists of a sprinkler system equipped with manual system actuation. Water type hose stations and fire extinguishers are also provided to supplement this system. Fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.2.1.2 Analysis

Only one division of Unit 2 power would be aligned as a backup. The batteries and control equipment and circuits required for the Unit 2 power are separated from the Unit 1 areas by 3-hr rated fire barriers and there are no instrumentation or control circuits for the Unit 2 batteries which could cause a loss of the backup power supplies routed in the Unit 1 fire areas. For a fire in this area a redundant train of Unit 1 equipment would be available for plant shutdown.

These combustibles contained within the 2,991 ft^2 floor area, yields a fire loading of 118,854 Btu/ft^2 for this fire area.

9A.4.4.4.2.1.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1-1/2 hours. Since this area is designed with 3 hour rated fire walls, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further assurance of limiting fire spread is achieved since the area is equipped with a preaction type sprinkler system for fire suppression, and an early warning fire detection system.

9A.4.4.4.2.2 Fire Area 2CC-4b

9A.4.4.4.2.2.1 Description

Fire Area 2CC-4b is shown on <Figure 9A-11>, <Figure 9A-15>, <Figure 9A-16>, and <Figure 9A-19>. It consists of a vertical cable chase along the east end of the Unit 2, Division 2 control complex extending from Elevation 620’-6” to Elevation 693’-2”. This fire area houses Unit 1 Division 2 safe shutdown cables. It is bounded on the north by Fire Area 1CC-4f and the interior of the intermediate building, on the east by the Unit 2 Division 2 cable chase, on the south by Fire Area 2CC-4f, and on the west by Fire Area 2CC-4a. A partition wall to resist tornado depressurization and a three hour fire rated barrier are located at the west end of the Unit 2 horizontal cable chase in the Intermediate Building at Elevation 639’-6”.

The east wall of this area within the control complex, and all walls within the intermediate building and the Unit 2 reactor building, are constructed of reinforced concrete. The north, south and west walls of this area within the control complex are constructed of drywall. Doorways are equipped with Class A fire doors. Floor construction in the control complex is of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling in the control complex (at Elevation 693’-2”) is constructed of drywall and gypsum plank. Floor and ceiling construction within the intermediate building is of reinforced concrete. Walls and floors have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals, including the 3” rattle space at the reactor building. Floor drainage is provided in the control complex and intermediate building.

There is no ventilation system provided for this area during normal plant operation.

Safe shutdown equipment in this fire area consists of:

Power and control cables for Unit 1, Division 2

Fire protection for this area consists of a manually actuated water spray system. Fire extinguishers are also provided. Fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.2.2.2 Analysis

The only Unit 1 safe shutdown cables are Division 2. Functional redundancy for the Division 2 cables is provided by Division 1 equipment located in other fire areas.

Combustibles within this area, contained within the 2,285 ft^2 floor area, yields a fire loading of 183,764 Btu/ft^2 for this fire area.

9A.4.4.4.2.2.3 Conclusions

The results of the analysis for this fire area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 2 ½ hours. Since this area is designed with 3 hour rated fire walls, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further assurance of limiting fire spread is achieved since the area is equipped with a manually actuated water spray system for fire suppression, and an early warning fire detection system. In the event of a fire in this area, Unit 1, Division 1 could be used for safe shutdown.

9A.4.4.4.2.3 Fire Area 2CC-4c

9A.4.4.4.2.3.1 Description

Fire Area 2CC-4c is shown on <Figure 9A-15>. It is at Elevation 638’-6” and consists of a small square room within the Unit 2, Division 2 control complex that houses the 125 Vdc distribution equipment for Division 2. This area is bounded on the north and east by Fire Area 2CC-4a, on the south by Fire Area 2CC-4g and on the west by Fire Area 2CC-4d.

Walls are constructed of drywall. The floor and ceiling construction is of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one air handling unit operates continuously to supply air to this area. This air is then relieved to the adjacent battery room (Fire Area 2CC-4d) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

a. 125 Vdc distribution panels

b. Battery charger

c. 125 Vdc switchgear bus

d. Cables for Unit 2, Division 2 batteries utilized as backup power for Unit 1 systems.

e. 125 Vdc MCC

Fire detection equipment for this area consist of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.2.3.2 Analysis

Functional redundancy for the Division 2 equipment in this area is provided by Unit 1 Division 1 equipment located in other fire areas.

Total fire loading for this 256 ft^2 fire area is 30,313 Btu/ft^2.

9A.4.4.4.2.3.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1/2 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, and is provided with an early warning fire detection system, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved.

9A.4.4.4.2.4 Fire Area 2CC-4d

9A.4.4.4.2.4.1 Description

Fire Area 2CC-4d is shown on <Figure 9A-15>. It is at Elevation 638’-6” and consists of a rectangular room within the Unit 2, Division 2 control complex that houses the Division 2 batteries. This area is bounded on the north and west by Fire Area 2CC-4a, on the east by Fire Area 2CC-4c and on the south by Fire Area 2CC-4h.

Walls are constructed of drywall. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Also, floor drainage is provided for this area.

Ventilation air supplied to the adjacent dc switchgear room (Fire Area 2CC-4c) and the access corridor (Fire Area 2CC-4a) is routed to this area through transfer grilles located in the walls. This air is then exhausted to the atmosphere by two 100 percent capacity exhaust fans. All wall penetrations for ventilation are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

Unit 2, Division 2 125 Vdc batteries utilized as backup power for Unit 1 systems

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.2.4.2 Analysis

Functional redundancy for the Division 2 batteries in this fire area is provided by the Unit 1 Division 1 equipment located in other fire areas.

Combustibles within this 416 ft^2 fire area yields a fire loading of 7,212 Btu/ft^2 for this fire area.

Special consideration was given to the case of overcharging the batteries resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

9A.4.4.4.2.4.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, and is provided with an early warning fire detection system, the objective of preventing the spreading of a fire to adjacent areas containing redundant safe shutdown equipment is achieved.

9A.4.4.4.2.5 Fire Area 2CC-4e

9A.4.4.4.2.5.1 Description

Fire Area 2CC-4e is shown on <Figure 9A-15>. It is the cable spreading area for Unit 2, Division 1 and houses circuits for Unit 2 Division 1 batteries. This area is located at Elevation 638’-6” along the north side of the south wall of the Unit 2 control complex. The floor boundary includes the computer room ceiling. This area is bounded on the north by Fire Areas 2CC-4a, 2CC-4g, 2CC-4h, and 2CC-4i, on the east by Fire Area 2CC-4f, on the south by the service building, and on the west by the Diesel Generator Building.

The south wall of this area is constructed of reinforced concrete, with the north, east and west walls of drywall construction. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floors and ceilings separating redundant divisions have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Floor drainage is provided throughout this area.

Ventilation air for this area is supplied through transfer grilles located in the walls and floor. Return air is removed by two 100 percent capacity fans. All wall ventilation penetrations and floor openings for ventilation are provided with 3 hour rated fire dampers. In addition to operation (closing) of these dampers by melting of fusible links, the dampers to Fire Areas 2CC-3, 2CC-4f, and 2CC-4i will also operate upon a signal from the smoke detection system for this area.

Safe shutdown equipment in this area consists of:

Cables for Unit 2, Division 1 batteries utilized as backup power for Unit 1 systems

Fire protection for this area consists of a sprinkler system equipped with manual system actuation. Water type hose stations and fire extinguishers are also provided to supplement this system. Fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.2.5.2 Analysis

Functional redundancy for the Division 1 cables in this area is provided by the Unit 1 Division 2 equipment located in other fire areas.

Combustible material yields a fire loading of 117,774 Btu/ft^2 for this fire area.

9A.4.4.4.2.5.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1-1/2 hours. Since this area is designed with 3 hour rated fire walls, and is provided with an early warning fire detection system, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved. Further assurance of limiting fire spread is achieved since the area is equipped with a sprinkler system for fire protection.

9A.4.4.4.2.6 Fire Area 2CC-4f

9A.4.4.4.2.6.1 Description

Fire Area 2CC-4f is shown on <Figure 9A-11>, <Figure 9A-12>, <Figure 9A-15>, <Figure 9A-16>, and <Figure 9A-19>. It consists of a vertical cable chase along the east end of the control complex extending from Elevation 620’-6” to Elevation 693’-2”. It is bounded on the north by Fire Area 2CC-4b and the interior of the intermediate building, on the east by the Unit 2, Division 1 cable chase, on the south by the service building, and on the west by Fire Area 2CC-4e. A partition wall to resist tornado depressurization and a three hour fire rated barrier are located at the west end of the Unit 2 horizontal cable chase in the Intermediate Building at Elevation 639’-6”.

The east and south walls of this area within the control complex, and all walls within the intermediate building and the Unit 2 reactor building, are constructed of reinforced concrete. The north and west walls of this area within the control complex are constructed of drywall. Doorways are equipped with Class A fire doors. Floor construction in the control complex is of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling in the control complex (at Elevation 693'-2") is constructed of drywall and gypsum plank. Floor and ceiling construction within the intermediate building is of reinforced concrete. Walls and floors have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals, including the 3" rattle space at the reactor building. Floor drainage is provided in both the control complex and intermediate building.

There is no ventilation system provided for this area during normal plant operation.

There are no Unit 1 safe shutdown components or cables located in this fire area.

Fire protection for this area consists of a manually actuated water spray system.

Fire extinguishers are also provided. Fire detection equipment is also provided for this area by smoke detectors.

9A.4.4.4.2.6.2 Analysis

Since there is no functionally redundant Unit 1 equipment in other fire areas, equipment separation is not required.

Combustible material contained within this 1,404 ft^2 fire area yields a fire loading of 243,590 Btu/ft^2 for this fire area.

9A.4.4.4.2.6.3 Conclusions

Fire barriers having a three hour rating are provided to prevent fire spreading to adjacent fire areas. Further assurance of limiting fire spread is achieved since the area is equipped with a manually actuated water spray system for fire suppression and an early warning fire detection system.

9A.4.4.4.2.7 Fire Area 2CC-4g

9A.4.4.4.2.7.1 Description

Fire Area 2CC-4g is shown on <Figure 9A-15>. It is at Elevation 638’-6” and consists of a small square room within the Unit 2, Division 1 control complex that houses the 125 Vdc distribution equipment for Unit 2, Division 1. This area is bounded on the north by Fire Area 2CC-4c, on the east and south by Fire Area 2CC-4e and on the west by Fire Area 2CC-4h.

Walls are constructed of drywall. The floor and ceiling construction is of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

The ventilation system for this area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one air handling unit operates continuously to supply air to this area. This air is then relieved to the adjacent battery room (Fire Area 2CC-4h) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

Cables for Unit 2, Division 1 batteries utilized as backup power for Unit 1 systems

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.2.7.2 Analysis

Functional redundancy for the Division 1 equipment in this area is provided by Unit 1 Division 2 equipment located in other fire areas.

Total fire loading contained in this 256 ft^2 fire area is approximately 49,000 Btu/ft^2.

9A.4.4.4.2.7.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, and is provided with an early warning fire detection system, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved.

9A.4.4.4.2.8 Fire Area 2CC-4h

9A.4.4.4.2.8.1 Description

Fire Area 2CC-4h is shown on <Figure 9A-15>. It is at 638'-6" and consists of a rectangular room within the Unit 2, Division 1 control complex that houses the Division 1 batteries. This area is bounded on the north by Fire Area 2CC-4d, on the east by Fire Area 2CC-4g and on the west and south by Fire Area 2CC-4e.

Walls are constructed of drywall. The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals. Also, floor drainage is provided for this area.

Ventilation air supplied to the adjacent dc switchgear room (Fire Area 2CC-4g) and the access corridor (Fire Area 2CC-4e) is routed to this area through transfer grilles located in the walls. This air is then exhausted to the atmosphere by two 100 percent capacity exhaust fans. All ventilation penetrations are provided with 3 hour rated fire dampers.

Safe shutdown equipment located within this area is as follows:

Unit 2 Division 1 125 Vdc batteries utilized as backup power for Unit 1 systems

Fire detection equipment for this area consists of smoke detectors. Manual fire extinguishers and carbon dioxide hose reels are provided for fire suppression.

9A.4.4.4.2.8.2 Analysis

Functional redundancy for the Division 1 batteries in this fire area is provided by Unit 1 Division 2 equipment located in other fire areas.

Combustible material in this 416 ft^2 fire area yields a fire loading of 7,212 Btu/ft^2 for this fire area.

Special consideration was given to the case of overcharging the batteries resulting in the production of hydrogen gas. The ventilation system for this area continuously exhausts air to the outside, ensuring that hydrogen gas concentration is maintained below 1 percent by volume.

9A.4.4.4.2.8.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, and is provided with an early warning fire detection system, the objective of preventing the spread of a fire to adjacent areas containing redundant safe shutdown equipment is achieved.

For this reason, no modifications are recommended for this fire area.

9A.4.4.4.2.9 Fire Area 2CC-4i

9A.4.4.4.2.9.1 Description

Fire Area 2CC-4i is shown on <Figure 9A-15>. It is located at the center of the Unit 2 control complex at Elevation 638'-6" and consists of the computer room. This area is bounded on the north, east and west by Fire Area 2CC-4a and on the south, east and west by Fire Area 2CC-4e.

Walls are constructed of drywall with doorways equipped with Class A fire doors. The ceiling is constructed of drywall and gypsum plank. The computer room has a raised floor above the typical floor construction which is reinforced concrete over form deck and 3 hour protected framing. All penetrations have 3 hour fire rated seals.

The ventilation system for this fire area consists of two 100 percent capacity air handling units that also supply air to other areas. During normal operation, one air handling unit operates continuously to supply air to this area. This supply air is relieved to the adjacent cable spreading areas (2CC-4a and 2CC-4e) through transfer grilles located in the walls. All ventilation penetrations through the walls are provided with 3 hour rated fire dampers. The operation (closing) of all these dampers is initiated either by heat melting a fusible element or by a signal from the smoke detection system for this area.

No safe shutdown equipment is located in this fire area.

Fire detection equipment for this area consists of smoke detectors in the computer room and in the subfloor. Fire suppression equipment includes manual fire extinguishers and carbon dioxide hose reels.

9A.4.4.4.2.9.2 Analysis

Since there is no functionally redundant equipment in other fire areas, equipment separation is not required.

Total fire loading in this 672 ft^2 fire area is 73,512 Btu/ft^2.

9A.4.4.4.2.9.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to adjacent areas containing safe shutdown equipment is achieved. Also, an early warning fire detection system is provided.

9A.4.4.5 Fire Areas, Floor 5

9A.4.4.5.1 Unit 1 Fire Areas, Floor 5 (1CC-5)

9A.4.4.5.1.1 Fire Area 1CC-5a

9A.4.4.5.1.1.1 Description

Fire Area 1CC-5a is shown on <Figure 9A-19>. It contains the control equipment required for operation of Unit 1. The equipment consists primarily of prefabricated floor section modules. Each of these modules which consists of floor sections, termination cabinets and panels or console assemblies, has wireways in the floor section for routing cable from the various panels (consoles) to the termination cabinets. This fire area is at Elevation 654’-6” and is bounded on the north by the outside wall, on the east by Fire Areas 1CC-4b and 1CC-4f, on the south by Fire Area 2CC-5a, and on the west by Fire Zone 1CC-5b and Fire Area 1CC-5c.

The north wall of this area is constructed of reinforced concrete. East, south and west walls are constructed of drywall. Doorways are equipped with Class A fire doors. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The control room floor configuration is steel plate raised 12 inches above the reinforced concrete. Walls, floor and ceiling have 3 hour fire resistance ratings. The floor, ceiling, east, and west walls provide separation of redundant trains of safe shutdown equipment. All penetrations have 3 hour fire rated seals.

The control room HVAC system consists of two 100 percent capacity supply fans, plenums, and return fans. The emergency recirculation systems consists of two 100 percent capacity charcoal filter trains and recirculating fans. In the event of a fire, a smoke venting system can be manually initiated to purge smoke from the control room and allow outside air to be supplied.

Safe shutdown equipment located within this fire area consists of termination cabinets, floor section modules, consoles and control panels associated with the equipment identified in <Appendix 9A.3>.

Fire detection equipment for this area consists of both smoke detectors and heat detectors covering the floor section modules, and smoke detectors in the control room proper. This coverage includes the wireways in the modules and the cabinets and panels on top of the modules. Fire suppression equipment consists of a manually activated carbon dioxide total flooding system for the wireways in the floor section modules. The floor area is divided into three sections. Should a fire occur in one of these three main sections, the wireways in the entire section are flooded simultaneously. Manual water type hose stations and water, Halon, dry chemical and carbon dioxide type fire extinguishers are also provided for backup fire suppression.

9A.4.4.5.1.1.2 Analysis

Both divisions of safe shutdown components and circuits are located in this fire area. Functional redundancy is provided for equipment in this area since diesel generator control, reactor trip and long term shutdown can be accomplished from outside of the control room. Redundant divisions of cabling are not located in common wireways within the floor sections. Separation is in accordance with separation design criteria. Tests, documented in NEDO Report No. 10466, were performed to determine fire spreading capability within a floor section, and show that a fire in one wireway will not affect cabling in adjacent wireways. Non-Tefzel cables resulting from field run wiring comprise less than 20 percent of the total subfloor cabling. This arrangement would preclude the development of deep-seated fires prior to the manual initiation of the CO_2 system.

Combustibles within this area consist of cable insulation, electrical panels, floor panels and covering and combustible supplies. Total fire loading contained in the 7,124 ft^2 floor area of this fire zone is less than 200,000 Btu/ft^2.

9A.4.4.5.1.1.3 Conclusions

A redundant means of control for safe shutdown of the reactor from outside the control room is provided by equipment located in other fire areas. These areas are separated from the control room by 3 hour rated fire barriers. Early warning fire detection and a manually activated carbon dioxide system will provide responsive and adequate control of the subfloor fire. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.5.1.2 Fire Zone 1CC-5b

9A.4.4.5.1.2.1 Description

Fire Zone 1CC-5b is shown on <Figure 9A-19>. It is a small rectangular room in the northwest corner of the Elevation 654'-6" floor that serves as an office. This zone is bounded on the north by the outside wall, on the east by Fire Area 1CC-5a, on the south by Fire Area 1CC-5c, and on the west by the stairtower.

The north wall of this zone is constructed of reinforced concrete. East, south and west walls are constructed of drywall with the west wall of bullet resistant construction. The floor and ceiling are constructed of reinforced concrete over steel form deck with 3 hour protected framing. Walls, floor and ceiling have 3 hour fire resistance ratings. All penetrations have 3 hour fire rated seals.

This fire zone contains power and control cables for Unit 1, Division 2.

Fire detection equipment for this zone consists of smoke detectors. Manual water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.5.1.2.2 Analysis

Only Division 2 cables required for safe shutdown are contained in this fire zone. Redundant equipment is located in other fire areas and zones.

The combustibles in this fire zone consist of minimal Class A material associated with the office. This material, contained within a 127 ft^2 floor area, yields a fire loading estimated to be less than 60,000 Btu/ft^2 for this fire zone.

9A.4.4.5.1.2.3 Conclusions

The objective of preventing the spread of a fire to any area containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design, and by providing an early warning fire detection system. In the event of a fire in this zone, Division 1 could be used for safe shutdown.

9A.4.4.5.1.3 Fire Area 1CC-5c

9A.4.4.5.1.3.1 Description

Fire Area 1CC-5c is shown on <Figure 9A-19>. It is at Elevation 654'-6" in the northwest corner of the floor and consist of the corridor that provides access to the Unit 1 fire areas on this floor. This area is bounded on the north by Fire Zone 1CC-5b and the stairwell, on the east by Fire Area 1CC-5a, on the south by Fire Area 2CC-5b, and on the west by the outside wall.

The west wall is constructed of reinforced concrete. North, east and south walls are constructed of drywall. Doorways are equipped with Class A fire doors. Floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floor and ceiling have 3 hour fire resistance ratings. All penetrations have 3 hour fire rated seals.

This fire area contains power and control cables for Unit 1, Division 2, and several nonsafety circuits which can affect both divisions of safe shutdown equipment.

Fire detection equipment for this area consists of smoke detectors in lunch and conference rooms.

Fire suppression equipment for this area consists of manual water type hose stations and fire extinguishers.

9A.4.4.5.1.3.2 Analysis

Only Division 2 cables required for safe shutdown exist in this fire area. Loss of the nonsafety circuits does not affect safe shutdown (equipment fails to the safe position).

Combustibles contained in this 1,242 ft^2 area consist of electrical panels and cable insulation, hence the fire loading is negligible (<10,000 Btu/ft^2).

9A.4.4.5.1.3.3 Conclusions

To contain a fire within this area, fire area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to any area containing safe shutdown equipment is easily achieved. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.5.2 Unit 2 Fire Areas, Floor 5 (2CC-5)

9A.4.4.5.2.1 Fire Area 2CC-5a

9A.4.4.5.2.1.1 Description

Fire Area 2CC-5a is shown on Figure 9A-19. It was originally designed to contain all the control equipment for the operation of Unit 2. This area is now used as office space.

This fire area is at Elevation 654'-6" and is bounded on the north by Fire Area 1CC-5a, on the east by Fire Areas 2CC-4b and 2CC-4f, on the south by the service building, and on the west by Fire Area 2CC-5b.

The south wall of this area is constructed of reinforced concrete. The north, east and west walls are constructed of drywall. Doorways are equipped with Class A fire doors. The base floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing.

The finished floor decking is constructed of fire retardant material with carpeting raised 12 inches above the reinforced concrete base floor. The walls, base floor and ceiling have 3 hour fire resistance ratings. All penetrations to Unit 1 fire areas have 3 hour fire rated seals.

The control room HVAC system consists of two 100 percent capacity supply fans, plenums and return fans. The emergency recirculation system consists of two 100 percent capacity charcoal filter trains and recirculating fans.

There are no Unit 1 safe shutdown components or cables located within this fire area.

Fire detection equipment for this area consists of ionization detectors at the ceiling level. Fire detection for the sub-floor has been provided for by adding open grating into the floor decking in order to allow the passage of smoke from the sub-floor to the overhead smoke detection system.

Fire suppression equipment for this area consists of manual water type hose stations as well as Halon, dry chemical, and carbon dioxide type fire extinguishers.

9A.4.4.5.2.1.2 Analysis

The combustible loading within this fire area consists of typical office materials, fire retardant flooring, and some additional cabling in the sub-floor. Of the originally designed cable runs for Unit 2 operation, only a small portion were actually pulled. The combustible loading has been assessed based on the current use of this area as office space. The overall fire loading in this fire area is considered low, less than 80,000 BTU/ft^2, which corresponds to a fire severity of less than 1 hour.

Because there is no safe shutdown equipment in this fire zone, the objective of providing adequate protection to adjacent fire areas containing safe shutdown equipment is achieved by the 3-hour rated construction surrounding the area. This protection is further enhanced by the smoke detection system and the manual firefighting capabilities designed for the area.

9A.4.4.5.2.1.3 Conclusions

The objective of preventing a fire in Fire Area 2CC-5a from spreading to adjacent areas containing safe shutdown equipment is achieved. This is accomplished by the 3-hour fire rated walls surrounding the area. The fire detection and suppression capabilities provide an additional level of safety.

9A.4.4.5.2.2 Fire Area 2CC-5b

9A.4.4.5.2.2.1 Description

Fire Area 2CC-5b is shown on <Figure 9A-19>. It is at Elevation 654'-6" in the southwest corner of the floor and consists of the kitchen, conference room, and the corridor that provides access to the Unit 2 fire areas on this floor. This area is bounded on the north by Fire Area 1CC-5c, on the east by Fire Area 2CC-5a, on the south by the service building, and on the west by the outside wall.

The west and south walls are constructed of reinforced concrete. North, and east walls are constructed of drywall. Doorways are equipped with Class A fire doors. The floor and ceiling are constructed of reinforced concrete over steel form deck and with 3 hour protected framing. Walls, floor and ceiling have 3 hour fire resistance ratings. All penetrations have 3 hour fire rated seals.

Safe shutdown equipment within this fire area consists of control and power cables for Division 1, Unit 1.

Fire detection equipment for this area consists of smoke detectors in the conference room and kitchen. Manual water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.4.5.2.2.2 Analysis

This fire area contains only Division 1 cables required for safe shutdown. Redundant equipment is located in other fire areas and zones.

The combustible materials in this fire area consist of paper and furniture contained within a 1,242 ft^2 floor area, which yields a fire loading of less than 20,000 Btu/ft^2 for this fire area.

9A.4.4.5.2.2.3 Conclusions

The results of the analysis for this area indicate that, to contain a fire of the loading calculated, the fire area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to any area containing redundant safe shutdown equipment is achieved. Also, manual water type hose stations and fire extinguishers are provided for fire suppression. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.6 <u>Fire Areas, Floor 6</u>

9A.4.4.6.1 Unit 1 Fire Areas, Floor 6

9A.4.4.6.1.1 Fire Area 1CC-6

9A.4.4.6.1.1.1 Description

Fire Area 1CC-6 is shown on <Figure 9A-19>. It is located at Elevation 679'-6" above the Unit 1 control room. The ceiling is at the control complex roof elevation of 707'-2". This area houses the ventilation equipment required to maintain the habitability of the control room and to cool the electrical equipment required to control the operation and safe shutdown of Unit 1. It is bounded on the north and west by outside walls, on the south by Fire Area 2CC-6 and on the east by Fire Areas 1CC-4b, 1CC-4f (cable chases) and CC-6.

The north and west walls of this area are constructed of reinforced concrete. East and south walls are constructed of drywall. Doorways are equipped with Class A fire doors. Floor and ceiling (roof) are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, south and east walls provide separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling have 3 hour fire resistance ratings. Wall and floor penetrations have 3 hour fire rated seals. Floor drains are provided for this fire area.

The ventilation for this fire area, and corresponding Fire Area 2CC-6, is accomplished as follows: The return fans for the controlled access and miscellaneous equipment area HVAC system and the MCC, switchgear and miscellaneous electrical equipment area HVAC system (refer to <Appendix 9A.4.4>, items a, b) flow directly into this area. Excess air used for pressurization of the Unit 1 and Unit 2 control rooms (Fire Areas 1CC-5a and 2CC-5a, respectively) is relieved to this fire area as well as Fire Area 2CC-6. The supply branch of these two ventilation systems provides air to Fire Area 2CC-6, which is returned to this fire area through transfer grilles in the wall separating these areas. Duct penetration for both fire areas are provided with 3 hour fire dampers.

Safe shutdown equipment located within this fire area is as follows:

a. Control room HVAC supply plenum

b. Control room HVAC supply fan

c. Control room HVAC exhaust fan

d. MCC, switchgear and misc. electrical area HVAC plenum

e. MCC, switchgear and misc. electrical area supply fan

f. MCC, switchgear and misc. electrical area return fan

g. Battery room exhaust fan

h. Power and control cables for Unit 1, Division 1 and Division 2

i. HVAC system control panel

j. MCC, switchgear and misc. electrical equipment area HVAC, and battery room exhaust system instrument rack

k. Control room HVAC and Emergency Recirculation instrument rack

l. Chilled water valves

Fire detection for this area consists of smoke detectors.

Fire suppression equipment for this area consists of a manually activated deluge system in the charcoal filter plenums, water type hose stations and fire extinguishers.

9A.4.4.6.1.1.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this fire area. Functional redundancy for the components in this fire area is provided by the equipment located in Fire Area 2CC-6 <Appendix 9A.4.4.6.2>. Also, divisional separation of mechanical equipment is provided by Fire Area 2CC-6. Division 1 power and control cables needed for safe shutdown are wrapped with 1 hour fire rated barriers.

Combustibles within this area consist of cable insulation, electrical panels, charcoal, raceway fire barrier material and motor windings. Total fire loading contained in the 8,251 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Special consideration was given to the charcoal filter as a fire hazard. The filter has heat sensors incorporated in the design to initiate signals in the control room so that the water deluge system can be actuated, if required.

9A.4.4.6.1.1.3 Conclusions

The results of this analysis indicate that to contain a fire of the loading calculated, the fire area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to any other area containing redundant safe shutdown equipment is achieved. The water deluge system in the charcoal filter plenums and the early warning fire detection provide adequate fire protection. Required Division 1 circuits are provided with adequate fire barriers. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.4.6.2 Unit 2 Fire Areas, Floor 6

9A.4.4.6.2.1 Fire Area 2CC-6

9A.4.4.6.2.1.1 Description

Fire Area 2CC-6 is shown on <Figure 9A-19>. It is located at Elevation 679'-6" above the Unit 2 control room. The ceiling is at the control complex roof elevation of 707'-2". This area houses the ventilation equipment required to maintain the habitability of the Unit 2 control room. It is bounded on the south and west by outside walls, on the north by Fire Area 1CC-6 and on the east by Fire Areas 2CC-4b, 2CC-4f (cable chases) and CC-6.

The south and west walls of this area are constructed of reinforced concrete. North and east walls are constructed of drywall. Doorways are equipped with Class A fire doors. Floor and ceiling (roof) are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor, north and east walls provide separation of redundant trains of safe shutdown equipment. Walls, floor and ceiling have 3 hour fire resistance ratings. Wall and floor penetrations have 3 hour fire rated seals. Floor drains are provided for this fire area.

The ventilation system for this fire area is described in <Appendix 9A.4.4.6.1.1>.

Safe shutdown equipment located within this fire area is as follows:

a. Control room HVAC supply plenum

b. Control room HVAC supply fan

c. Control room HVAC exhaust fan

d. MCC, switchgear and misc. electrical area HVAC plenum

e. MCC, switchgear and misc. electrical area supply fan

f. MCC, switchgear and misc. electrical area return fan

g. Battery room exhaust fan

h. Power and control cables for Unit 1 and Unit 2, Division 1 and Division 2

i. HVAC system control panel

j. MCC, switchgear and misc. electrical equipment area HVAC and battery room exhaust system instrument racks

k. Chilled water valves

l. Control room HVAC and Emergency Recirculation instrument rack

Fire detection equipment for this area consists of smoke detectors.

Fire suppression equipment for this area consists of a manually activated water deluge system in the charcoal filter plenums, water type hose stations and fire extinguishers.

9A.4.4.6.2.1.2 Analysis

Functional redundancy for the components in this fire area is provided by the equipment located in Fire Area 1CC-6 <Appendix 9A.4.4.6.1>. Also, divisional separation of mechanical equipment is provided by Fire Area 1CC-6.

Combustibles within this area consist of cable insulation, electrical panels, charcoal, raceway fire barrier material and motor windings. Total fire loading contained in the 8,531 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Special consideration was given to the charcoal filter as a fire hazard. The filter has heat sensors incorporated in the design to initiate signals in the control room so that the water deluge system can be actuated, if required.

9A.4.4.6.2.1.3 Conclusions

The results of this analysis indicate that to contain a fire of the loading calculated, the fire area boundaries must have a fire resistance rating of 1/2 hour. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to any area containing redundant safe shutdown equipment is achieved. The water deluge systems in the charcoal filter plenums and the early warning fire detection provide adequate fire protection. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.4.6.3 Fire Areas Common to Unit 1 and Unit 2, Floor 6

9A.4.4.6.3.1 Fire Area CC-6

9A.4.4.6.3.1.1 Description

Fire Area CC-6 is shown on <Figure 9A-19>. It houses Unit 1 and Unit 2 ventilation ducts and comprises the horizontal chase in the upper, east section of the control complex at Elevation 693’-2”. The ceiling is at the control complex roof Elevation 707’-2”. This area is bounded on the north and south by the outside wall, on the west by Fire Areas 1CC-6 and 2CC-6 and on the east by the intermediate building.

The north, east and south walls of this area are constructed of reinforced concrete. The west wall is constructed of drywall. The floor is constructed of gypsum plank and drywall. Ceiling (roof) construction is reinforced concrete over steel form deck and 3 hour protected framing. Walls and ceiling have 3 hour fire resistance ratings. The floor and west wall provide separation of redundant trains of safe shutdown equipment. The floor provides adequate separation from other areas. Wall and floor penetrations have 3 hour fire rated seals. Access to this area is through access panels from Fire Areas 1CC-6 and 2CC-6.

Safe shutdown equipment for this fire area consists of HVAC ductwork for the systems identified in <Appendix 9A.4.4>, and Unit 1, Division 1 and Division 2 power and control cables.

Fire detection equipment for this area consists of smoke detectors.

Fire suppression equipment for this area consists of manual fire extinguishers.

9A.4.4.6.3.1.2 Analysis

Both redundant divisions of the ventilation ductwork, and both divisions of safe shutdown circuits, are contained in this fire area. Each division of redundant ductwork entering into this common area is provided with 3 hour rated fire dampers. The only Division 1 cable located in this area is more than 100 feet from any Division 2 safe shutdown cables.

The combustibles contained in this 3,836 ft^2 floor area are cable insulation. The amount is insignificant; hence, the fire loading is negligible (less than 6,500 Btu/ft^2).

9A.4.4.6.3.1.3 Conclusions

Due to the negligible fire loading, early warning fire detection, and the presence of 3 hour rated fire dampers, the objective of preventing the spread of a fire to any area containing redundant safe shutdown equipment is easily achieved. The only Division 1 safe shutdown circuit is provided with adequate spatial separation from Division 2 circuits. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.5 DIESEL GENERATOR BUILDING

The diesel generator building is a two story structure constructed of reinforced concrete. The three Unit 1 diesel generator rooms are located at Elevation 620’-6”. Above the diesel generator rooms, at Elevation 646’-6”, are the diesel generator air intake room and the exhaust silencer.

The diesel generator building is bounded on the east by the control complex, the north by the radwaste building and the south by the service building. The west wall is exposed to grade.

The diesel generator building houses the three Unit 1 emergency diesel generators, fuel oil day tanks and other equipment necessary to supply standby electric power to operate safe shutdown equipment should normal power be lost.

Each of the Unit 1 diesel generator rooms is provided with a separate and independent ventilation system. The ventilation for each room consists of two 100% capacity supply air fans and four 50% capacity exhaust louvers.

For purposes of this fire hazards analysis, the diesel generator building is divided into seven fire areas. Each of the three Unit 1 diesel generator rooms and its associated penthouse containing the air intake equipment comprise a fire area, while the common corridor is considered the fourth, the LLRW room is the fifth, and the underground duct bank serving 1DG-1c is the sixth fire area. The seventh is the FLEX Storage Room (2DG-1a). The two Office/Maintenance Areas South of 2DG-1a (formerly 2DG-1b and 2DG-1c), are not designated fire areas since they do not contain Unit 1 Safe Shutdown components.

9A.4.5.1 Unit 1 Fire Areas

9A.4.5.1.1 Fire Area 1DG-1a

9A.4.5.1.1.1 Description

Fire Area 1DG-1a is shown on <Figure 9A-11> and <Figure 9A-15>. It is located in the northernmost portion of the diesel generator building.

The main floor, at Elevation 620’-6”, houses the diesel generator and auxiliary equipment; the air intake penthouse structure is at Elevation 646’-6”. This area is bounded on the north by the radwaste building, on the east by Fire Area DG-1e, on the south by Fire

Area 1DG-1b, and on the west by the outside wall which is exposed to grade. The diesel generator housed in this area provides Division 2 onsite ac power in case of an emergency.

Wall, floor and ceiling construction for this area is of reinforced concrete. The walls have a 3 hour fire resistance rating. The south wall provides separation of redundant trains of safe shutdown equipment. Doorways are equipped with Class A fire doors. Wall penetrations are sealed to provide a 3 hour rating. Floor drain piping is configured to form traps between each fire area. Access to this area is through a Class A fire door from Fire Area 1DG-1b. Each doorway is provided with a curb to prevent an oil spill within the room from spreading to adjacent fire areas.

Ventilation for this area is accomplished by taking in outside air that enters the penthouse through the fixed outside air louvers. Two 100 percent capacity fans are provided. Ventilating air is vented to the atmosphere through electric motor-operated discharge louvers. During summer operation all of the intake air is relieved to the atmosphere. During winter operation room air is partially recirculated to maintain a minimum supply air mixture temperature of 60°F.

Safe shutdown equipment located within this area is as follows:

a. Diesel generator, Division 2

b. Fuel oil day tank

c. Starting air receiver tanks

d. Fuel oil transfer pumps

e. Diesel generator, generator control panel

f. Diesel generator, engine control panel

g. Diesel generator, high voltage exciter cabinet

h. Ventilation fans

i. Power and control cables for Unit 1, Division 2

j. Air intake filters

Fire detection for this area is provided by rate-of-rise fixed temperature detectors and smoke detectors. Fire suppression equipment consists of an automatically activated total flooding carbon dioxide system on the main floor. Actuation of the carbon dioxide system will trip the ventilation fans and close all ventilation dampers. Also, manual fire extinguishers are provided for fire suppression.

9A.4.5.1.1.2 Analysis

Only Division 2 components and circuits required for safe shutdown are located in this area. Functional redundancy for the diesel generator and associated components in this fire area is provided by the Division 1 diesel generator and associated equipment located in Fire Area 1DG-1c <Appendix 9A.4.5.1.3>.

Combustibles within this area consist of cable insulation, lubricating oil and grease, electrical panels, diesel fuel oil, and motor windings. Total fire loading contained in the 1,530 ft^2 floor area of this fire zone is less than 240,000 Btu/ft^2.

The diesel fuel oil day tank and supports are protected to obtain a 3 hour fire resistance rating. Should lubricating oil leak from the diesel generator, the leakage would be contained within the room by curbs provided at the doorways, and would be collected by the floor drains and be piped to an oil interceptor tank.

9A.4.5.1.1.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 3 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to an adjacent area containing redundant safe shutdown equipment is achieved. Also, the main floor is protected by a total flooding carbon dioxide system for fire suppression, and early warning fire detection is provided for both floors. In the event of a fire in this area, Division 1 could be used for safe shutdown.

9A.4.5.1.2 Fire Area 1DG-1b

9A.4.5.1.2.1 Description

Fire Area 1DG-1b is shown on <Figure 9A-11> and <Figure 9A-15>. It is located in the northern portion of the diesel generator building. The main floor at Elevation 620'-6" houses the diesel generator and auxiliary equipment; the air intake penthouse structure is at Elevation 646'-6". This area is bounded on the north by Fire Area 1DG-1a, on the south by Fire Area 1DG-1c, on the east by Fire Areas DG-1d and DG-1e, and on the west by the outside wall which is exposed to grade. The diesel generator housed in this area provides Division 3 onsite ac power in case of an emergency.

Wall, floor and ceiling construction for this area is of reinforced concrete. The north, south and east walls provide separation of redundant trains of safe shutdown equipment. The walls have a 3 hour fire resistance rating. Doorways are equipped with Class A fire doors.

Wall penetrations are sealed to provide a 3 hour rating. Floor drain piping is configured to form traps between each fire area. Access to this area is through a Class A fire door from the common corridor (Fire Area DG-1d). Each doorway is provided with a curb to prevent an oil spill within the room from spreading to adjacent fire areas.

Ventilation for this area is accomplished by taking in outside air that enters the penthouse through the fixed outside air louvers. Two 100 percent capacity fans are provided. Ventilating air is vented to the atmosphere through electric motor-operated discharge louvers. During summer operation all of the intake air is relieved to the atmosphere. During winter operation room air is partially recirculated to maintain a minimum supply air mixture temperature of 60°F.

There is no safe shutdown equipment located within this area.

Fire detection for this area is provided by rate-of-rise fixed temperature detectors and smoke detectors. Fire suppression equipment consists of an automatically activated total flooding carbon dioxide system on the main floor. Actuation of the carbon dioxide system will trip the ventilation fans and close all ventilation dampers. Also, manual fire extinguishers are provided for fire suppression.

9A.4.5.1.2.2 Analysis

Combustibles within this area consist of cable insulation, lubricating oil and grease, electrical panels, diesel fuel oil, and motor windings. Total fire loading contained in the 1,470 ft^2 floor area of this fire zone is less than 120,000 Btu/ft^2.

The diesel fuel oil day tank and supports are protected to obtain a 3 hour fire resistance rating. Should lubricating oil leak from the diesel generator, the leakage would be contained within the room by curbs provided at the doorways, and would be collected by the floor drains and be piped to an oil interceptor tank.

9A.4.5.1.2.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1-1/2 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to an adjacent area is achieved. Also, the main floor is protected by a total flooding carbon dioxide system for fire suppression, and early warning fire detection is provided for both floors.

9A.4.5.1.3 Fire Area 1DG-1c

9A.4.5.1.3.1 Description

Fire Area 1DG-1c is shown on <Figure 9A-11> and <Figure 9A-15>. It is located in the northern portion of the diesel generator building. The main floor, at Elevation 620’-6”, houses the diesel generator and auxiliary equipment; the air intake penthouse structure is at Elevation 646’-6”. This area is bounded on the north by Fire Area 1DG-1b, on the south by Fire Area 2DG-1a, on the east by Fire Area DG-1d, and on the west by the outside wall which is exposed to grade. It is partially bounded below by Fire Area DGDB (electrical duct bank). The diesel generator housed in this area provides Division 1 onsite ac power in case of an emergency.

Wall, floor and ceiling construction for this area is of reinforced concrete. The north and east walls provide separation of redundant trains of safe shutdown equipment. The walls have a 3 hour fire resistance rating. Doorways are equipped with Class A fire doors. Wall penetrations are sealed to provide a 3 hour rating. Floor drain piping is configured to form traps between each fire area. Access to this area is through a Class A fire door from the common corridor (Fire Area DG-1d). Each doorway is provided with a curb to prevent an oil spill within the room from spreading to adjacent fire areas.

Ventilation for this area is accomplished by taking in outside air that enters the penthouse through the fixed outside air louvers. Two 100 percent capacity fans are provided. Ventilating air is vented to the atmosphere through electric motor-operated discharge louvers. During summer operation all of the intake air is relieved to the atmosphere. During winter operation room air is partially recirculated to maintain a minimum supply air mixture temperature of 60°F.

Safe shutdown equipment located within this area is as follows:

a. Diesel generator, Division 1

b. Fuel oil day tank

c. Starting air receiver tanks

d. Fuel oil transfer pumps

e. Diesel generator, generator control panel

f. Diesel generator, engine control panel

g. Diesel generator, high voltage exciter cabinet

h. Ventilation fans

i. Power and control cables for Unit 1, Division 1

j. Air intake filters

Fire detection for this area is provided by rate-of-rise fixed temperature detectors and smoke detectors. Fire suppression equipment consists of an automatically activated total flooding carbon dioxide system on the main floor. Actuation of the carbon dioxide system will trip the ventilation fans and close all ventilation dampers. Also, manual fire extinguishers are provided for fire suppression.

9A.4.5.1.3.2 Analysis

Only Division 1 components and circuits are located in this area. Functional redundancy for the diesel generator and associated equipment in this fire area is provided by the Division 2 diesel generator and equipment located in Fire Area 1DG-1a <Appendix 9A.4.5.1.1>.

Combustibles within this area consist of cable insulation, lubricating oil and grease, electrical panels, diesel fuel oil, and motor windings. Total fire loading contained in the 1,530 ft^2 floor area of this fire zone is less than 240,000 Btu/ft^2.

The diesel fuel oil day tank and supports are protected to obtain a 3 hour fire resistance rating. Should lubricating oil leak from the diesel generator, the leakage would be contained within the room by curbs provided at the doorways, and would be collected by the floor drains and be piped to an oil interceptor tank.

9A.4.5.1.3.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 3 hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to an adjacent area containing redundant safe shutdown equipment is achieved. Also, the main floor is protected by a total flooding carbon dioxide system for fire suppression, and early warning fire detection is provided for both floors. In the event of a fire in this area, Division 2 could be used for safe shutdown.

9A.4.5.2 Unit 2 Fire Areas

9A.4.5.2.1 Fire Area 2DG-1a

9A.4.5.2.1.1 Description

Fire Area 2DG-1a is shown on <Figure 9A-11> and <Figure 9A-15>. It is located in the southern portion of the diesel generator building. The main floor, at Elevation 620'-6", is used for FLEX equipment storage; the air intake penthouse structure is at Elevation 646'-6".

This area is bounded on the north by Fire Area 1DG-1c, on the south by two Office/Maintenance Areas (formerly 2DG-1b and 2DG-1c), on the east by Fire Area DG-1d, and on the west by the outside wall which is exposed to grade.

Wall, floor and ceiling construction for this area is of reinforced concrete. The walls have a 3 hour fire resistance rating. Doorways are equipped with Class A fire doors. Wall penetrations are sealed to provide a 3 hour rating. Floor drain piping is configured to form traps between each fire area. Access to this area is through a Class A fire door from the common corridor (Fire Area DG-1d). Each doorway is provided with a curb to prevent an oil spill within the room from spreading to adjacent fire areas.

There are no Unit 1 safe shutdown components or cables located in the fire area.

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Fire detection for this area is provided by smoke detectors. Also, manual fire extinguishers are provided for fire suppression.

9A.4.5.2.1.2 Analysis

The major combustibles located within this area consist of a variety of maintenance-related materials consistent with the activity in the area. An estimate of the current combustible loading was made to evaluate the potential fire exposure to other plant areas. The estimated fire loading is 100,000 Btu/ft^2, with a fire severity of 75 minutes. This is considered a moderate fire loading, however, as noted above, this area is separated from other areas by 3-hour rated barriers.

9A.4.5.2.1.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 ½ hour fire resistance rating. Since this area is designed with 3 hour rated fire barriers, the objective of preventing the spread of a fire to an adjacent area is achieved. Also, the main floor is provided with early warning fire detection.

9A.4.5.2.2 Office/Maintenance Areas

9A.4.5.2.2.1 Description

The two Office/Maintenance Areas are shown on <Figure 9A-11> and <Figure 9A-15>. They are located in the southern portion of the diesel generator building. The main floor is at Elevation 620’-6”, and the air intake penthouse structure is at Elevation 646’-6”. These areas are bounded on the north by Fire Area 2DG-1a, on the south by the service building, on the east by Fire Area DG-1d, and on the west by the outside wall which is exposed to grade. These two areas do not contain Unit 1 safe shutdown components or cables and are not designated as fire areas.

Wall, floor and ceiling construction for this area is of reinforced concrete. The walls between these areas and adjacent fire areas, and the service building, have a 3-hour fire resistance rating. Doorways are equipped with Class A fire doors. Wall penetrations in fire rated walls are sealed to provide a 3-hour rating. Floor drain piping is configured to form traps between each area. Access to these areas is through Class A fire doors from the corridor (Fire Area DG-1d). Each doorway is provided with a curb to prevent an oil spill within the room from spreading to adjacent fire areas.

There is no Unit 1 safe shutdown equipment located within these areas.

Fire detection for this area is provided by smoke detectors. Also, manual fire extinguishers are provided for fire suppression.

9A.4.5.2.2.2 Analysis

The major combustibles located within these areas consist of a variety of maintenance-related and office materials consistent with the activity in each area. An estimate of the current combustible loading was made to evaluate the potential fire exposure to other plant areas. The estimated fire loading is 100,000 BTU/ft^2, with a fire severity of 75 minutes, in each of the two Office/Maintenance areas. This is considered a moderate fire loading, however, as noted above, the two areas are separated from adjacent fire areas by 3-hour rated barriers.

9A.4.5.2.2.3 Conclusions

The results of the analysis for this area indicate that to contain a fire of the loading calculated, the area boundaries must have a 1 hour fire resistance rating. Since these areas are designed with 3-hour rated fire barriers to adjacent fire areas and the service building, the objective of preventing the spread of a fire to an adjacent area is achieved. Also, both floors are provided with early warning fire detection.

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9A.4.5.3 Common Fire Areas

9A.4.5.3.1 Fire Area DG-1d

9A.4.5.3.1.1 Description

Fire Area DG-1d is shown on <Figure 9A-11>. It is at Elevation 620'-6" and serves as a common connecting corridor between the control complex, service building and diesel generator areas thereby providing access to the diesel generator rooms. This area is bounded on the north by the radwaste building, on the east by Fire Areas 1CC-3 and 2CC-3 of the control complex, on the south by the service building, and on the west by Fire Areas 1DG-1b, 1DG-1c and 2DG-1a, and the Office/Maintenance Areas.

Wall, floor and ceiling construction for this area is of reinforced concrete. The north, east and west walls provide separation of redundant trains of safe shutdown equipment. The walls have a 3 hour fire resistance rating. Doorways are equipped with Class A fire doors. Wall penetrations are sealed to provide a 3 hour rating. Access to this area is through Class A fire doors from the control complex, service building and the diesel generator rooms.

Safe shutdown equipment located within this area is as follows:

a. Power and control cables for Unit 1, Division 1 and Division 2

Fire detection for this area consists of smoke detectors.

Fire suppression equipment for this area consists of manual fire extinguishers.

9A.4.5.3.1.2 Analysis

Division 1 and Division 2 power and control cables required for safe shutdown for Unit 1 are contained in this area. Spatial separation between redundant diesel generator power and control cables serving a unit is more than 7 feet. Moreover, cabling for Unit 1 diesel generators is routed so that spatial separation in excess of 11 feet is maintained between cables serving different units. Most of the Division 2 circuits needed for safe shutdown are wrapped with a 1 hour fire rated barrier. Manual action will compensate for the effects of fire on remaining Division 2 equipment required for shutdown.

The only combustible material in this area is cable insulation and fire barrier material. This insulation, contained within the 1,968 ft^2 floor area, yields a fire loading of less than 80,000 Btu/ft^2 for this fire area.

9A.4.5.3.1.3 Conclusions

The results of the analysis indicate that because of the spatial separation of cables, cable wrapping, the low fire loading, and the provision of early warning fire detection, the objective of preventing a fire from damaging cables associated with more than one division of safe shutdown equipment or spreading to another fire area is achieved. Therefore, in the event of a fire, Division 2 could be utilized for safe shutdown.

9A.4.5.3.2 Fire Area DG-1e

9A.4.5.3.2.1 Description

The LLRW room is shown on <Figure 9A-11>. Walls, floors and ceiling are constructed of reinforced concrete. Doorways to adjacent buildings are equipped with Class A fire doors. Walls to adjacent buildings have 3 hour fire resistance ratings with all penetrations provided with 3 hour fire rated seals.

Safe shutdown equipment in this area consists of power and control cables, Division 2, Unit 1.

Fire detection equipment for this area consists of smoke detectors.

Fire suppression equipment consists of an automatic sprinkler system.

9A.4.5.3.2.2 Analysis

Only Division 2 safe shutdown circuits are located in this fire area. Redundant safe shutdown equipment is located in other areas.

Combustibles within this area consist of cable insulation raceway fire barrier material and storage of in situ-transient combustibles. Total fire loading contained in the 540 ft^2 area of this fire zone is less than 240,000 Btu/ft^2.

9A.4.5.3.2.3 Conclusions

The results of the analysis indicate that the objective of preventing a fire from damaging both divisions of required safe shutdown equipment is achieved. This is accomplished by barrier design, and locating the Division 1 equipment required for safe shutdown in other fire areas. Division 1 would be used for safe shutdown in the event of a fire in this area.

9A.4.5.4 Unit 1 Duct Bank

9A.4.5.4.1 Fire Area DGDB

9A.4.5.4.1.1 Description

Fire Area DGDB is shown on <Figure 9A-11>. It consists of an underground electrical duct bank starting at the west wall of Fire Zone CC-2b in the control complex (Elevation 599'-0"), and terminating in the floor of Fire Zone 1DG-1c in the Diesel Generator Building. This zone contains circuits for the Diesel Generator System.

The duct bank is constructed of reinforced concrete. Penetrations through walls and floors are also reinforced concrete.

Safe shutdown equipment in this fire area consists of power system cables, Division 1, Unit 1.

9A.4.5.4.1.2 Analysis

Only Division 1 circuits are located in this fire area. Redundant equipment required for safe shutdown is located in other fire areas.

9A.4.5.4.1.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and locating redundant equipment in other fire zones and areas. Division 2 could be used for safe shutdown in the event of a fire in this area.

9A.4.6 EMERGENCY SERVICE WATER PUMPHOUSE

The emergency service water pumphouse is a single story, rectangular building constructed of reinforced concrete shown on the <Figure 9A-34>. It is an isolated structure located north of the main plant area with the service water pumphouse as the closest building. This building houses pumps and associated equipment required to supply cooling water for safe shutdown systems.

The ventilation system for the emergency service water pumphouse consists of intake louvers, two 100 percent capacity supply fans and two 100 percent capacity motor-operated exhaust louvers for each reactor unit. Each fan is sized to dissipate heat generated by the emergency service water (ESW) pump motors along with miscellaneous equipment. The supply fan draws outside air through the intake louvers and supplies it to the pump area. This supply air is relieved to the atmosphere through the motor-operated exhaust louvers which automatically open when the corresponding fan is energized. During winter operations some room air is recirculated to maintain room temperature. The supply fans operate only when the emergency pumps are operated.

Two 100 percent capacity supply fans are provided for ventilation of the diesel driven fire pump room. These fans operate only when the diesel driven fire pump operates. The supply fan draws ambient air from the emergency service pumphouse and supplies it to the fire pump room. This air is then relieved through exhaust louvers to the atmosphere. Penetrations through the roof of the diesel driven fire pump room are provided with 3 hour rated fire dampers.

For purposes of this fire hazards analysis, the emergency service water pumphouse is divided into two fire areas and two fire zones: Fire Area ESW-1a contains ESW pumps, associated equipment and the electric motor driven fire pump; Fire Area ESW-1b contains the diesel driven fire pump, associated control panel, batteries, and diesel fuel oil storage tank; Fire Zones ESW Duct Bank No. 1 and No. 2 contain Division 1 and Division 2 cables (respectively), for the ESW system.

9A.4.6.1 Fire Area ESW-1a

9A.4.6.1.1 Description

Fire Area ESW-1a is shown on <Figure 9A-34>. It comprises the entire emergency service water pumphouse except for the diesel fire pump room located in the northeast corner of the main floor (Elevation 586'-6"). It is also bounded on the southeast and southwest by Fire Zones ESW Duct Bank No. 1 and No. 2 (electrical duct banks). This area houses equipment for the ESW system including screen wash pumps, ESW pumps, discharge strainers, and associated control equipment.

Walls, floor and ceiling are constructed of reinforced concrete. Walls to Fire Area ESW-1b have a 3 hour fire resistance rating and are equipped with Class A fire doors. The ceiling of Fire Area ESW-1b is constructed of 3 hour rated reinforced concrete, except for a small (2 foot by 2 foot) steel hatch which is not fire rated (ESW-1b is provided with sprinklers and smoke detectors, and does not expose safe shutdown equipment). Wall penetrations have 3 hour fire rated seals. Floor drains are configured with a header on the east side and another on the west side of the floor which carry drainage to the sump. Access to the area is provided from the outside by doors at grade.

The safe shutdown equipment in this fire area consists of:

a. ESW pumps for Division 1 and Division 2, Unit 1

b. Screen wash pumps for Division 1 and Division 2

c. Screen wash pump discharge strainers for Division 1 and Division 2

d. Motor control centers (MCC) for Division 1 and Division 2, Unit 1

e. Power and control cables for Division 1 and Division 2, Unit 1

f. Emergency service water pumphouse intake screens for Division 1 and Division 2

g. Emergency service water pumphouse ventilation for Division 1 and Division 2, Unit 1

h. Emergency service water valves

Fire detection equipment for this area consists of smoke detectors. Manual water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.6.1.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this area. Most of the redundant cable trays are spatially separated by a minimum of 20 feet. Division 2 pumps and equipment for Unit 1 are located in the western portion of the building. Division 1 pumps and equipment are located in the eastern portion. An exception is the Division 1 MCC for Unit 1, which is located in the center of the building near the south wall and is adequately separated from the redundant Division 2 MCC and associated equipment located in the northwest part of this fire area. Redundant Division 1 and Division 2 screen wash and traveling screen systems are separated by approximately 3 feet. Manual action will compensate for the effects of fire on this Division 1 and Division 2 equipment required for cold shutdown.

The combustibles contained within this fire area consist of cable insulation, lubricating oil and grease, electrical panels, raceway fire barrier material and motor windings. Total fire loading contained in the 5,244 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

9A.4.6.1.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from damaging cables or equipment associated with both divisions of required safe shutdown equipment, and preventing safe shutdown, is achieved. This is accomplished by adequate spatial separation between redundant safe shutdown equipment and low fire loading. Early warning fire detection is also provided. In the event of a fire in this area, Division 1 or Division 2 will be available for safe shutdown, depending upon the location of the fire.

9A.4.6.2 Fire Area ESW-1b

9A.4.6.2.1 Description

Fire Area ESW-1b is shown on <Figure 9A-34>. It is a room located in the northeast corner of the emergency service water pumphouse at Elevation 586’-6”. This area houses the diesel driven fire pump, control panel, diesel engine, and diesel fuel oil tank.

Walls, floor and ceiling are constructed of reinforced concrete. The walls and ceiling have 3 hour fire resistance ratings. The ceiling ventilation openings are provided with 3 hour rated fire dampers. A small (2 foot by 2 foot) steel hatch is also located in the ceiling, and is not firerated; however, this hatch does not expose safe shutdown equipment in Fire Area ESW-1a. The doorways to Fire Area ESW-1a are equipped with Class A fire doors. Wall and ceiling penetrations are provided with 3 hour fire rated seals. Floor drains for this area are trapped and trenched to a sump.

There is no safe shutdown equipment contained within this fire area.

Fire detection equipment for this area consists of smoke detectors. An automatic sprinkler system, manual water type hose stations and fire extinguishers are provided for fire suppression.

9A.4.6.2.2 Analysis

Combustibles within this fire area consist of cable insulation, lubricating oil and grease, diesel fuel oil, battery cases, electrical panels and motor windings. Total fire loading contained in the 440 ft^2 floor area of this fire zone is less than 120,000 Btu/ft^2.

Special consideration was given to the case of a rupture of the 300 gallon diesel fuel oil tank or failure of a connection to the tank. This fire area has trenches to collect any spillage, and thus prohibit an oil leak from flowing across the floor and into Fire Area ESW-1a.

Each trench is connected to a 4 inch drain line with a trap. The drain lines are interconnected and empty into the 360 gallon capacity sump in Fire Area ESW-1a.

9A.4.6.2.3 Conclusions

The results of the analysis for this fire area indicate that the objective of preventing a fire from spreading to Fire Area ESW-1a, which contains safe shutdown equipment, is achieved. This is accomplished by barrier design and by the provision of trenches and drains to collect oil spillage. Also, the automatic sprinkler system provides added assurance of containing a fire to this area.

9A.4.6.3 Fire Zone ESW Duct Bank No. 1

9A.4.6.3.1 Description

This fire zone is shown on <Figure 9A-1> and <Figure 9A-34>. It consists of an underground electrical duct bank starting at the southeast corner of the ESW building (approximate Elevation 618'-6") and terminating in the Fuel Handling Building (FH-2a). This zone contains Division 1 circuits for the ESW system.

The duct bank is constructed of reinforced concrete. Wall penetrations are also reinforced concrete. Access to this zone is provided by electric manhole No's. 3 and 4.

Safe shutdown equipment in this fire zone consists of power and control cables, Division 1, Unit 1.

9A.4.6.3.2 Analysis

Only Division 1 cables required for safe shutdown are located in this zone. Redundancy for the safe shutdown equipment located in this zone is provided by equipment located in other areas and zones.

9A.4.6.3.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and spatial separation. Division 2 could be utilized for safe shutdown in the event of a fire in this zone.

9A.4.6.4 Fire Zone ESW Duct Bank No. 2

9A.4.6.4.1 Description

This fire zone is shown on <Figure 9A-1> and <Figure 9A-34>. It consists of an underground electrical duct bank starting on the southwest corner of the ESW building (approximate Elevation 618’-6”), and splits into two parallel duct banks, one terminating in the Diesel Generator Building (Fire Zone IDG-1c) and one in the control complex (Fire Zone CC-2b). This zone contains Division 2 circuits for the ESW system.

The duct bank is constructed of reinforced concrete. Wall penetrations are also reinforced concrete. Access to this zone is provided by electric manhole No’s. 1 and 2.

Safe shutdown equipment in this fire zone consists of power and control cables, Division 2, Unit 1.

9A.4.6.4.2 Analysis

Only Division 2 cables required for safe shutdown are located in this zone. Redundancy for the safe shutdown equipment located in this zone is provided by equipment located in other areas and zones.

9A.4.6.4.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and spatial separation. Division 1 could be utilized for safe shutdown in the event of a fire in this zone.

9A.4.7 FUEL HANDLING BUILDING

The Fuel Handling Building is a three story building constructed of reinforced concrete. The building is located between the Unit 1 and Unit 2 reactor buildings and serves as a preparation and storage area for new fuel and a storage area for spent fuel from the Unit 1 reactor. This building also houses miscellaneous mechanical and electrical equipment. It is bounded on the north by the Unit 1 Reactor Building, on the south by the Unit 2 Reactor Building, on the west by the Intermediate Building, and has no building interface on the east.

The ventilation system for the Fuel Handling Building consists of one 100 percent capacity supply plenum, two 100 percent capacity supply fans, three 50 percent capacity charcoal filter trains with exhaust fans, and distribution ductwork. The supply plenum and supply fans are located at Elevation 599’-0” of the Fuel Handling Building and the charcoal filter trains and exhaust fans are at Elevation 682’-0” of the Intermediate Building. The supply fan draws outside air through filters and heating coils and supplies it to locations in the Fuel Handling Building such as the operating floor, CRD pump area and the railway and overhead crane area. This supply air is drawn through the charcoal filter train by the exhaust fans prior to discharge through the unit vent. Air from the fuel pool cooling and cleaning equipment rooms in the intermediate building is also exhausted through these filter trains.

All duct penetrations in the fuel handling building floors, and in the walls that interface with the intermediate building, are provided with 3 hour rated fire dampers with 160°F fusible links.

Smoke detectors are provided in the common discharge ducts of the supply fans and exhaust fans. Upon detection of smoke, these detectors will initiate an alarm in the control room

.

The rattle space provided between the fuel handling and the reactor building constitutes an unprotected opening; therefore, the entire three story fuel handling building is one fire area. This fire area is divided into four fire zones: Fire Zone FH-1 is Elevation 574'-10"; Fire Zone FH-2a is Elevation 599'-0", north side; Fire Zone FH-2b is Elevation 599'-0", south side; Fire Zone FH-3 is at Elevation 620'-6". Only Division 1 circuits are present in the fuel handling building.

9A.4.7.1 Fire Zone FH-1

9A.4.7.1.1 Description

Fire Zone FH-1 is shown on <Figure 9A-3>. It is at Elevation 574'-10", comprising the entire first level of the fuel handling building. This zone contains equipment for the control rod drive hydraulic system and the fuel pool cooling and cleanup system. It is bounded on the north by Unit 1 reactor building, on the south by Unit 2 reactor building, on the west by the intermediate building, and has no building interface on the east.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings, except for the 3 inch rattle space at the reactor building interface. Penetrations have 3 hour fire rated seals, except for this rattle space.

There is no safe shutdown equipment located within this fire zone.

Fire detection equipment consists of smoke detectors.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.7.1.2 Analysis

Protection for equipment is not required since there is no safe shutdown equipment in this zone.

Combustibles within this zone consist of cable insulation, lubricating oil and grease, electrical panels, motor windings and storage of combustible materials. Total fire loading contained in the 5,142 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

9A.4.7.1.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging safe shutdown equipment in other zones is achieved. This is accomplished because of the low fire loading and the provision of early warning fire detection.

9A.4.7.2 Fire Zone FH-2a

9A.4.7.2.1 Description

Fire Zone FH-2a is shown on <Figure 9A-8>. It is at Elevation 599’-0”, comprising the north half of the second level of the fuel handling building. This zone contains equipment required for control rod drive maintenance. It is bounded on the north by the Unit 1 reactor building, on the south by Fire Zone FH-3, on the west by the intermediate building, and has no building interface on the east.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have 3 hour fire resistance ratings, except for the 3 inch rattle space at the Unit 1 reactor building interface. Penetrations have 3 hour fire rated seals, except for this rattle space.

Safe shutdown equipment in this zone consists of Division 1 power and control cables.

Fire detection equipment consists of smoke detectors.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.7.2.2 Analysis

Only Division 1 circuits required for safe shutdown are located in this zone. Redundant safe shutdown equipment is located in other areas.

The only combustible material in this fire zone is comprised of cable insulation, and electrical panels. Total fire loading contained in the 2,359 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

9A.4.7.2.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished because of the low fire loading and the presence of only one division of cable trays in this zone, and the provision of early warning fire detection. Division 2 could be utilized for safe shutdown in the event of a fire in this zone.

9A.4.7.3 <u>Fire Zone FH-2b</u>

9A.4.7.3.1 Description

Fire Zone FH-2b is shown on <Figure 9A-8>. It is at Elevation 599'-0", comprising the south half of the second level of the fuel handling building. This zone contains equipment required for refueling activities. It is bounded on the south by the Unit 2 reactor building, on the north by Fire Zone FH-3, on the west by the intermediate building, and has no building interface on the east.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls, floor and ceiling have 3 hour fire resistance ratings, except for the 3 inch rattle space at the Unit 2 reactor building interface. Penetrations have 3 hour fired rated seals, except for this rattle space.

There is no safe shutdown equipment located in this fire zone.

Fire detection equipment for this zone consists of smoke detectors.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.7.3.2 Analysis

Protection for equipment is not required since there is no safe shutdown equipment in this zone.

The only combustible material in this fire zone is comprised of cable insulation. This material, contained in a 2,359 ft^2 floor area, yields a fire loading of less than 20,000 Btu/ft^2 for this fire zone.

9A.4.7.3.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging safe shutdown equipment in other zones is achieved. This is accomplished because of the low fire loading.

9A.4.7.4 Fire Zone FH-3

9A.4.7.4.1 Description

Fire Zone FH-3 is shown on <Figure 9A-3>, <Figure 9A-8> and <Figure 9A-12>. It is at Elevation 620’-6”, comprising the entire third floor of the fuel handling building. This zone contains equipment required for refueling activities. It is bounded on the north by the Unit 1 reactor building, on the south by the Unit 2 reactor building, on the west by the intermediate building, and has no building interface on the east (and partially exposed on the north and south).

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. The walls, floor and ceiling have 3 hour fire resistance ratings, except for the 3 inch rattle space at the reactor building interface. Wall and ceiling penetrations have 3 hour fire rated seals, except for this rattle space.

The safe shutdown equipment in this zone consists of power and control cables, Division 1.

Fire detection equipment for this zone consists of flame detectors.

Fire suppression equipment for this zone consists of manual water type hose stations and fire extinguishers.

9A.4.7.4.2 Analysis

Only Division 1 circuits required for safe shutdown are located in this fire zone. Redundant safe shutdown equipment is located in other areas.

Combustibles within this zone consist of cable insulation, electrical panels, motor windings and combustible supplies. Total fire loading contained in the 15,014 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

9A.4.7.4.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from damaging cables or equipment associated with more than one division of safe shutdown equipment is achieved. This is accomplished because of the low fire loading, the presence of only one division of cables in this zone and the provision of early warning fire detection. Division 2 could be utilized for safe shutdown in the event of a fire in this zone.

9A.4.8 UNIT 1 STEAM TUNNEL

The steam tunnel is a structure located between Elevations 614'-6" and 620'-6" that houses main steam, feedwater and other major pipes extending from the Reactor Building. The tunnel extends in the north-south direction (0° azimuth) from the Reactor Building through the Auxiliary Building at Elevation 620'-6", connects to the east end of the turbine power complex and continues to the Turbine Building. The portion of this structure from the Reactor Building to the end of the Auxiliary Building is safety-related. The steam tunnel also serves to maintain radiological shielding around the main steam lines.

For purposes of this fire hazards analysis, the steam tunnel is considered one fire zone.

9A.4.8.1 Description

The steam tunnel is shown on <Figure 9A-10>. Walls, floor and ceiling are constructed of reinforced concrete. The east and west walls and the south reactor building walls are 3 hour rated and penetrations are provided with 3 hour rated fire seals. There is no wall adjacent to the Turbine Building. The floor is 3 hour rated and penetrations are provided with 3 hour fire rated seals. Access to the steam tunnel is through hatches at Elevation 652’-0” from the Auxiliary Building or from the Turbine Building.

The ventilation air for the steam tunnel is supplied by two 100 percent capacity supply fans that provide cooled air to the area. The supply fans draw ambient air from the south half of the Auxiliary Building at Elevation 620’-6” through filters and cooling coils and distributes it to the steam tunnel area. This supply air is partially exhausted by the Auxiliary Building exhaust fans and partially relieved to the Turbine Building. The duct penetrations on the steam tunnel walls have 3 hour rated fire dampers with 160°F fusible links.

Safe shutdown equipment within the steam tunnel consists of:

a. Main steam line isolation valves

b. RHR shutdown valves (including interfacing system isolation valves B21-F065A/B)

c. RCIC valve

d. Power and control cables for Unit 1, Division 1 and Division 2

9A.4.8.2 Analysis

Both divisions of components and circuits required for safe shutdown are located in this zone. Functional redundancy for the containment isolation valves located in the steam tunnel is provided by isolation valves inside containment that are powered by a separate division. The ADS valves provide a redundant means of transferring the reactor vessel water to the RHR system should the RHR shutdown suction valve become inoperative. Manual action will compensate for the effects of fire on the Division 2 equipment required for cold shutdown.

Combustibles within this area consist of lubricating oil and grease. Total fire loading contained in the 1,920 ft^2 floor area of this fire zone is less than 10,000 Btu/ft^2.

The combustible load in the steam tunnel is concentrated in the south end, away from the opening into the Turbine Building. Safety-related cabling in the Turbine Building is not exposed by the combustibles in the Steam Tunnel.

9A.4.8.3 Conclusions

The objective of preventing a fire in the steam tunnel from affecting both divisions of required safe shutdown equipment in this structure and preventing safe shutdown or spreading to adjacent buildings containing safe shutdown equipment is achieved. This is accomplished by the low fire loading, barrier design and the adequate separation from combustibles provided. In the event of a fire in this zone, Division 2 could be used for safe shutdown.

9A.4.9 YARD AREA

The yard area is shown on <Figure 9A-1>. It includes the open areas of the plant site that surrounds the buildings. Equipment located in this area includes:

a. Diesel generator fuel oil storage tanks, Unit 1

b. Deleted

c. Condensate storage tank, Unit 1

d. Deleted

e. Auxiliary boiler fuel oil storage tank

f. Hydrogen storage tanks, Unit 1

g. Deleted

h. Transformers

i. Hydrogen Water Chemistry (HWC) Storage Area

j. ISFSI and Spent Fuel Dry Storage Electrical Building

k. Cooling Tower, Unit 1

The only pieces of equipment from this listing required for safe shutdown operations are the diesel generator fuel oil storage tanks and the condensate storage tank.

9A.4.9.1 <u>Diesel Generator Fuel Oil Storage Tanks, Unit 1</u>

9A.4.9.1.1 Description

Three diesel generator fuel oil storage tanks are located approximately 80 feet west of the diesel generator building. The tanks are underground and are approximately 14 feet from one another. The two larger tanks each have a capacity of 90,000 gallons of diesel fuel oil; the smaller tank has a capacity of 44,000 gallons.

Only one of the two larger tanks is required for safe shutdown; the smaller tank is not required for safe shutdown.

Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) for fire fighting operations.

9A.4.9.1.2 Analysis

Only one division of safe shutdown equipment is located at each tank. The two 90,000 gallon tanks are functionally redundant since each tank supplies one diesel generator. Vent pipes from the tanks are equipped with flame arrestors.

9A.4.9.1.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished because of the underground location and spatial separation of the tanks. In the event of a fire at one tank, the other division could be used for safe shutdown.

9A.4.9.2 <u>Condensate Storage Tank, Unit 1</u>

9A.4.9.2.1 Fire Zone CST-1

9A.4.9.2.1.1 Description

The condensate storage tank is located approximately 340 feet north of the Unit 1 reactor building.

These tanks provide a source of supply water for the reactor core isolation cooling (RCIC) system, which is used during safe shutdown of the reactor when normal feedwater is not available.

The safe shutdown equipment in this fire zone consists of:

a. Condensate storage tanks, Unit 1

b. Level transmitters for condensate storage tanks

c. Instrumentation cables, Division 1

Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) for fire fighting operations.

9A.4.9.2.1.2 Analysis

Only Division 1 safe shutdown equipment is located at the tank. Redundant safe shutdown equipment is located in other areas and zones. The condensate storage tank, instrumentation and cables are located within a Seismic Category I concrete structure designed to accommodate the total liquid capacity of the condensate storage tank with at least one foot freeboard. This concrete structure also serves as a fire barrier should a fire occur in the adjacent buildings. The tank is adequately cut off from the rest of the yard area by the barrier.

9A.4.9.2.1.3 Conclusions

The objective for this portion of the yard area is to prevent damage to a condensate storage tank as a result of a fire in nearby equipment or buildings. This is achieved since the tank is protected with a surrounding fire barrier. Division 2 could be used for shutdown in the event of a fire at this tank.

9A.4.9.2.2 Fire Zone CST Duct Bank

9A.4.9.2.2.1 Description

Fire Zone CST Duct Bank is shown on <Figure 9A-1>. It consists of an underground electrical duct bank starting at the condensate storage tank and terminating in the auxiliary building (Fire Zone 1AB-2). This zone contains instrumentation circuits for the condensate storage tank.

The duct bank is constructed of reinforced concrete. Wall penetrations are also reinforced concrete.

Safe shutdown equipment in this fire zone consists of instrumentation circuits, Division 1.

9A.4.9.2.2.2 Analysis

Only Division 1 circuits are located in this fire zone. Redundant safe shutdown equipment is located in other areas and zones.

9A.4.9.2.2.3 Conclusions

The results of the analysis for this fire zone indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by barrier design and locating the redundant equipment in other fire zones and areas. In the event of a fire in this zone, Division 2 could be used for safe shutdown.

9A.4.9.3 Auxiliary Boiler Fuel Oil Storage Tank

9A.4.9.3.1 Description

The auxiliary boiler fuel oil storage tank is located approximately 240 feet east of the Unit 1 auxiliary boiler and turbine buildings. It is above ground and is surrounded by a dike to contain potential spillage.

Fire suppression equipment located in this region of the yard area consists of a fire hydrant (with a hydrant house and fire fighting equipment) supplied by the fire service water system. The oil storage tank is equipped with a fixed foam suppression system. Foam hose stations are also provided for spills within the dike and for the oil tank unloading area.

9A.4.9.3.2 Analysis

Functional redundancy is not a consideration since this tank is not required for safe shutdown. A separation of 350 feet exists between this tank and buildings containing safe shutdown equipment.

9A.4.9.3.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished by providing a dike to surround the tank, the remote location of the tank and availability of fire suppression equipment.

9A.4.9.4 Hydrogen Storage Tanks

9A.4.9.4.1 Description

The Unit 1 hydrogen storage tanks are located approximately 45 feet north of the heater bay. Hydrogen supply to the generator is expected to be normally provided from the connection to the Hydrogen Water Chemistry supply piping for the plant. The Unit 1 Hydrogen Bulk Storage System may be aligned to provide a hydrogen supply to the generator, as required. This hydrogen supply piping to the generator also provides for connection of a temporary hydrogen supply. Temporary hydrogen storage and handling activities for providing a backup supply to the generator will be accomplished in an equivalent manner in this same yard location.

Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) for fire fighting operations.

An excess flow valve is provided in the upstream hydrogen supply piping from the Hydrogen Water Chemistry System to prevent hydrogen gas concentrations in the turbine building from reaching their explosive limits in the event of a line rupture. A similar excess flow valve will be utilized for temporary hydrogen supply configurations to limit hydrogen gas concentrations in an equivalent manner. A remotely operated, air actuated shutoff valve is provided downstream of the generator hydrogen pressure reducing manifold. In case of a fire or line break in the turbine building, the valve can be remotely closed.

9A.4.9.4.2 Analysis

Spatial separation between either the permanent or temporary hydrogen storage tanks, and buildings that contain safe shutdown equipment is adequate. Also, these tanks are/will be oriented to minimize the probability of missiles striking a building should a tank explosion occur.

9A.4.9.4.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished by adequate spatial separation between the permanent or temporary hydrogen storage tanks and buildings containing safe shutdown equipment.

9A.4.9.5 Transformers

9A.4.9.5.1 Description

The Unit 1 startup transformer, unit auxiliary transformer and main transformer (which consists of three single phase transformers) are located in the Unit 1 portion of the yard area just north of the turbine building and west of the heater bay and hydrogen storage tanks. Three Unit 1 interbus transformers are located along the outside of the south wall of the Unit 1 turbine power complex.

The Unit 2 startup transformer is located just outside of the west wall of the Unit 2 turbine building. Three Unit 2 interbus transformers are located along the outside of the north wall of the Unit 2 turbine power complex.

Fire suppression for the Unit 1 main transformers, Unit 1 startup transformer and the Unit 2 startup transformer is provided by a water spray deluge system that is manually activated. Heat detectors located at each of these transformers provide annunciation signals to the Control Room that can be utilized to determine if initiation of the deluge system is necessary. Fire suppression for the Unit 1 auxiliary transformer, the Unit 1 interbus transformers and the Unit 2 interbus transformers consists of a deluge water spray system that is activated automatically by a signal from the heat detectors located at each transformer.

9A.4.9.5.2 Analysis

These transformers are not required for safe shutdown operations since electrical power can be supplied by the emergency diesel generators.

Fire barriers are provided between phases of the main transformer and on the east and west sides of the unit auxiliary transformer. Each transformer is surrounded by a curb to contain any oil leakage. Interbus transformers are separated from each other by fire barriers and are surrounded by a curb to contain any oil leakage. All building walls located within 50 feet of any of these transformers has a minimum fire resistance rating of 2 hours.

9A.4.9.5.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished because of the separation provided by the fire barriers, the absence of safe shutdown equipment in this area and the fire suppression systems available.

9A.4.9.6 Hydrogen Water Chemistry (HWC) Storage Area

9A.4.9.6.1 Description

The 9,000 gallon capacity cryogenic liquid hydrogen storage tank and six supplemental 8,350 scf each (at 2,400 psi) gaseous hydrogen storage tanks are located approximately 1,240 feet south of the Fuel Handling Building. The 6,000 gallon capacity cryogenic liquid oxygen storage tank is located approximately 1,100 feet south of the Fuel Handling Building.

The gaseous and liquid hydrogen storage meets the requirements of NFPA-50A and NFPA-50B, respectively. The required safety features required by NFPA-50A and NFPA-50B include, but are not limited to, proper vent stacks and an emergency stop pushbutton to isolate the flow of liquid hydrogen by shutting down the hydrogen tank fire control valves. Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) to cool adjoining equipment in the event of a hydrogen fire.

Excess flow check valves are provided at the storage facility to limit any hydrogen or oxygen release that may develop in the supply or injection subsystems.

9A.4.9.6.2 Analysis

Spatial separation between the HWC storage area and buildings that contain safe shutdown equipment is adequate. Also, these tanks are oriented to minimize the probability of missiles striking a building should a tank explosion occur.

9A.4.9.6.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished by adequate spatial separation between the HWC storage area and buildings containing safe shutdown equipment.

9A.4.9.7 Independent Spent Fuel Storage Installation (ISFSI) and Spent Fuel Dry Storage Electrical Building

9A.4.9.7.1 Description

Spent Fuel Dry Storage (SFDS) operations and the Independent Spent Fuel Storage Installation (ISFSI) are discussed in <Section 9.1.4.2.10.14>. The ISFSI site is located inside the Protected Area fence, southeast of the Fuel Handling Building between the Unit 2 Plant and the Unit 2

Cooling Tower. The ISFSI pad is designed to support up to 80 HI-STORM storage casks. The ISFSI haul path enables HI-STORM storage casks to be transported between the Fuel Handling Building and the ISFSI pad, carried by the Vertical Cask Transporter (VCT). The SFDS Electrical Building, located at the north end of the ISFSI site approximately 54 ft. north of the ISFSI pad, is a one-story concrete block building with a steel roof having no significant combustibles associated with the building materials.

9A.4.9.7.2 Analysis

There are no Division 1 or Division 2 circuits located in this fire zone. Redundant safe shutdown equipment is located in other areas and zones. Combustibles are limited and controlled so that a fire in this zone would not spread to adjacent zones or areas containing redundant safe shutdown equipment.

The HI-STORM storage cask systems that contain spent fuel are not combustible (with the exception of painted coatings and the insulation on the temperature monitoring instrumentation wiring, present in small quantities), and during normal spent fuel storage operations at the PNPP ISFSI pad there are no combustibles present that constitute a significant fire hazard. The area within the ISFSI fence is routinely cleared of vegetation and any wind born debris. The SFDS Electrical Building contains electrical equipment associated with the ISFSI, including a cask temperature monitoring panel, a 480 V power feed in conduit, a dry type 480 V/120 V stepdown transformer, junction boxes, electrical panels for lighting, heater and ventilation fans, and electrical space heaters. The potential electrical fire hazards in this building do not represent a significant threat to the safe storage of spent fuel in the HI-STORM storage casks, nor to safe shutdown equipment located in other areas and zones.

Transporting a HI-STORM storage cask between the FHB and the ISFSI pad does involve the presence of combustible materials. The VCT will carry up to 50 gallons of diesel fuel as well as hydraulic fluid, oil and rubber tires, which are combustible. In addition, the prime mover that is used to move a HI-STORM storage cask into and out of the Fuel Handling Building on the Zero Profile Transporter (ZPT) will carry up to 50 gallons of diesel fuel as well as lubricating oil and rubber tires, also combustible. PNPP Report G58-S-R-L-011, Evaluation of Fire and Explosion Hazards for ISFSI, analyzes postulated fires involving the VCT and/or ZPT prime mover while these are in the vicinity of a loaded HI-STORM storage cask. Measures have been established in the PNPP Fire Protection Program to ensure that the consequences of a fire involving combustibles associated with either the VCT or ZPT prime mover, or both when the storage cask is lifted out of the ZPT (and both vehicles are in close proximity to the storage cask), cannot exceed the consequences analyzed for the HI-STORM storage cask design basis fire in the HI-STORM 100 FSAR <Section 9.1.6> (Reference 31). In addition, the PNPP Fire Protection Program specifies safe standoff distances of gasoline and diesel fueled vehicles from loaded HI-STORM storage casks to ensure fires and explosions associated with such vehicles do not result in heat fluxes or explosion overpressures in excess of those for which the HI-STORM storage cask has been analyzed in the HI-STORM FSAR. Fires involving the VCT or ZPT prime mover along the haul path or the VCT at the ISFSI do not pose a threat to safe shutdown equipment located in other areas and zones, such as the diesel generator fuel oil storage tanks or the condensate storage tanks.

Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) for fire fighting operations.

9A.4.9.7.3 Conclusions

The results of the analysis for the ISFSI fire zone, including the SFDS Electrical Building, indicate that the objective of preventing a fire from spreading to adjacent zones or areas containing redundant safe shutdown equipment is achieved. This is accomplished by locating the redundant equipment in other fire zones and areas with spatial separation from the ISFSI site. In the event of a fire in this zone, either Division 1 or Division 2 could be used for safe shutdown.

9A.4.9.8 Cooling Tower, Unit 1

9A.4.9.8.1 Description

The Unit 1 Cooling Tower is located more than 500 feet from any buildings containing safety related equipment. The cooling tower is predominantly of concrete (noncombustible) construction with some internal combustibles in the form of PVC fill material and combustible "air dams." Combustibles are located in the interior of the tower and surrounded by the concrete veil wall.

Fire suppression equipment located in this region of the yard area consists of fire hydrants (supplied from the fire service water system) and hydrant houses with the necessary equipment (hose, nozzles, etc.) for firefighting operations.

9A.4.9.8.2 Analysis

Functional redundancy is not a consideration since this tower is not required for safe shutdown, does not function as the ultimate heat sink and does not function as the permanent fire water supply. A separation of at least 500 feet exists between the cooling tower and buildings containing safe shutdown equipment. Additionally, the tower veil wall functions as an intervening structure preventing exposure to safe shutdown structures.

9A.4.9.8.3 Conclusions

The objective of preventing a fire in this region of the yard area from spreading to buildings or locations containing safe shutdown equipment is achieved. This is accomplished by the remote location of the tower and availability of fire suppression equipment.

9A.4.10 WATER TREATMENT BUILDING

The water treatment building is a two story structure. The building is located on the Unit 1 side of the plant. It is bounded by the turbine building on the east; the north, south and west walls are exposed.

The water treatment building houses process equipment required to convert raw water into the various grades of water used in the plant.

For the purpose of this fire hazards analysis, this entire two story building is considered a fire area.

9A.4.10.1 Description

The water treatment building is shown on <Figure 9A-1>. The east wall, shared with the turbine building, is constructed of drywall and has a 3 hour fire resistance rating. The north, south and west walls are exterior walls constructed of metal siding. The roof is of steel frame and metal deck construction with roofing that meets Factory Mutual (FM) Class I requirements. Doorways in the east wall are equipped with Class A fire doors. Other penetrations in this wall are sealed to provide a 3 hour fire resistance rating.

The ventilation system for the water treatment building consist of roof exhausters, intake louvers and a supply fan that provides ambient air to the laboratory enclosure. No fire dampers are provided in this system.

No safe shutdown equipment is located in the water treatment building.

Fire suppression equipment for this building consists of portable fire extinguishers and water type hose stations inside the building.

9A.4.10.2 Analysis

No safe shutdown equipment is located in the water treatment building. Also, the building fire loading is low.

9A.4.10.3 Conclusions

The objective for this fire area is to prevent fire within the water treatment building from endangering the ability to safely shut down the plant. This objective is achieved since this building has a low fire loading and is remote from safe shutdown equipment in other buildings.

9A.4.11 UNIT 1 TURBINE POWER COMPLEX

The turbine power complex is a four story structure. The Unit 1 turbine power complex is bounded by the turbine building on the north, the steam tunnel on the east and the offgas building on the west; the south wall is partially bounded by the auxiliary building with the remainder of the wall exposed.

This building contains equipment for the condensate demineralizer system, condensate filtration system, motor control centers, dc distribution equipment, and metal clad switchgear.

For purposes of this fire hazards analysis, the entire turbine power complex is considered a fire area.

9A.4.11.1 Description

The turbine power complex is shown on <Figure 9A-1>. Exterior walls are constructed of metal siding. Walls adjacent to other buildings are of reinforced concrete or drywall construction. These walls have 3 hour fire resistance ratings and penetrations are provided with 3 hour fire rated seals. Doorways to adjacent structures are equipped with Class A fire doors. Floors are constructed of reinforced concrete. The roof is of metal deck construction with roofing that meets FM Class I requirements.

The ventilation system for the turbine power complex consists of supply plenums and supply fans supplying cooled or heated outdoor air to various areas. This supply air is directed to the atmosphere through relief louvers. All duct penetrations through the fire rated walls have 3 hour rated fire dampers with 160°F fusible links.

Safe shutdown equipment located in the turbine power complex consists of power and control cables for Unit 1, Division 1, Division 2, Division 3, and Division 4.

Fire detection equipment for this building consists of smoke detectors for the 125 volt dc equipment area (Elevation 620’-6”) and switchgear and MCC area (Elevation 647'-6"). Fire suppression equipment consists of manual carbon dioxide hose reels for the electrical equipment (Elevations 620'-6" and 647'-6") and water type hose reels throughout the remainder of the turbine power complex.

9A.4.11.2 Analysis

Both divisions of safe shutdown circuits are located in this area. Loss of this equipment does not prevent safe shutdown because of equipment located in other areas and zones.

The major combustible in the turbine power complex is cable insulation. Conservatively, this amount of combustible material would require the protection of 2 hour rated fire walls as adequate barriers between the turbine power complex and adjacent buildings.

9A.4.11.3 Conclusions

The objective of preventing a fire in the turbine power complex from spreading to an adjacent building containing safe shutdown equipment is achieved. This is accomplished by the designed 3 hour rated fire walls when 2 hour rated fire walls would be sufficient. In the event of a fire in this area, Division 1 or Division 2 would be available for safe shutdown.

9A.4.12 UNIT 1 HEATER BAY

The heater bay is a four story structure. The heater bay is bounded by the turbine building on the south, with the north and west walls exposed; the majority of the east wall is bounded by the auxiliary boiler building with the remainder of the wall exposed.

This building contains heaters associated with the condensate, feedwater and building heating systems. For purposes of this fire hazards analysis, the entire heater bay is considered a fire area.

9A.4.12.1 Description

The heater bay is shown on <Figure 9A-1>. Walls are constructed of reinforced concrete, except for metal siding on the north wall. Doorways to adjacent buildings are equipped with Class A fire doors. Walls to adjacent buildings have 3 hour fire resistance ratings with all penetrations having 3 hour fire rated seals. Floors are constructed of reinforced concrete.

The ventilation system for the heater bay consists of supply fans blowing heated outdoor air to various areas. This supply air is exhausted to the atmosphere through the exhaust fans. The duct penetrations through the fire rated partition enclosing the lubricating oil purifier have 3 hour rated fire dampers with 160°F fusible links.

There is no safe shutdown equipment located in the heater bay.

Fire suppression equipment for this building consists of a preaction water spray system for the feedwater pump-turbine lubricating oil area. Manual water type hose stations and fire extinguishers are also provided.

9A.4.12.2 Analysis

Combustibles within the heater bay include hydrogen supply piping for the Hydrogen Water Chemistry (HWC) System, cable insulation, motor winding insulation, and lubricating oil. The amount of combustible material would conservatively require the protection of 1 hour rated fire walls to prevent the spread of a fire to adjacent buildings. However, the adjacent buildings contain no safe shutdown equipment.

9A.4.12.3 Conclusions

The objective of preventing a fire in the heater bay from affecting safe plant shutdown is achieved. This is accomplished by the designed 3 hour rated fire walls and the absence of safe shutdown equipment in this building and the adjacent buildings.

9A.4.13 UNIT 1 OFFGAS BUILDING

The offgas building is a four story structure. The offgas building is bounded by the turbine building on the north and the turbine power complex on the east; the south and west walls are exposed.

This building contains equipment used in the filtering and absorption of radioactive, noncondensible gases from the main and auxiliary condensers.

For purposes of this fire hazards analysis, the entire offgas building is considered a fire area.

9A.4.13.1 Description

The offgas building is shown on <Figure 9A-1>. Walls, floor and ceiling are constructed of reinforced concrete. Doorways to adjacent buildings are equipped with Class A fire doors. Walls to adjacent buildings have 3 hour fire resistance ratings with all penetrations having 3 hour fire rated seals.

The ventilation system for the offgas building consists of supply plenums and supply fans blowing cooled outdoor air to various areas.

This supply air is discharged to the atmosphere by the exhaust fans. All duct penetrations through fire rated walls have 3 hour rated fire dampers with 160°F fusible links.

There is no safe shutdown equipment located in the offgas building.

Fire detection equipment for this building consists of partial coverage with smoke and heat detectors that alarm in the control room.

Fire suppression equipment for this building consists of a manually actuated deluge type water spray system for charcoal filters, water type hose stations and fire extinguishers.

9A.4.13.2 Analysis

Combustibles in the offgas building include charcoal and hydrogen gas. Special consideration was given to the charcoal filters and to a possible explosive hydrogen mixture, as hazards in this building. The charcoal filters are provided with heat sensors that initiate signals in the control room so that the deluge system can be manually actuated. The components and piping for the offgas system up to the recombiners are designed to withstand a hydrogen explosion. The ventilation system supplies sufficient circulation of room air so that any hydrogen leakage will be limited to levels below 4 percent by volume hydrogen concentration.

9A.4.13.3 Conclusions

The objective of preventing a fire in the offgas building from affecting safe plant shutdown is achieved. This is accomplished by the absence of safe shutdown equipment in this building and adjacent buildings, provision of early warning fire detection and a manually actuated deluge system in the charcoal filters.

9A.4.14 RADWASTE BUILDING

The radwaste building is a four story structure. It is located on the Unit 1 side of the plant and is bounded by the diesel generator building and control complex on the south and the auxiliary and intermediate buildings on the east. The north and west walls are exposed.

The radwaste building houses equipment used in the storage and processing of liquid and solid radioactive waste.

For purposes of this fire hazards analysis, the entire radwaste building is considered a fire area.

9A.4.14.1 Description

The radwaste building is shown on <Figure 9A-1>. Walls, floor and ceiling are constructed of reinforced concrete. Doorways to adjacent buildings are equipped with Class A fire doors. Walls to adjacent buildings have 3 hour fire resistance ratings with all penetrations provided with 3 hour fire rated seals.

The ventilation system for this building consists of a supply plenum and two 100 percent capacity fans supplying heated outdoor air to various areas. This supply air is exhausted through a charcoal filter train and is then discharged to the atmosphere by one of the two 100 percent capacity exhaust fans. All duct penetrations through fire rated walls have 3 hour rated fire dampers with 160°F fusible links.

There is no safe shutdown equipment located in the radwaste building.

Fire detection equipment for this building consists of smoke detectors for the radwaste control room. Fire suppression equipment consists of an automatic water sprinkler system for radwaste storage, manual water type hose stations, fire extinguishers, and a manually actuated deluge type water spray system for the charcoal filters.

9A.4.14.2 Analysis

The major combustibles within the radwaste building are due to chemical storage, radwaste storage, cable, and charcoal. A conservative estimate of these combustibles results in a low fire loading for the entire building.

Special consideration was given to equipment in the radwaste building containing high levels of radioactivity. This material is normally contained in tanks, piping and drains. Nonmetal tanks to store spent resins may be used where a fixed automatic suppression is adequate for its protection. If a fire occurred in this building, limited radioactivity would be released and would be collected by the drain system or charcoal exhaust system. It has been determined that the radioactive release due to this postulated fire in the radwaste building would be less than the releases analyzed in <Section 15.7.2> and <Section 15.7.3>.

9A.4.14.3 Conclusions

The objective of preventing a fire in the radwaste building from spreading to an adjacent building containing safe shutdown equipment is achieved. This is accomplished by the designed 3 hour rated fire barriers, an automatic sprinkler system in the radwaste storage area and a deluge system for charcoal filters.

9A.4.15 SERVICE WATER PUMPHOUSE

The service water pumphouse is a one story building located at the north end of the Unit 1 side of the plant. It is an isolated structure containing pumps and equipment for the nonsafety class service water system.

For purposes of this analysis, the entire building is considered a fire area.

9A.4.15.1 Description

The service water pumphouse is shown on <Figure 9A-1>. Walls are constructed of steel frame and metal siding. The floor is constructed of reinforced concrete and the roof is of steel frame and metal deck construction with roofing that meets FM Class 1 requirements.

The ventilation system for the service water pumphouse consists of supply fans blowing outdoor air into the building. This supply air is discharged to the atmosphere through wall relief louvers. There are no fire dampers associated with this system.

There is no safe shutdown equipment located in the service water pumphouse.

Fire suppression equipment for this building consists of manual water type hose stations and fire extinguishers.

9A.4.15.2 Analysis

The combustibles in this building consist of cable insulation and motor winding insulation.

9A.4.15.3 Conclusions

The objective of preventing a fire in the service water pumphouse from affecting safe plant shutdown is achieved. This is accomplished since this building contains no safe shutdown equipment and is remotely located relative to buildings that contain safe shutdown equipment.

9A.4.16 UNIT 1 TURBINE BUILDING

The turbine building is a five story structure. The turbine building is bounded by the water treatment building on the west, the offgas building, turbine power complex and steam tunnel along the majority of the south wall, and is partially bounded by the heater bay and auxiliary boiler building on the north. The remainder of the north and south walls and the east wall are exposed.

The turbine building houses the turbine generator and related auxiliaries. These include the exciter, condensers, lubricating oil storage and handling equipment, and the hydrogen seal oil system.

For the purpose of this fire hazards analysis, this entire five story building is considered a fire area.

9A.4.16.1 Description

The turbine building is shown on <Figure 9A-1>. Walls separating the turbine building from other buildings are constructed of either reinforced concrete or drywall and are 3 hour fire resistance rated. Floors are of reinforced concrete with numerous penetrations and metal gratings where equipment extends through floors. The roof is of steel frame and metal deck construction with roofing that meets FM Class 1 requirements. Doorways in boundary walls between the turbine building and other buildings are equipped with Class A fire doors. Other penetrations in these boundary walls are sealed to provide a 3 hour fire resistance rating.

The ventilation system serving the turbine building consists of supply fans blowing cooled outdoor air to various areas. This supply air is discharged to the atmosphere through the exhaust fans. All duct penetrations through boundary walls between the turbine building and other buildings have 3 hour rated fire dampers with 160°F fusible links.

Safety-related equipment located in the turbine building consists of power and control cables and instrumentation, for Unit 1, Division 1 and Division 2.

Fire suppression systems located within the turbine building consists of the following:

a. An automatic deluge water spray system for the hydrogen seal oil unit

b. An automatic preaction water spray system for the turbine generator bearing and piping above the operating floor

c. An automatic wet pipe sprinkler system for areas below the operating floor

d. Automatic total flooding CO_2 systems for the turbine lube oil tank room and the turbine lube oil purifier room

Additional fire suppression equipment for manual fire fighting consists of water type hose stations and portable fire extinguishers.

9A.4.16.2 Analysis

Both divisions of safety-related components and circuits are located in this area. Loss of both divisions of this equipment does not prevent safe shutdown.

Combustibles within the turbine building are typical for a turbine generator complex. The major fire hazard is comprised of the large quantity of oil required for turbine bearing lubrication and cooling and oil for the generator hydrogen seals. In addition the Hydrogen Water Chemistry (HWC) System contains oxygen supply piping that is routed into the turbine building. The turbine lube oil systems are in 3 hour rated, cut off rooms.

The turbine building is open to the north end of the steam tunnel on the 620' elevation, with only a partial missile shield separating the two buildings. There are limited combustibles within 60 feet of the opening, with the majority of the combustible load in the turbine building located in fire rated, cut off rooms or in areas remote from this opening.

9A.4.16.3 Conclusions

The objective of preventing a fire in the turbine building from affecting safe plant shutdown is achieved. This is accomplished by the 3 hour fire resistance rating of the walls or adequate spatial separation between adjacent areas and the turbine building, low fire loading in building areas and the fire suppression equipment provided in the turbine building. In the event of a fire in this area, Division 1 or Division 2 would be available for safe shutdown.

9A.4.17 AUXILIARY BOILER BUILDING

The auxiliary boiler building is a one story structure. The building is located at the north end on the Unit 1 side of the plant. It is bounded on the south by the turbine building and on the west by the heater bay; the north and east walls are exposed.

The auxiliary boiler building houses the auxiliary boiler, piping and other equipment associated with the auxiliary boiler system.

For purposes of this fire hazards analysis, the entire building is considered a fire area.

9A.4.17.1 Description

The auxiliary boiler building is shown on <Figure 9A-1>. The south and west walls separate the auxiliary boiler building from adjacent buildings and are constructed of reinforced concrete. The north and east walls are exposed to the outside and are constructed of metal siding. Walls to adjacent buildings have 3 hour fire resistance ratings with penetrations provided with 3 hour fire rated seals. Doorways to adjacent buildings are equipped with Class A fire doors. The floor is constructed of reinforced concrete and the roof is of steel frame and metal deck construction with roofing that meets FM Class I requirements.

The ventilation system for the auxiliary boiler building consists of intake louvers and roof exhausters. There are no fire dampers in this system.

No safe shutdown equipment is located in the auxiliary boiler building.

Fire suppression systems located within the auxiliary boiler building consist of an automatic sprinkler system which provides coverage to the entire area, manual type water hose stations and fire extinguishers.

9A.4.17.2 Analysis

Combustibles within the auxiliary boiler building consist of fuel oil and cable insulation. The fuel oil is considered a hazard but will not jeopardize safe shutdown equipment.

9A.4.17.3 Conclusions

The objective of preventing a fire in the auxiliary boiler building from spreading to adjacent buildings containing safe shutdown equipment is achieved. This is accomplished by building remoteness relative to safe shutdown equipment, barrier design and an automatic sprinkler system.

9A.4.18 SERVICE BUILDING

The service building is a three story structure. It is bounded by the diesel generator building, control complex on the north, and the Intermediate Building on the east, with the south and west walls exposed. The east wall is exposed above the roof of the Hot Shop addition.

The service building contains offices, administrative facilities and shops for the plant, the security office, and the technical support center (TSC). The TSC is located in the basement.

For the purpose of this fire hazards analysis, this entire three story building, together with the basement, is considered a single fire area.

9A.4.18.1 Description

The service building is shown on <Figure 9A-1>. The north wall of the basement is constructed of reinforced concrete and constitutes a 3 hour rated fire barrier. Above elevation 620’-6” the north wall is constructed of drywall. Above the service building hot shop roof the east wall is an exterior wall constructed of metal siding. The south and west walls are exterior walls constructed of metal siding. The east side of the hot shop abuts the west wall of the intermediate building, which has a three hour fire rating. The roof is of steel frame and metal deck construction with roofing that meets FM Class I requirements. Doorways in the north wall are equipped with Class A fire doors. A Class A roll-up door is provided in the east side of the hot shop (El. 620'-0") in the intermediate building wall. Penetrations in the north wall are sealed to provide a 3 hour fire resistance rating.

The ventilation of the service building is accomplished by rooftop air handling units recirculating cooled air to various offices, ventilating fans blowing outside air to the storage areas and wall ventilators in the machine shop. All duct penetrations through rated walls are provided with fire dampers with a rating consistent with the fire ratings of the walls.

No safe shutdown equipment is located in the service building. Safe shutdown equipment is located in the diesel generator building, intermediate building and control complex which are adjacent structures.

Fire suppression has been provided for most areas of the service building and consists of either an automatic, wet pipe sprinkler system or an automatic Halon system. Manual water type hose stations and portable fire extinguishers are also provided.

The radio and communications rooms, on the 605'-0" elevation of the service building, house equipment for the emergency radio system used by the fire brigade. Equipment for two of the six repeaters are located in a separate room from the remaining channels. The rooms are separated by a gypsum wall and an automatic Halon system is provided.

The CAS, which houses equipment for security alarms, is located on the 620'-6" elevation.

9A.4.18.2 Analysis

No safe shutdown equipment is jeopardized by a fire in the service building. This building is separated from adjacent buildings containing safe shutdown equipment by 3 hour rated fire barriers.

9A.4.18.3 Conclusions

The objective for the service building is to prevent fire in this building from jeopardizing the ability to safely shut down the plant. This objective is achieved since the service building is adequately separated from safe shutdown equipment in adjacent buildings with 3 hour fire rated walls. The Service Building areas adjacent to these buildings are also provided with automatic, fire suppression systems.

9A.4.19 TRAINING CENTER

The training center is a two story building located southwest of the Unit 2 side of the plant and outside of the fenced area (approximately 1/4 mile). It is an isolated structure containing offices and training rooms.

For purposes of this analysis, the entire building is considered a fire area.

9A.4.19.1 Description

The training center is shown on <Figure 9A-1>. Construction is steel frame, masonry, insulated siding, and glass. Roofing consists primarily of steel frame and metal deck construction with roofing that meets FM Class 1-90 and UL Class A requirements.

The ventilation system for the first floor TC consist of two 50% capacity rooftop air handling units, one 100% capacity return fan, one 100% capacity HEPA filter plenum, and miscellaneous exhaust fans.

Each of these systems distributes and recirculates conditioned air to the various office areas. All duct penetrations through rated walls are provided with fire dampers with a rating consistent with the fire ratings of the walls and ceilings.

There is no safe shutdown equipment located in the training center.

The fire detection and suppression features provided in the Training Center are adequate for the hazards present to detect, control, and then suppress a fire before it can propagate to plant structures, systems or components important to safety located in other buildings.

9A.4.19.2 Analysis

Combustibles in this building are typical of those found in an office building.

9A.4.19.3 Conclusions

This building is located offsite, and therefore presents no danger to safe shutdown equipment.

9A.4.20 PRIMARY ACCESS FACILITY (PAF)

The PAF is a two story building located west of the service building. It is an isolated structure containing offices, personnel processing and the arms storage room.

For purposes of this analysis, the entire building is considered a fire area.

9A.4.20.1 Description

The PAF is shown on <Figure 9A-1>. Construction is steel frame, insulated siding and glass. The roofing system on the concrete deck meets UL Class A requirements.

The ventilation for the guardhouse is accomplished by an air handling unit recirculating cooled air to various rooms, and exhaust fans exhausting the lavatory, locker room and the mechanical equipment room. One hundred percent outdoor air is supplied to the locker rooms by a rooftop air conditioner. All duct penetrations through rated walls are provided with fire dampers with a rating consistent with fire ratings of the walls.

There is no safe shutdown equipment located in the PAF.

The fire detection and suppression features provided in the PAF are adequate for the hazards present to detect, control, and then suppress a fire before it can propagate to plant structures, systems or components important to safety located in other buildings. Manual water type hose stations and portable fire extinguishers are also provided.

9A.4.20.2 Analysis

No safe shutdown equipment is jeopardized by a fire in the PAF.

9A.4.20.3 Conclusions

The objective for the PAF is to prevent fire in this building from jeopardizing the ability to safely shutdown the plant. This objective is achieved since the PAF is adequately separated from buildings containing safe shutdown equipment.

9A.4.21 SERVICE BUILDING ANNEX

The service building annex is a three story structure located west of the service building. It is an isolated structure containing offices.

For purposes of this analysis, the entire building is considered a fire area.

9A.4.21.1 Description

The service building annex is shown on <Figure 9.5-1>. Construction is steel frame with wood siding.

Ventilation is accomplished by an air handling unit located at ground level.

There is no safe shutdown equipment located in the service building annex.

Fire suppression equipment consists of an automatic, wet pipe sprinkler system for all floors. Manual water type hose stations and portable fire extinguishers are also provided.

9A.4.21.2 Analysis

No safe shutdown equipment is jeopardized by a fire in the service building annex.

9A.4.21.3 Conclusions

The objective for the service building annex is to prevent fire in this building from jeopardizing the ability to safely shut down the plant. This objective is achieved since the service building annex is adequately separated from buildings containing safe shutdown equipment.

9A.4.22 LOW LEVEL RADIOACTIVE WASTE BUILDING (WARF/RISB)

The Low Level Radioactive Waste Building is a single story structure located north of the plant, more than 100 ft. east of the Emergency Service Water Pumphouse. It is an isolated structure used for the storage of contaminated waste material and the storage of the radioactive material such as: tooling equipment, components (i.e., valves, pumps) which may be reused.

9A.4.22.1 Description

The Low Level Radioactive Waste Building is shown on <Figure 9A-1>. Construction of the Waste Abatement Recovery Facility (WARF) is a protected metal frame with steel siding. The Radwaste Interim Storage Building (RISB) is constructed of reinforced concrete.

Fire suppression equipment consists of an automatic, wet pipe type sprinkler system for both areas. Manual water type hose stations and portable extinguishers are also provided.

9A.4.22.2 Analysis

For the purpose of this analysis the entire building is considered a fire area. There is no safe shutdown equipment located in this building.

9A.4.22.3 Conclusions

The objective of the fire protection for the Low Level Radioactive Waste Building is to prevent a fire from jeopardizing the ability to achieve safe plant shutdown. This objective is met since the structure is adequately separated from any structure containing safety-related equipment.

9A.4.23 UNIT 2 BUILDINGS

As described in USAR Section 1.0, construction activities on Unit 2 were formally terminated in 1994.

- Unit 2 Reactor Building
- Unit 2 Auxiliary Building
- Unit 2 Turbine Power Complex
- Unit 2 Heater Bay
- Unit 2 Turbine Building
- Unit 2 Offgas Building
- Unit 2 Steam Tunnel

The Unit 2 reactor and auxiliary buildings are directly adjacent to the Intermediate and Fuel Handling Buildings which are required for Unit 1 operation. In addition, the Unit 2 auxiliary building, the turbine power complex, and the turbine building contain a small amount of equipment credited for support of Unit 1 operation (e.g., Unit 2 startup transformer cables). None of the buildings contain equipment required for Unit 1 fire safe shutdown. These buildings are maintained to the extent needed to support Unit 1 operation or to prevent a fire from adversely affecting Unit 1.

9A.4.23.1 Unit 2 Reactor Building (RB)

The Unit 2 reactor building is shown on <Figure 9A-1>. It is comprised of the shield building and the primary steel containment vessel and extends from Elevation 574’-10” to Elevation 767’-5”. The outside wall and ceiling (dome) are constructed of reinforced concrete. The inside wall and ceiling (dome) are the steel containment vessel. The Unit 2 RB does not contain components required for safe shutdown of Unit 1 and is not required to designated as a Fire Area. The Unit 2 RB fire zones originally established based on the plant licensing criteria (NRC BTP APCSB 9.5-1, Appendix A) are also not required since the building does not contain active fire safe shutdown components or safety-related equipment.

The Unit 2 RB contains combustible materials that were placed there to support construction activities, however, the combustible loading is low. Due to the presence of these combustibles, the Unit 2 RB has 3-hour rated fire separation from the Intermediate Building (IB), Fuel Handling Building (FHB), and the Control Complex (CC), which contain equipment required for Unit 1 operation. This separation is provided by the reinforced concrete shield building wall and the personnel hatch access room walls/ceilings separating the Unit 2 RB from the IB. In addition, fire separation between the Unit 2 RB Division 1 and 2 cable chases and the IB and CC areas, is provided by 3-hour rated barriers. Penetrations, doors, and ducts are adequately sealed to prevent fire spread. Combustibles and ignition sources in the Unit 2 RB are administratively controlled to minimize the likelihood of a fire.

Therefore, the objective of preventing a fire in Unit 2 RB from adversely affecting Unit 1 areas is achieved.

9A.4.23.2 Unit 2 Auxiliary Building (AB)

The Unit 2 auxiliary building is shown on <Figure 9A-1>. It is a three story building constructed of reinforced concrete. Floor 1 is located at Elevations 568’-4” and 574’-10”, Floor 2 is at Elevation 599’-0” and Floor 3 is at Elevation 620’-6” (grade). The third floor is divided by the portion of the steam tunnel that passes through the auxiliary building from the reactor building to the turbine power complex enroute to the turbine building. The Unit 2 AB is adjacent to the Unit 2 RB, the IB, and the Unit 2 turbine power complex; the remainder of the building is exposed.

The Unit 2 AB does not contain components required for safe shutdown of Unit 1 and is not required to be designated as a Fire Area. The Unit 2 AB fire areas and zones originally established based on the plant licensing criteria (NRC BTP APCSB 9.5-1, Appendix A) are also not required since the building does not contain active fire safe shutdown components or safety-related equipment.

The Unit 2 AB contains combustible materials that were placed there to support construction activities, however, the combustible loading is very low. Due to the presence of these combustibles, the Unit 2 AB has 3-hour rated fire separation from the IB, which contains equipment required for Unit 1 operation. This separation is provided by the reinforced concrete IB south wall, fire doors, and penetration seals. Penetrations, doors, and ducts are adequately sealed to prevent fire spread. Combustibles in the Unit 2 AB are administratively controlled to minimize the likelihood of a fire. The abandoned pipes that penetrate from Unit 2 AB to the IB on El. 574′-10″ and 599′-0″ have been evaluated for acceptability considering the guidance in GL 86-10.

Therefore, the objective of preventing a fire in Unit 2 AB from adversely affecting Unit 1 areas is achieved.

9A.4.23.3 Unit 2 Turbine Power Complex (2TPC)

The Unit 2 turbine power complex is shown on <Figure 9A-1>. It is a four story structure bounded by the turbine building on the south, the steam tunnel on the east and the offgas building on the west; the north wall is partially bounded by the auxiliary building with the remainder of the wall exposed. This building does not contain components required for safe shutdown of Unit 1 and is not designated as a fire area, however, it does contain equipment that supports Unit 1 operation.

Exterior walls are constructed of metal siding. Walls adjacent to other buildings are of reinforced concrete or drywall construction. These walls have 3-hour rated construction, however, all penetrations are not sealed. Doorways to the adjacent Unit 2 AB are equipped with fire doors. Floors are constructed of reinforced concrete. The roof is of metal deck.

Cable insulation is the major combustible in 2TPC and is primarily located on El. 620’-0” and 647’-0”.

Fire detection equipment for this building consists of smoke detectors for the 125 volt dc equipment area (Elevation 620’-6”) and switchgear and MCC area (Elevation 647”-6”).

With the presence of smoke detection in 2TPC, the low combustible loading in the adjacent Unit 2 AB, and the 3-hour fire barrier separating Unit 2 AB and the IB, adequate protection is provided to prevent fire propagation from 2TPC to Unit 1 fire areas.

9A.4.23.4 Unit 2 Heater Bay

The Unit 2 heater bay is shown on <Figure 9A-1>. It is a four story structure bounded by the turbine building on the north, with the east, south and west walls exposed. This building does not contain components required for safe shutdown of Unit 1 and is not designated as a fire area.

Walls are constructed of reinforced concrete, except for metal siding on the north wall. Walls to adjacent buildings have 3-hour rated construction. Floors are constructed of reinforced concrete.

Fire propagation from the Unit 2 heater by to the Unit 1 buildings is prevented by spatial separation of the buildings and the 3-hour rated barriers between the Unit 2 AB and the IB.

9A.4.23.5 Unit 2 Turbine Building

The Unit 2 turbine building is shown on <Figure 9A-1>. It is a five story structure bounded by the offgas building, turbine power complex and steam tunnel along the majority of the north wall and is partially bounded by the heater bay on the south. The remainder of the north and south walls, and the east and west walls, are exposed. This building does not contain components required for safe shutdown of Unit 1 and is not designated as a fire area, however, it does contain equipment that supports Unit 1 operation.

Walls separating the turbine building from other buildings are constructed of either reinforced concrete or drywall. Floors are of reinforced concrete with numerous penetrations and metal gratings where equipment extends through floors. The roof is of steel frame and metal deck construction.

Fire propagation from the Unit 2 turbine building to the Unit 1 buildings is prevented by spatial separation of the buildings and the 3-hour rated barriers between the Unit 2 AB and the IB.

9A.4.23.6 Unit 2 Offgas Building

The offgas building is shown on <Figure 9A-1>. It is a four story structure bounded by the turbine building on the south and the turbine power complex on the east; the north and west walls are exposed.

This building does not contain components required for safe shutdown of Unit 1 and is not designated as a fire area. Walls, floor and ceiling are constructed of reinforced concrete.

Fire propagation from the Unit 2 offgas building to the Unit 1 buildings is prevented by spatial separation of the buildings and the 3-hour rated barriers between the Unit 2 AB and the IB.

9A.4.23.7 Unit 2 Steam Tunnel

The steam tunnel is a structure located between Elevations 614”-6” and 620’-6” that was designed to house main steam, feedwater and other major pipes extending from the Unit 2 Reactor Building. The tunnel extends in the north-south direction from the Unit 2 RB through the Unit 2 AB at Elevation 620’-0”, connects to the east end of the 2TPC and continues to the Unit 2 turbine building. It is constructed of reinforced concrete. This structure does not contain components required for safe shutdown of Unit 1 and is not designated as a fire area.

Fire propagation from the Unit 2 steam tunnel to the Unit 1 buildings is prevented by the 3-hour rated barriers between the Unit 2 RB and the IB, and the Unit 2 AB and the IB.

9A.5 POINT-BY-POINT COMPARISON

This section contains a point-by-point comparison with NRC Branch Technical Position APCSB 9.5-1 Appendix A.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
Positions	
A. Overall Requirements of Nuclear Plant Fire Protection Program	
1. Personnel	
Responsibility for the overall fire protection program should be assigned to a designated person in the upper level of management. This person should retain ultimate responsibility even though formulation and assurance of program implementation is delegated. Such delegation of authority should be to staff personnel prepared by training and experience in fire protection and nuclear plant safety to provide a balanced approach in directing the fire protection programs for nuclear power plants. The qualification requirements for the fire protection engineer or consultant who will assist in the design and selection of equipment, inspect and test the completed physical aspects of the system, develop the fire protection program, and assist in the fire fighting training for the operating plant should be stated. Subsequently, the USAR should discuss the training and the updating provisions such as fire drills provided for maintaining the competence of the station fire fighting	The V.P. Nuclear Operations is responsible for the overall fire protection program and retains ultimate responsibility for program implementation. He will delegate authority to formulate the program to the plant fire protection staff, which will consist of key plant personnel prepared by training in fire protection and nuclear plant safety. The fire protection staff will be responsible for providing a balanced approach in directing the fire protection program. Fire Protection Staff responsibilities are described in PAP-1910. Responsibility for the original design of fire protection facilities was assigned to the Manager, Nuclear Engineering Department, who had under his direction the Nuclear Engineering staff and the consulting engineers, Gilbert Associates, Inc. The fire protection engineers at Gilbert Associates, Inc. either held or were qualified to hold full membership in the Society of Fire Protection Engineers and have been responsible for design. The engineering staff retains a similarly qualified fire protection engineer to assist in reviews/acceptance of system tests and to aid in the opera-

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
and operating crew, including personnel responsible for maintaining and inspecting the fire protection equipment.	tional fire protection program development as detailed in PAP-1910. The company is responsible for installation, testing and continued operational performance of fire protection system and support systems. The USAR <Section 13.2.5> discusses training for maintaining the competence of the station fire fighting and operating crew, including personnel responsible for maintaining and inspecting the fire protection equipment.
The fire protection staff should be responsible for:	
(a) coordination of building layout and systems design with fire area requirements, including consideration of potential hazards associated with postulated design basis fires,	Responsibility for coordination of building layout and systems design with fire area requirements is assigned to the Manager, Nuclear Engineering Department and is assisted by Gilbert Associates, Inc.
(b) design and maintenance of fire detection, suppression and extinguishing systems,	The plant fire protection staff is responsible for maintenance of fire detection, suppression and extinguishing systems.
(c) fire prevention activities,	The plant fire protection staff is responsible for fire prevention activities.
(d) training and manual fire fighting activities of plant personnel and the fire brigade.	The plant fire protection staff is responsible for training and manual fire fighting activities of plant personnel and the fire brigade. NFPA 6-1974 will be used as a guide for organization and operation of the fire loss prevention program.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(NOTE: NFPA 6 - Recommendations for Organization of Industrial Fire Loss Prevention, contains useful guidance for organization and operation of the entire fire loss prevention program.)	
2. Design Bases The overall fire protection program should be based upon evaluation of potential fire hazards throughout the plant and the effect of postulated design basis fires relative to maintaining ability to perform safety shutdown functions and minimize radioactive releases to the environment.	<Appendix 9A.4> (Fire Hazards Analysis) provides this evaluation. Likewise, plant emergency procedures are based on maintaining the plant in a safe condition.
3. Backup Total reliance should not be placed on a single automatic fire suppression system. Appropriate backup fire suppression capability should be provided.	In areas where automatic suppression systems are provided, adequate manual suppression equipment including fire hose stations and/or portable fire extinguishers are available.
4. Single Failure Criterion A single failure in the fire suppression system should not impair both the primary and backup fire suppression capability. For example, redundant fire water pumps with independent power supplies and controls should be provided. Postulated fires or fire protection system	The fire suppression systems satisfy the single failure criteria and are described in the fire hazard analysis. The present fire protection water supply is assumed to fail as a result of SSE. Provisions are made for the emergency service water (ESW) system to supply hose stations in areas

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
failures need not be considered concurrent with other plant accidents or the most severe natural phenomena. However, in the event of the most severe earthquake, i.e., the Safe Shutdown Earthquake (SSE), the fire suppression system should be capable of delivering water to manual hose stations located within hose reach of areas containing equipment required for safe plant shutdown. The fire protection systems should, however, retain their original design capability for (1) natural phenomena of less severity and greater frequency (approximately once in 10 years) such as tornadoes, hurricanes, floods, ice storms, or small intensity earthquakes which are characteristic of the site geographic region and (2) for potential man-created site related events such as oil barge collisions, aircraft crashes which have a reasonable probability of occurring at a specific plant site.	containing equipment required for safe plant shutdown independent of the fire protection system. The fire protection system is designed and installed in accordance with applicable NFPA standards. However, the piping that supplies the water from the ESW system to hose stations in areas with equipment required for safe plant shutdown is designed in accordance with B31.1, except for limited sections of A120 pipe which analysis has shown to be of adequate strength, and is seismically supported to withstand the safe shutdown earthquake.
The effects of lightning strikes should be included in the overall plant fire protection program.	The effects of lightning strikes have been considered in the design of the plant and lightning protection has been provided.
5. Fire Suppression Systems	
Failure or inadvertent operation of the fire	Failure or inadvertent operation of the fire suppression system

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
suppression system should not incapacitate safety-related systems or components. Fire suppression systems that are pressurized during normal plant operation should meet the guidelines specified in APCSB Branch Technical Position 3-1, “Protection Against Postulated Piping Failures in Fluid Systems Outside Containment.”	will not incapacitate both divisions of safety-related systems or components. Fire suppression systems that are pressurized during normal operation meet the guidelines specified in APCSB Branch Technical Position 3-1.
6. Fuel Storage Areas	
The fire protection program (plans, personnel and equipment) for buildings storing new reactor fuel and for adjacent fire zones which could affect the fuel storage zone should be fully operational before fuel is received at the site.	Manual suppression equipment, such as hose stations or portable extinguishers, installed in the fuel handling building will be operational.
7. Fuel Loading	
The fire protection program for an entire reactor unit should be fully operational prior to initial fuel loading in that reactor unit.	The fire protection program for the reactor unit is anticipated to be essentially complete and operational prior to initial fuel loading.
8. Multiple-Reactor Sites	
On multiple-reactor sites where there are operating reactors and construction of remaining units is being completed, the fire protection program should provide continuing evaluation and include additional fire barriers, fire protection	Not Applicable

Redundant CPU Fire Alarm Control Panel, Printers, field Fire Alarm Control Panels, as well as the Zone Adapter Modules and Individual Addressable Modules located at the LFPs. The remainder of the system down stream of these devices, such as smoke detector panels, fire protection control panels, valve position switches, manual pull stations, etc., as well as the selection and location of fire detectors remains governed by NFPA 72D and 72E in effect in 1973.

c. Ohio Building Code, 1970 Edition.

9.5.1.2.4 Multi-unit Requirements

The special fire hazards created and the fire protection required while Unit 1 is in operation.

9.5.1.2.5 General Description of Fixed Suppression and Detection Systems

The following list provides a general description of the types of fire protection systems at PNPP and identifies the areas or hazards protected by each type (<Figure 9A-001>, <Figure 9A-002>, <Figure 9A-003>, <Figure 9A-005>, <Figure 9A-006>, <Figure 9A-007>, <Figure 9A-008>, <Figure 9A-010>, <Figure 9A-011>, <Figure 9A-012>, <Figure 9A-014>, <Figure 9A-015>, <Figure 9A-016>, <Figure 9A-018>, <Figure 9A-019>, <Figure 9A-020>, <Figure 9A-022>, <Figure 9A-023>, <Figure 9A-024>, <Figure 9A-025>, <Figure 9A-026>, <Figure 9A-027>, <Figure 9A-028>, <Figure 9A-029>, <Figure 9A-030>, <Figure 9A-031>, <Figure 9A-032>, <Figure 9A-033>, <Figure 9A-034>, of the FPER show areas covered by the fire protection and detection systems in relation to safe shutdown systems and components for those areas):

a. Wet pipe automatic sprinkler system

   Major components - alarm check valve, water flow pressure switch, shutoff valve with position switch.

   1. Unit 1 turbine building below the operating floors, including areas beneath the turbine condenser (hydraulically designed).

	Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
	Guidance is contained in the following publications: NFPA 4 - Organization for Fire Services NFPA 4A - Organization for Fire Department NFPA 6 - Industrial Fire Loss Prevention NFPA 7 - Management of Fire Emergencies NFPA 8 - Management Responsibility for Effects of Fire on Operations NFPA 27 - Private Fire Brigades	Administrative Controls, Fire Brigade Programs, and Training and Instruction Activities.
2.	Effective administrative measures should be implemented to prohibit bulk storage of combustible materials inside or adjacent to safety-related buildings or systems during operation or maintenance periods. <Regulatory Guide 1.39>, "Housekeeping Requirements for Water-Cooled Nuclear Power Plants," provides guidance on housekeeping, including the disposal of combustible materials.	Administrative measures will be implemented in PAP-0204 "Housekeeping/Cleanliness Control Program."
3.	Normal and abnormal conditions or other anticipated operations such as modifications (e.g., breaking fire stops, impairment of fire detection and suppression systems) and refueling activities	

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
should be reviewed by appropriate levels of management and appropriate special actions and procedures such as fire watches or temporary fire barriers implemented to ensure adequate fire protection and reactor safety. In particular:	
(a) Work involving ignition sources such as welding and flame cutting should be done under closely controlled conditions. Procedures governing such work should be reviewed and approved by persons trained and experienced in fire protection. Persons performing and directly assisting in such work should be trained and equipped to prevent and combat fires. If this is not possible, a person qualified in fire protection should directly monitor the work and function as a fire watch.	Administrative controls for ignition sources are required per PAP-1910. Fire watch training is required by PAP-1910.
(b) Leak testing, and similar procedures such as air flow determination, should use one of the commercially available aerosol techniques. Open flames or combustion generated smoke should not be permitted.	The company will comply with the exception that other leak detectors of a non-fire hazard type may be used. The prohibiting of open flames is stated in PAP-1910 - Fire Protection Program.
(c) Use of combustible material, e.g., HEPA	Administrative Controls for flammable and combustible

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
and charcoal filters, dry ion exchange resins or other combustible supplies, in safety-related areas should be controlled. Use of wood inside buildings containing safety-related systems or equipment should be permitted only when suitable noncombustible substitutes are not available. If wood must be used, only fire retardant treated wood (scaffolding, lay down blocks) should be permitted. Such materials should be allowed into safety-related areas only when they are to be used immediately. Their possible and probable use should be considered in the fire hazard analysis to determine the adequacy of the installed fire protection systems.	materials are required per PAP-1910.
4. Nuclear power plants are frequently located in remote areas, at some distance from public fire departments. Also, first response fire departments are often volunteer. Public fire department response should be considered in the overall fire protection program. However, the plant should be designed to be	A Plant Fire Brigade is established in PAP-1910, Fire Protection Program Interface with offsite fire departments is described in procedures and instructions written to fulfill PAP-1910 requirements.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
self-sufficient with respect to fire fighting activities and rely on the public response only for supplemental or backup capability.	
5. The need for good organization, training and equipping of fire brigades at nuclear power plant sites requires effective measures be implemented to assure proper discharge of these functions. The guidance in <Regulatory Guide 1.101>, "Emergency Planning for Nuclear Power Plants," should be followed as applicable.	Training for the Fire Brigade is described in procedures and instructions which are sub-tier to PAP-1910.
(a) Successful fire fighting requires testing and maintenance of the fire protection equipment, emergency lighting and communication, as well as practice as brigades for the people who must utilize the equipment. A test plan that lists the individuals and their responsibilities in connection with routine tests and inspections of the fire detection and protection systems should be developed. The test plan should contain the types, frequency and detailed procedures for testing. Procedures should also contain instructions on maintaining fire protection during those	A program of testing and surveillance of fire suppression and detection systems and fire barrier features is established through Fire Protection Periodic Test Instruction (PTI) and Surveillance Instructions. Fire fighting equipment is inspected in accordance with procedures and instructions which are sub-tier to PAP-1910. Impairments to fire protection systems are handled in accordance with procedures and instructions which are sub-tier to PAP-1910.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
periods when the fire protection system is impaired or during periods of plant maintenance, e.g., fire watches or temporary hose connections to water systems.	
(b) Basic training is a necessary element in effective fire fighting operation. In order for a fire brigade to operate effectively, it must operate as a team. All members must know what their individual duties are. They must be familiar with the layout of the plant and equipment location and operation in order to permit effective fire fighting operations during times when a particular area is filled with smoke or is insufficiently lighted. Such training can only be accomplished by conducting drills several times a year (at least quarterly) so that all members of the fire brigade have had the opportunity to train as a team, testing itself in the major areas of the plant. The drills should include the simulated use of equipment in each area and should be preplanned and post-critiqued to	Basic training is controlled by administrative procedures and instructions which are sub-tier to PAP-1910. Each fire brigade member will receive a comprehensive training program consisting of both class room instruction and actual fire fighting methods under controlled fire conditions. Brigade leaders will receive additional special training on organization and use of pre-fire plans. Non-Operations personnel assigned to the fire brigade will in addition receive training programs on plant systems. The development and updating of pre-fire plans is described in PAP-1910, Fire Protection Program and sub-tier documents. The duties of the fire brigade are described in procedures and instructions sub-tier to PAP-1910. Drills will be conducted according to procedures and instructions sub-tier to PAP-1910 which requires as a minimum one drill per quarter per shift, and at least one annual drill with local fire department participation. The lead drill controller will

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
establish the training objective of the drills and determine how well these objectives have been met. These drills should periodically (at least annually) include local fire department participation where possible. Such drills also permit supervising personnel to evaluate the effectiveness of communications within the Fire Brigade and with the on scene fire team leader, the reactor operator in the control room and the offsite command post.	ensure that all participants receive a post-drill critique.
(c) To have proper coverage during all phases of operation, members of each shift crew should be trained in fire protection. Training of the plant Fire Brigade should be coordinated with the local fire department so that responsiblities and duties are delineated in advance. This coordination should be part of the training course and implemented into the training of the local fire department staff. Local fire departments should be educated in the operational precautions when fighting fires on nuclear power plant sites. Local fire	Training for the Fire Brigade is described in procedures and instructions which are sub-tier to PAP-1910. Interface with offsite fire departments is described in PAP-1910, Fire Protection Program, and sub-tier documents.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
departments should be made aware of the need for radioactive protection of personnel and the special hazards associated with a nuclear power plant site.	
(d) NFPA 27, "Private Fire Brigade" should be followed in organization, training and fire drills. This standard also is applicable for the inspection and maintenance of fire fighting equipment. Among the standards referenced in this document, the following should be utilized: NFPA 194, "Standard for Screw Threads and Gaskets for Fire Hose Couplings," NFPA 196, "Standard for Fire Hose," NFPA 197, "Training Standard on Initial Fire Attacks," NFPA 601, "Recommended Manual of Instructions and Duties for the Plant Watchman on Guard." NFPA booklets and pamphlets listed on Page 27-11 of Volume 8, 1971-72 are also applicable for good training references.	These standards were referenced in establishing the administrative procedures.
In addition, courses in fire protection and fire suppression which are recognized and/or	Site fire training facilities and programs are certified

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
sponsored by the fire protection industry should be utilized.	by the State of Ohio in Trade & Industrial Fire Fighting.
C. Quality Assurance Program	
Quality assurance (QA) programs of applicants and contractors should be developed and implemented to ensure that the requirements for design, procurement, installation, and testing and administrative controls for the fire protection program for safety-related areas as defined in this Branch Position are satisfied. The program should be under the management control of the QA organization. The QA program criteria that apply to the fire protection program should include the following:	The Operational Quality Assurance Plan as it addresses the Perry Nuclear Power Plant Fire Protection Program is implemented to ensure that the project commitments for design, procurement, installation, testing, and administrative controls are satisfied. The QA Program includes inspections, tests and audits, where applicable, to verify equipment and/or systems meet fire protection program requirements.
1. Design Control and Procurement Document Control	
Measures should be established to ensure that all design-related guidelines of the Branch Technical Position are included in design and procurement documents and that deviations therefrom are controlled.	The QA Program ensures that the design related commitments to this program are adhered to and procurement documents reflect these requirements. This is accomplished where necessary through audits, inspections and reviews. All changes to these documents or deviations are controlled and reviewed similarly to the original documents. These reviews are performed by qualified personnel.
2. Instructions, Procedures and Drawings	
Inspections, tests, administrative controls, fire drills, and training that	The QA Program ensures that inspections, tests, fire drills, administrative controls, and

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
govern the fire protection program should be prescribed by documented instructions, procedures or drawings and should be accomplished in accordance with these documents.	training as committed to for fire protection are prescribed by documented instructions, procedures and/or drawings and are accomplished in accordance with these documents.
3. <u>Control of Purchased Material, Equipment and Services</u> Measures should be established to ensure that purchased material, equipment and services conform to the procurement documents.	The QA Program verifies the adequacy of purchase material, equipment and services. This is accomplished by one or more of the following: (a) detailed receipt inspection for compliance of equipment to the procurement documents and verification of completeness of the documents for equipment already on site; (b) review of manufacturer's certified test results when applicable; (c) items are certified, listed, labeled, or adopted, as appropriate, by a Nationally Recognized Testing Laboratory (NRTL) recognized by the Occupational Safety and Health Administration (OSHA) 1910.7, as required by the design documents; (d) witness testing when applicable.
4. <u>Inspection</u> A program for independent inspection of activities affecting fire protection should be established and executed by, or for, the organization performing the activity to verify conformance with documented installation drawings and test procedures for accomplishing the activities.	A program is established for independent inspection of installation and testing activities. The results of the inspection are documented and evaluated.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
5. Test and Test Control	
A test program should be established and implemented to ensure that testing is performed and	A test program is established and implemented to verify that the system conforms with operational and system

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
verified by inspection and audit to demonstrate conformance with design and system readiness requirements. The tests should be performed in accordance with written test procedures; test results should be properly evaluated and acted on.	readiness requirements. The tests are performed in accordance with approved written test procedures. Cognizant personnel evaluate test results and take appropriate actions when required.
6. Inspection, Test and Operating Status	
Measures should be established to provide for the identification of items that have satisfactorily passed required tests and inspections.	Items that have satisfactorily passed required test or inspections are identified by appropriate means.
7. Non-Conforming Items	
Measures should be established to control items that do not conform to specified requirements to prevent inadvertent use of installation.	Measures are established to ensure that non-conforming items are identified to prevent their inadvertent use or installation.
8. Corrective Action	
Measures should be established to ensure that conditions adverse to fire protection, such as failures, malfunctions, deficiencies, deviations, defective components, uncontrolled combustible material, and nonconformances are promptly identified, reported and corrected.	Measures are established to ensure that conditions adverse to fire protection, such as failures, malfunctions, deficiencies, deviations, defective components, uncontrolled combustible material, and nonconformances are promptly identified, reported and corrected.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
9. Records	
Records should be prepared and maintained to furnish evidence that the criteria enumerated above are being met for activities affecting the fire protection program.	Records are prepared and maintained to furnish documented evidence that commitments of the fire protection program and the quality criteria are met.
10. Audits	
Audits should be conducted and documented to verify compliance with the fire protection program including design and procurement documents; instructions; procedures and drawings; and inspection and test activities.	Audits are conducted and documented to written procedures to verify compliance with the fire protection program. Audits are performed by qualified personnel not having direct responsibility with the activity being audited.
D. General Guidelines for Plant Protection	
1. Building Design	
(a) Plant layouts should be arranged to:	
(1) Isolate safety-related systems from unacceptable fire hazards, and	The fire hazards analysis portion of <Appendix 9A.4> identifies the fire areas and the safe shutdown equipment within each area.
(2) Separate redundant safety-related systems from each other so that both are not subject to damage from a single fire hazard.	Locations where redundant systems are exposed to a single fire hazard are identified in the fire hazards analysis <Appendix 9A.4>. Adequate fire protection is provided for these locations.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(b) In order to accomplish 1.(a) above, safety-related systems and fire hazards should be identified throughout the plant. Therefore, a detailed fire hazard analysis should be made. The fire hazards analysis should be reviewed and updated as necessary.	See the fire hazards analysis, <Appendix 9A.4>. Safety-related systems required for safe shutdown are described in the Safe Shutdown Capability Report.
(c) For multiple reactor sites, cable spreading rooms should not be shared between reactors. Each cable spreading room should be separated from other areas of the plant by barriers (walls and floors) having a minimum fire resistance of three hours. Cabling for redundant safety divisions should be separated by walls having three hour fire barriers.	These requirements for the cable spreading rooms are met.
(d) Interior wall and structural components, thermal insulation materials and radiation shielding materials and soundproofing should be noncombustible. Interior finishes should be noncombustible or listed by a nationally recognized testing laboratory, such as Factory Mutual or Underwriters' Laboratory, Inc. for	Plant structural components satisfy this criterion. Interior walls are constructed as detailed in PY-CEI/NRR-0330L, dated August 30, 1985. Other materials are noncombustible, where possible. The control room carpeting has a critical radiant flux (CRF) figure of .59 (watts per square centimeter) and an average Optical Density rating of 432 at 4 minutes, as detailed in our letter PY-CEI/NRR-0322L, dated August 30, 1985.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
flame spread, smoke and fuel contribution of 25 or less in its use configuration (ASTM E-84 Test), "Surface Burning Characteristics of Building Materials."	
(e) Metal deck roof construction should be noncombustible (see the building materials directory of the Underwriters Laboratory, Inc.) or listed as Class I by Factory Mutual System Approval Guide.	Metal deck roof construction meets the requirements of Class I of the Factory Mutual Loss Prevention Guidelines.
(f) Suspended ceilings and their supports should be of noncombustible construction. Concealed spaces should be devoid of combustibles.	Suspended ceilings and their supports are of noncombustible construction.
(g) High voltage - high amperage transformers installed inside buildings containing safety-related systems should be of the dry type or insulated and cooled with noncombustible liquid.	Indoor transformers meet this criterion.
(h) Buildings containing safety-related systems should be protected	Subject exposed buildings walls within 50 feet of the outdoor oil filled transformers have a

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
from exposure or spill fires involving oil filled transformers by: (1) locating such transformers at least 50 feet distant; or (2) ensuring that such building walls within 50 feet of oil filled transformers are without openings and have a fire resistance rating of at least three hours.	fire resistance rating of two hours.
(i) Floor drains, sized to remove expected fire fighting water flow should be provided in those areas where fixed water fire suppression systems are installed. Drains should also be provided in other areas where hand hose lines may be used if such fire fighting water could cause unacceptable damage to equipment in the area. Equipment should be installed on pedestals, or curbs should be provided as required to contain water and direct it to floor drains. (See NFPA 92M, "Waterproofing and Draining of Floors.") Drains in areas	Floor drains are designed to remove the expected fire fighting water flow from areas where fixed fire suppression systems are installed or where fire hose may be used. Protection of equipment exposed to water damage is provided as required, unless analysis has shown that there is no potential for unacceptable damage due to expected water accumulation.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
containing combustible liquids should have provisions for preventing the spread of the fire throughout the drain system. Water drainage from areas which may contain radioactivity should be sampled and analyzed before discharge to the environment.	The switchgear rooms, fire Areas 1CC-3a and 1CC-3C, at Elevation 620’-6” in the control complex, do not have floor drains. However, water can be removed from the area by opening doors to direct water to drains or stairways in other areas as described in Chapter 4 of NFPA 92M, 1974, and in our Letter PY-CEI/NRR-0323L dated August 30, 1985. This will prevent water from damaging the redundant safe shutdown switchgear. Drains in areas containing combustible liquids are designed to prevent the spread of fire throughout the drain system. Water drainage from areas which may contain radioactivity is collected by storage tanks in the radwaste building for normal liquid waste processing.
(j) Floors, walls and ceilings enclosing separate fire areas should have minimum fire rating of three hours. Penetrations in these fire barriers, including conduits and piping, should be sealed or closed to provide a fire resistance rating at least equal to that	The floors, walls and ceilings enclosing separate fire areas (as defined in the fire hazards analysis, <Appendix 9A.4>) have fire resistance ratings adequate for the fire hazard involved. All non-conduit penetrations to these fire areas are sealed or dampered to maintain the continuous 3 hour fire resistance rating. The penetration seal designs have been tested in accordance with

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
of the fire barrier itself. Door openings should be protected with equivalent rated doors, frames and hardware that have been tested and approved by a national recognized laboratory. Such doors should be normally closed and locked or alarmed with alarm and annunciation in the control room. Penetrations for ventilation system should be protected by a standard "fire door damper" where required. (Refer to NFPA 80, "Fire Doors and Windows.")	ASTM E-119. Conduit penetrations will be sealed inside (to prevent the passage of smoke) based upon engineering criteria developed by testing and submitted in our letter PY-CEI/NRR-0304L, dated August 1, 1985. Door openings to these fire areas are provided either with approved doors and hardware (or the doors have been tested in a certified laboratory) for openings in a 3 hour rated wall. These doors will either be locked, alarmed or self-closing.
2. Control of Combustibles (a) Safety-related systems should be isolated or separated from combustible materials. When this is not possible because of the nature of the safety system or the combustible material, special protection should be provided to prevent a fire from defeating the safety system function. Such protection may involve a combination of automatic fire suppression, and construction capable of withstanding and containing a fire	The fire hazards analysis identifies these hazards and the protection afforded.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
that consumes all combustibles present. Examples of such combustible materials that may not be separable from the remainder of its system are:	
(1) Emergency diesel generator fuel oil day tanks	Tank and support protected by pyrocrete coating.
(2) Turbine generator oil and hydraulic control fluid systems	Turbine oil storage and purification separated by 3 hour wall.
(3) Reactor coolant pump lube oil system	Protected by CO_2 suppression.
(b) Bulk gas storage (either compressed or cryogenic), should not be permitted inside structures housing safety-related equipment. Storage of flammable gas such as hydrogen, should be located outdoors or in separate detached buildings so that a fire or explosion will not adversely affect any safety-related systems or equipment.	Bulk gas is stored in outside areas in accordance with OSHA 1910.101. A fire or explosion will not adversely affect any safety-related systems or equipment. Hydrogen storage is separated from the building by more than 50 feet. This is described in <Appendix 9A.4>
(Refer to NFPA 50A, "Gaseous Hydrogen Systems.")	
Care should be taken to locate high pressure gas storage containers with the	High pressure gas storage containers are located with the long axes parallel to building walls.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
long axis parallel to building walls. This will minimize the possibility of wall penetration in the event of a container failure. Use of compressed gases (especially flammable and fuel gases) inside buildings should be controlled. (Refer to NFPA 6, "Industrial Fire Loss Prevention.")	
(c) The use of plastic materials should be minimized. In particular, halogenated plastics such as polyvinyl chloride (PVC) and neoprene should be used only when substitute noncombustible materials are not available. All plastic materials, including flame and fire retardant materials, will burn with an intensity and BTU production in a range similar to that of ordinary hydrocarbons. When burning, they produce heavy smoke that obscures visibility and can plug air filters, especially charcoal and HEPA. The halogenated plastics also release free chlorine and hydrogen chloride when burning, which are toxic to humans and corrosive to equipment.	Plastic materials throughout the plant are negligible.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(d) Storage of flammable liquids should, as a minimum, comply with the requirements of NFPA 30, "Flammable and Combustible Liquids Code."	Flammable liquids will be stored in accordance with the requirements of NFPA 30 and OSHA 1910.106.
3. <u>Electric Cable Construction, Cable Trays and Cable Penetrations</u>	
(a) Only noncombustible materials should be used for cable tray construction.	Cable trays are noncombustible steel construction.
(b) See Section E.3 for fire protection guidelines for cable spreading rooms.	
(c) Automatic water sprinkler systems should be provided for cable trays outside the cable spreading room. Cables should be designed to allow wetting down with deluge water without electrical faulting. Manual hose stations and portable hand extinguishers should be provided as backup. Safety-related equipment in the vicinity of such cable trays, that does not itself require water fire protection, but is subject to unacceptable damage from sprinkler water discharge, should be protected from	Automatic water type fire suppression systems are provided in areas of concentrated cable loading, as identified in the fire hazards analysis <Appendix 9A.4>. Manual hose stations and portable hand extinguishers are provided as backup. Potential water damage has been considered where these systems are used.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
sprinkler system operation or malfunction.	
(d) Cable and cable tray penetration of fire barriers (vertical and horizontal) should be sealed to give protection at least equivalent to that fire barrier. The design of fire barriers for horizontal and vertical cable trays should, as a minimum, meet the requirements of ASTM E-119, "Fire Test of Building Construction and Materials," including the hose stream test.	Cable penetrations in fire barriers are sealed consistent with fire barrier fire resistance requirements.
(e) Fire breaks should be provided as deemed necessary by the fire hazards analysis. Flame or flame retardant coatings may be used as a fire break for grouped electrical cables to limit spread of fire in cable ventings. (Possible cable derating owing to use of such coating materials must be considered during design.)	As a result of the fire hazards analysis, fire break design provided by cable construction materials and raceway protection features is deemed adequate.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(f) Electric cable constructions should as a minimum pass the current IEEE No. 383 flame test. (This does not imply that cables passing this test will not require additional fire protection.)	Those cable types that are acceptable for routing in cable trays were tested in accordance with the flame test requirements of IEEE-383(1974). Other cable types were tested in accordance with those fire resistance tests that were applicable to their specific installation and usage.
(g) To the extent practical, cable construction that does not give off corrosive gases while burning should be used.	Those cable types that are acceptable for routing in cable trays were tested in accordance with the flame test requirements of IEEE-383(1974). Other cable types were tested in accordance with those fire resistance tests that were applicable to their specific installation and usage.
(h) Cable trays, raceways, conduit, trenches, or culverts should be used only for cables. Miscellaneous storage should not be permitted, nor should piping for flammable or combustible liquids or gases be installed in these areas.	This criterion is satisfied.
(i) The design of cable tunnels, culverts and spreading rooms should provide for automatic or manual smoke venting as required to facilitate manual fire fighting capability.	These areas were studied; smoke venting is provided as deemed necessary.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(j) Cables in the control room should be kept to the minimum necessary for operation of the control room. All cables entering the control room should terminate there. Cables should not be installed in floor trenches or culverts in the control room.	Cables in the control room come from the termination cabinets in the cable spreading area and terminate in control panels, consoles or equipment. The cables are installed in wireways in the base of prefabricated floor modules.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
4. Ventilation	
(a) The products of combustion that need to be removed from a specific fire area should be evaluated to determine how they will be controlled. Smoke and corrosive gases should generally be automatically discharged directly outside to a safe location. Smoke and gases containing radioactive materials should be monitored in the fire area to determine if release to the environment is within the permissible limits of the plant Technical Specifications.	Ventilation for critical areas is evaluated in <Appendix 9A.2> and <Appendix 9A.4> of this report. Areas having potential for release of radioactive material are monitored.
(b) Any ventilation system designed to exhaust smoke or corrosive gases should be evaluated to ensure that inadvertent operation or single failures will not violate the controlled areas of the plant design. This requirement includes containment functions for protection of the public and maintaining habitability for operations personnel.	The ventilation systems which would be used for smoke removal satisfy this criterion.
(c) The power supply and controls for mechanical ventilation	This criterion is met except in the control complex. However, in the control complex

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
systems should be run outside the fire area served by the system.	redundant sets of ventilating equipment are provided and located in separate fire areas.
(d) Fire suppression systems should be installed to protect charcoal filters in accordance with <Regulatory Guide 1.52>, "Design Testing and Maintenance Criteria for Atmospheric Clean-up Air Filtration."	Manual deluge systems are provided for the protection of the charcoal filters.
(e) The fresh air supply intakes to areas containing safety-related equipment or systems should be located remote from the exhaust air outlets and smoke vents of other fire areas to minimize the possibility of contaminating the intake air with the products of combustion.	Fresh air supply intakes are remotely located with respect to exhaust air outlets. Thus the possibility of contaminating the intake air with the products of combustion is minimized.
(f) Stairwells should be designed to minimize smoke infiltration during a fire. Staircases should serve as escape routes and access routes for fire fighting. Fire exit routes should be clearly marked. Stairwells, elevators and chutes should be enclosed in masonry towers with minimum fire rating of three hours and automatic fire doors at least equal to the enclo-	Stairwells are enclosed as indicated on the fire protection layout drawings. Stairwells serve as escape routes and access routes for fire fighting. Fire exit routes are marked as required. Stairwells and elevators are in 3 hour fire resistance rated/designed enclosures, except for the control complex, where stair towers and elevator enclosures have a minimum fire resistance of 1-3/4 hour. The stairwells are provided with Class A fire doors and the elevators with Class B fire doors. Escape and

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
sure construction, at each opening into the building. Elevators should not be used during fire emergencies.	access routes will be established by pre-fire plan and will be practiced in drills by operating and fire brigade personnel.
(g) Smoke and heat vents may be useful in specific areas such as cable spreading rooms and diesel fuel oil storage areas and switchgear rooms. When natural-convection ventilation is used, a minimum ratio of 1 sq foot of venting area per 200 sq feet of floor area should be provided. If forced-convection ventilation is used, 300 cfm should be provided for every 200 sq feet of floor area. See NFPA No. 204 for additional guidance on smoke control.	Forced convection ventilation is provided throughout the plant, and is in excess of 300 cfm for each 200 ft^2 of floor area.
(h) Self-contained breathing apparatus, using full face positive pressure masks, approved by NIOSH (National Institute for Occupational Safety and Health - approval formerly given by the U.S. Bureau of Mines) should be provided for fire brigade, damage control and control room personnel. Control room personnel may be furnished breathing air by a manifold system piped from a storage	NIOSH Self-contained breathing apparatus are strategically located throughout the plant as determined by the fire protection coordinator.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
reservoir if practical. Service or operating life should be a minimum of one half hour for the self-contained units.	
At least two extra air bottles should be located onsite for each self-contained breathing unit. In addition, an onsite 6-hour supply of reserve air should be provided and arranged to permit quick and complete replenishment of exhausted supply air bottles as they are returned. If compressors are used as a source of breathing air, only units approved for breathing air should be used. Special care must be taken to locate the compressor in areas free of dust and contaminants.	Two extra air bottles are maintained onsite at the fire training facility for each unit. The air bottles can be filled by an air compressor located in a suitable location onsite or by offsite services. Special instructions will be followed for maintaining onsite equipment in a safe manner according to NFPA 1981.
(i) Where total flooding gas extinguishing systems are used, area intake and exhaust ventilation dampers should close upon initiation of gas flow to maintain necessary gas concentration. (See NFPA 12, "Carbon Dioxide Systems," and 12A, "Halon 1301 Systems.")	Where required, ventilation dampers close on actuation of gaseous extinguishing systems to maintain the necessary gas concentration.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
5. <u>Lighting and Communication</u>	
Lighting and two way voice communication are vital to safe shutdown and emergency response in the event of fire. Suitable fixed and portable emergency lighting and communication devices should be provided to satisfy the following requirements:	
(a) Fixed emergency lighting should consist of sealed beam units with individual 8-hour minimum battery power supplies.	PNPP has a backup ac power supply for areas where lighting is necessary for safe shutdown. A completely separate dc lighting system is provided, supplied by batteries ensuring at least 2 hours continuous operation for those areas provided with the backup ac power supply. In addition emergency lighting using sealed beam units supplied by batteries capable of at least 8-hours continuous operation are provided to illuminate the path of travel between the main control room and the Unit 1 remote shutdown rooms and their interiors.
(b) Suitable sealed beam battery powered portable hand lights should be provided for emergency use.	The company will comply.
(c) Fixed emergency communication should use voice powered head sets at pre-selected stations.	The maintenance calibration system is available for use. The primary system for fire fighting and safe shutdown operations is the portable radio system.
(d) Fixed repeaters installed to permit use of portable radio	A fixed repeater for fire service communication is installed in the service build-

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
communication units should be protected from exposure fire damage.	ing at Elevation 603’-6” where it is protected from exposure fire damage.
E. Fire Detection and Suppression	
1. Fire Detection	
(a) Fire detection systems should as a minimum comply with NFPA 72D, “Standard for the Installation, Maintenance and Use of Proprietary Protective Signaling Systems.”	Fire Detection systems are described in <Section 9.5.1.2.7i>. The design is in accordance with NFPA 72 and 72D, see <Section 9.5.1.2.3> for details on code applicability, except as noted in USAR <Section 9.5.1.2> and calculation P54-212.
(b) Fire detection system should give audible and visual alarm and annunciation in the control room. Local audible alarms should also sound at the location of the fire.	Fire detection systems give audible and visual alarms in the control room. The control room operator can actuate an audible fire alarm which sounds throughout the plant via the PA system. Local audible fire alarms (which are distinctive and unique from other plant alarms) are sounded at the location of the fire.
(c) Fire alarms should be distinctive and unique. They should not be capable of being confused with any other plant system alarms.	Fire alarms are distinctive and unique and will not be confused with any other plant systems alarm.
(d) Fire detection and actuation systems should be connected to the plant emergency power supply.	Except where otherwise described in the USAR, these systems are connected to the plant emergency power supply. See <Section 9.5.1.2.7> of the USAR for details.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
2. Fire Protection Water Supply Systems	
(a) An underground yard fire main loop should be installed to furnish anticipated fire water requirements. NFPA 24 - Standard for Outside Protection - gives necessary guidance for such installation. It references other design codes and standards developed by such organizations as the American National Standards Institute (ANSI) and the American Water Works Association (AWWA). Lined steel or cast iron pipe should be used to reduce internal tuberculation. Such tuberculation deposits in an unlined pipe over a period of years can significantly reduce water flow through the combination of increased friction and reduced pipe diameter. Means for treating and flushing the systems should be provided. Approved visually indicating sectional control valves, such as Post Indicator Valves, should be provided to isolate portions of the main for maintenance or repair without shutting off the entire system.	The underground yard fire main loop is installed in accordance with NFPA 24. Underground pipe is mainly unlined, unwrapped nickel copper alloy steel. There are also limited portions of fiberglass reinforced plastic and cement lined ductile iron mains. Above ground pipe is carbon steel. Flushing is accomplished using fire hydrants. No additional treatment is necessary. Sectional control valves (post indicator valves) are provided to isolate portions of the fire main for maintenance or repair without shutting down the entire system.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
The fire main system piping should be separate from service or sanitary water system piping.	Fire main piping is separate from domestic and sanitary water service piping.
(b) A common yard fire main loop may serve multi-unit nuclear power plant sites, if cross-connected between units. Sectional control valves should permit maintaining independence of the individual loop around each unit. For such installations, common water supplies may also be utilized. The water supply should be sized for the largest single expected flow. For multiple reactor sites with widely separated plants (approaching 1 mile or more), separate yard fire main loops should be used.	A common yard fire main loop serves PNPP Units 1 and 2. Sectional control valves (post indicator valves) are provided to permit independence of the individual loop around each unit.
(c) If pumps are required to meet system pressure or flow requirements, a sufficient number of pumps should be provided so that 100% capacity will be available with one pump inactive (e.g., three 50% pumps or two 100% pumps). The connection to the yard fire main loop from each fire pump should be widely separated, preferably located on opposite	Two 100 percent capacity fire pumps (2,500 gpm at 141 psig; one diesel driven and one electrical motor driven) are provided. Connections to the yard fire main loop are well separated with sectionalizing valves between connections. In the emergency service water pumphouse, the diesel driven fire pump is separated from the electric motor driven fire pump by a 3 hour rated fire barrier, except as noted in <Appendix 9A.4>.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
sides of the plant. Each pump should have its own driver with independent power supplies and control. At least one pump (if not powered from the emergency diesels) should be driven by non-electrical means, preferably diesel engine. Pumps and drivers should be located in rooms separated from the remaining pumps and equipment by a minimum three-hour fire wall. Alarms indicating pump running, driver availability or failure to start should be provided in the control room.	Alarms indicating pump running, controller not in automatic, and engine trouble are provided in the control panel.
Details of the fire pump installation should as a minimum conform to NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."	The fire pump installation conforms to NFPA 20.
(d) Two separate reliable water supplies should be provided. If tanks are used, two 100% (minimum of 300,000 gallons each) system capacity tanks should be installed. They should be so interconnected that pumps can take suction from	Water supply is from Lake Erie.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
either or both. However, a leak in one tank or its piping should not cause both tanks to drain. The main plant fire water supply capacity should be capable of refilling either tank in a minimum of eight hours.	
Common tanks are permitted for fire and sanitary or service water storage. When this is done, however, minimum fire water storage requirements should be dedicated by means of a vertical standpipe for other water services.	Not applicable.
(e) The fire water supply (total capacity and flow rate) should be calculated on the basis of the largest expected flow rate for a period of two hours, but not less than 300,000 gallons. This flow rate should be based (conservatively) on 1,000 gpm for manual hose streams plus the greater of:	The largest flow demand for a safety-related area is less than 1,500 gpm and the largest flow demand for the plant is less than 3,000 gpm. A minimum of 500 gpm is available for manual hose streams as a part of system design. A single pump is designed to operate at 150 percent of rated capacity and provide 3,750 gpm at 85 psig at the pump discharge.
(1) all sprinkler heads opened and flowing in the largest designed fire area; or	

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(2) the largest open head deluge system(s) operating.	
(f) Lakes or fresh water ponds of sufficient size may qualify as sole source of water for fire protection, but require at least two intakes to the pump supply. When a common water supply is permitted for fire protection and the ultimate heat sink, the following conditions should also be satisfied:	Two intakes are provided to the ESW forebay, which serves as the suction supply for both fire pumps. The normal water source is taken directly from Lake Erie through the intake tunnel. An alternate supply path from the discharge tunnel emergency cross-tie, can be manually aligned to the ESW forebay if the normal intake from Lake Erie is not available.
(1) The additional fire protection water requirements are designed into the total storage capacity; and	Not applicable.
(2) Failure of the fire protection system should not degrade the function of the ultimate heat sink.	Not applicable.
(g) Outside manual hose installation should be sufficient to reach any location with an effective hose stream. To accomplish this, hydrants should be installed approximately every 250 feet on the yard main system. The lateral to each hydrant from the yard main should be	Fire hydrants are located around the perimeter of PNPP Unit 1 and Unit 2 as shown on <Figure 9A-1>. The lateral to each fire hydrant is provided with a valve. The system is designed so that the sectional control valves (post indicator valves) can isolate one, two or three fire hydrants. Each fire hydrant is provided with a hose house containing

controlled by a visually indicating or key operated (curb) valve. A hose house, equipped with hose and combination nozzle, and other auxiliary equipment recommended in NFPA 24, "Outside Protection," should be provided as needed but at least every 1,000 feet.	2-1/2 inch hose, combination fog nozzle and auxiliary equipment.
Threads compatible with those used by local fire departments should be provided on all hydrants, hose couplings and standpipe risers.	Threads compatible with those used by local fire departments are provided on hydrants, hose couplings and standpipe risers.

3. Water Sprinklers and Hose Standpipe Systems

(a) Each automatic sprinkler system and manual hose station standpipe should have an independent connection to the plant underground water main. Headers fed from each end are permitted inside buildings to supply multiple sprinkler and standpipe systems. When provided, such headers are considered an extension of the yard main system. The header arrangement should be such that no single failure can impair both the primary and backup fire protection systems.	Automatic sprinkler/deluge systems and manual hose station standpipes are fed from headers. The header arrangement is such that no single failure can impair both a primary sprinkler/deluge system and its backup manual hose station standpipe system.
Each sprinkler and standpipe system should	Each sprinkler and standpipe system is equipped with an OS&Y

	Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
	be equipped with OS&Y (outside screw and yoke) gate valve, or other approved shutoff valve and water flow alarm. Safety-related equipment that does not itself require sprinkler water fire protection, but is subject to unacceptable damage if wetted by sprinkler water discharge should be protected by water shields or baffles.	gate valve. Each sprinkler system is equipped with a water flow alarm. Standpipe systems in areas containing safe shutdown equipment are equipped with a water flow alarm. Where safety-related equipment is subject to unacceptable water damage if wetted by sprinkler water discharge, it has been protected.
(b)	All valves in the fire water systems should be electrically supervised. The electrical supervision signal should indicate in the control room and other appropriate command locations in the plant (See NFPA 26, "Supervision of Valves.")	Control and sectionalizing valves in the fire water system are electrically supervised and actuate alarms in the control room or are locked in the open position under administrative control of the Fire Protection Program. Control valves for the reactor building hose stations are locked closed during normal plant operation. The valves are locked open during maintenance operations.
(c)	Automatic sprinkler systems should as a minimum conform to requirements of appropriate standards such as NFPA 13, "Standard for the Installation of Sprinkler Systems," and NFPA 15, "Standard for Water Spray Fixed Systems."	Automatic water type suppression systems throughout PNPP satisfy the design and installation requirements of the appropriate standards such as NFPA 13 and 15.
(d)	Interior manual hose installation should be able to reach any location with at least one effective hose stream. To accomplish	Interior manual hose stations are located so that at least one effective hose stream can be brought to bear at any location in the plant containing or presenting a hazard to

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
this, standpipes with hose connections equipped with a maximum of 75 feet of 1-1/2 inch woven jacket lined fire hose and suitable nozzles should be provided in all buildings, including containment, on all floors and should be spaced at not more than 100-foot intervals. Individual standpipes should be of at least 4-inch diameter for multiple hose connections and 2-1/2-inch diameter for single hose connections. These systems should follow the requirements of NFPA No. 14, "Standpipe and Hose Systems" for sizing, spacing and pipe support requirements.	structures, systems or components important to safety. A maximum of 100 feet of 1-1/2 inch fire hose is provided at each hose station with the exception of the containment drywell. Standpipe and piping supplying the hose stations are sized in accordance with system demands per hydraulic calculations using the following design criteria: 1. All interior hose stations are designed for Class II service and sized for a minimum flow of 100 gallons per minute at 65 psi at the hose station outlet. 2. The calculations are based on: A total flow of 500 gpm from both internal building and external (yard hydrant system) hose streams. 3. When a hazard area is within reach of several internal hose streams, the calculations will include simultaneous water flow from multiple hose streams. 4. Water flow from hose streams are based on hose stations located on the same floor level and within the same building as the area being protected. (There will always be a minimum of two internal hose streams.)

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
	5. The water flow from outside (yard hydrant system) hose streams is the difference between the 500 gpm (required allowance from <u>all</u> hose streams) and the internal building hose stream protection.
	6. In areas of the plant where fixed fire suppression systems are located, the calculations are based on a simultaneous operation of both the fixed fire suppression system and all fire hose stations whose hose streams would reach the area protected by the fixed fire suppression system. a. The demand for the fixed water spray system shall be based on the design calculations for each of these systems. b. The demand for sprinkler systems shall be based on the density curves of NFPA 13, Table 2-2.1(B) for the largest fire area within the protected area of the system, but, with an area of sprinkler operation not to exceed 3,000 square feet.
	7. The demand is calculated back to fire pumps and the sizing is considered adequate only if the water

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
	demand (gpm and pressure) is available individually from each fire pump.
Hose stations should be located outside entrances to normally unoccupied areas and inside normally occupied areas. Standpipes serving hose stations in areas housing safety-related equipment should have shutoff valves and pressure reducing devices (if applicable) outside the area.	Hose stations have been located to facilitate access and use for fire fighting operations. Shutoff valves and pressure reducing devices are provided for each hose station.
Provisions should be made to supply water at least to standpipes and hose connections for manual fire fighting in areas within hose reach of equipment required for safe plant shutdown in the event of a Safe Shutdown Earthquake (SSE). The standpipe system serving such hose stations should be analyzed for SSE loading and should be provided with supports to assure system pressure integrity. The piping and valves for the portion of hose standpipe system affected by this functional requirement should at least satisfy ANSI Standard B31.1, "Power Piping." The water	These conditions are met in areas containing equipment required for safe plant shutdown in the event of a SSE, except for limited sections of A120 pipe which analysis has shown to be of adequate strength.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
supply for this condition may be obtained by manual operator actuation of valve(s) in a connection to the hose standpipe header from a normal Seismic Category I water system such as Essential Service Water System. The cross connection should be (a) capable of providing flow to at least two hose stations (approximately 75 gpm/hose station), and (b) designed to the same standards as the Seismic Category I water system; it should not degrade the performance of the Seismic Category I water system.	
(e) The proper type of hose nozzles to be supplied to each area should be based on the fire hazard analysis. The usual combination spray/straight-stream nozzle may cause unacceptable mechanical damage (for example, the delicate electronic equipment in the control room) and be unsuitable. Electrically safe nozzles should be provided at locations where electrical equipment or cabling is located.	All areas are provided with adjustable pattern combination fog and straight stream nozzles. Personnel are adequately trained to make proper use of hose stations.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(f) Certain fires such as those involving flammable liquids respond well to foam suppression. Consideration should be given to use of any of the available foams for such specialized protection application. These include the more common chemical and mechanical low expansion foams, high expansion foam and the relatively new aqueous film forming foam (AFFF).	The only major flammable liquid hazards at the plants are the auxiliary boiler fuel oil storage tank and the fuel oil unloading area; these have foam system protection as described in <Appendix 9A.4>.
4. Halon Suppression Systems	
The use of Halon fire extinguishing agents should as a minimum comply with the requirements of NFPA 12A and 12B, "Halogenated Fire Extinguishing Agent Systems - Halon 1301 and Halon 1211." Only UL or FM approved agents should be used.	Halon 1301 systems are provided for areas of the service building (including the TSC) and are designed in accordance with NFPA 12A. The use of ultrasonic measurement is considered a special measuring device in lieu of weighing. There are no Halon systems in areas containing safe shutdown systems.
In addition to the guidelines of NFPA 12A and 12B, preventative maintenance and testing of the systems, including check weighing of the Halon cylinders should be done at least quarterly.	
Particular consideration should also be given to:	
(a) minimum required Halon concentration and soak time	
(b) toxicity of Halon	

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(c) toxicity and corrosive characteristics of thermal decomposition products of Halon.	
5. Carbon Dioxide Suppression Systems	
The use of carbon dioxide extinguishing systems should as a minimum comply with the requirements of NFPA 12, "Carbon Dioxide Extinguishing Systems." Particular consideration should also be given to: (a) minimum required CO_2 concentration and soak time; (b) toxicity of CO_2; (c) possibility of secondary thermal shock (cooling) damage; (d) offsetting requirements for venting during CO_2 injection to prevent overpressurization versus sealing to prevent loss of agent; (e) design requirements from overpressurization; and (f) possibility and probability of CO_2 systems being out-of-service because of personnel safety consideration. CO_2 systems are disarmed whenever people are	A low pressure carbon dioxide system is provided to supply total flooding systems, local applications systems and hose reels utilized throughout the plant. The system design is in in accordance with the requirements of NFPA 12. Consideration is given for each system regarding items (a) through (f).

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
present in an area so protected. Areas entered frequently (even though duration time for any visit is short) have often been found with CO_2 systems shut off.	
6. Portable Extinguishers	
Fire extinguishers should be provided in accordance with guidelines of NFPA 10 and 10A, "Portable Fire Extinguishers, Installation, Maintenance, and Use." Dry chemical extinguishers should be installed with due consideration given to cleanup problems after use and possible adverse effects on equipment installed in the area.	Portable fire extinguishers are provided and maintained in accordance with NFPA 10 and 10A, respectively.
F. Guidelines for Specific Plant Areas	
1. Primary and Secondary Containment	
(a) Normal Operation	
Fire protection requirements for the primary and secondary containment areas should be provided on the basis of specific identified hazards. For example:	The fire hazards analysis <Appendix 9A.4> outlines the protection for identified hazards in the containment area.
(1) Lubricating oil or hydraulic fluid system for the primary coolant pumps	

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
(2) Cable tray arrangements and cable penetrations	
(3) Charcoal filters	
Because of the general inaccessibility of these areas during normal plant operations, protection should be provided by automatic fixed systems. Automatic sprinklers should be installed for those hazards identified as requiring fixed suppression.	The systems provided for the identified hazards are automatic in operation.
Operation of the fire protection systems should not compromise integrity of the containment or the other safety-related systems. Fire protection activities in the containment areas should function in conjunction with total containment requirements such as control of contaminated liquid and gaseous release and ventilation.	Operation of the fire protection systems will not compromise the integrity of the containment or the other safety-related systems.
Fire detection systems should alarm and annunciate in the control room. The type of detection used and the location of the detectors should be most suitable to the particular type of fire that could be expected from the identified	Where fire detection systems are provided, they alarm and annunciate in the control room.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
hazard. A primary containment general area fire detection capability should be provided as backup for the above described hazard detection. To accomplish this, suitable smoke detection (e.g., visual obscuration, light scattering and particle counting) should be installed in the air recirculation system ahead of any filters.	
Automatic fire suppression capability need not be provided in the primary containment atmospheres that are inerted during normal operation. However, special fire protection requirements during refueling and maintenance operations should be satisfied as provided below.	
(b) <u>Refueling and Maintenance</u>	
Refueling and maintenance operations in containment may introduce additional hazards such as contamination control materials, decontamination supplies, wood planking, temporary wiring, welding, and flame cutting (with portable compressed fuel gas supply). Possible	Control of combustibles is described in PAP-1910.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
fires would not necessarily be in the vicinity of fixed detection and suppression systems.	
Management procedures and controls necessary to ensure adequate fire protection are discussed in Section 3a.	
In addition, manual fire fighting capability should be permanently installed in containment. Standpipes with hose stations, and portable fire extinguishers, should be installed at strategic locations throughout containment for any required manual fire fighting operations. Adequate self-contained breathing apparatus should be provided near the containment entrances for fire fighting and damage control personnel. These units should be independent of any breathing apparatus or air supply systems provided for general plant activities.	Hoses are installed in containment area. An extra length of hose is available to provide coverage to all areas of drywell from the containment hose stations. Extinguishers are provided at the entrance to containment, to be brought in, in the event of a fire. Also portable extinguishers will be placed in containment during refueling and maintenance periods. Self-contained breathing apparatus is provided outside entrances to containment.
2. Control Room	
The control room is essential to safe reactor operation. It must be protected against disabling fire damage and should be separated from other areas	The control room (Unit 1 and Unit 2) meets these requirements, as described in <Appendix 9A.4>.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
of the plant by floors, walls and roofs having minimum fire resistance ratings of three hours.	
Control room cabinets and consoles are subject to damage from two distinct fire hazards:	
(a) Fire originating within a cabinet or console; and	
(b) Exposure fire involving combustibles in the general room area.	
Manual fire fighting capability should be provided for both hazards. Hose stations and portable water and Halon extinguishers should be located in the control room to eliminate the need for operators to leave the control room. An additional hose piping shutoff valve and pressure reducing device should be installed outside the control room.	Hose stations and portable fire extinguishers, including Halon, multi-purpose dry chemical, and CO_2 types, are provided.
Hose stations adjacent to the control room with portable extinguishers in the control room are acceptable.	Hose stations are provided adjacent to the control room and fire extinguishers are located within.
Nozzles that are compatible with the hazards and equipment in the control room should be provided for the manual hose station. The nozzles chosen should satisfy actual fire fighting needs, satisfy electrical safety and minimize physical damage to electrical	The nozzles provided meet these requirements.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
equipment from hose stream impingement.	
Fire detection in the control room cabinets and consoles should be provided by smoke and heat detectors in each fire area. Alarm and annunciation should be provided in the control room. Fire alarms in other parts of the plant should also be alarmed and annunciated in the control room.	Fire detection in the control room is described in the fire hazards analysis portion of this report <Appendix 9A.4>; alarm and annunciation is provided in the control room.
Breathing apparatus for control room operators should be readily available. Control room floors, ceiling, supporting structures, and walls, including penetrations and doors, should be designed to a minimum fire rating of three hours. All penetration seals should be air tight.	These positions are satisfied.
The control room ventilation intake should be provided with smoke detection capability to automatically alarm locally and isolate the control room ventilation system to protect operators by preventing smoke from entering the control room. Manually operated venting of the control room should be available so that operators have the option of venting for visibility.	The design criteria is met except the isolation of the control room ventilation system is by manual operation only.
Cables should not be located in concealed floor and ceiling spaces. All cables that enter the control room should terminate in the control room.	As described in fire hazards analysis portion of <Appendix 9A.4>, the cable is routed in wireways which are part of the floor modules. These wireways are protected

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
That is, no cabling should be simply routed through the control room from one area to another.	by carbon dioxide suppression systems.
Safety-related equipment should be mounted on pedestals or the control room should have curbs and drains to direct water away from such equipment. Such drains should be provided with means for closing to maintain integrity of the control room in the event of other accidents requiring control room isolation.	Panels and consoles are mounted on the floor section of the prefabricated modules. Floor drains are provided with valves for isolation.
3. <u>Cable Spreading Room</u>	
The primary fire suppression in the cable spreading room should be an automatic water system such as closed head sprinklers, open head deluge or open directional spray nozzles. Deluge and open spray systems should have provisions for manual operation at a remote station; however, there should be provisions to preclude inadvertent operation. Location of sprinkler heads or spray nozzles should consider cable tray sizing and arrangements to ensure adequate water coverage. Cables should be designed to allow wetting down with deluge water without electrical faulting.	A preaction sprinkler system meeting these requirements is located in each cable spreading room.
Open head deluge and open directional spray systems	Not applicable.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
should be zoned to that a single failure will not deprive the entire area of automatic fire suppression capability.	
The use of foam is acceptable, provided it is of a type capable of being delivered by a sprinkler or deluge system, such as an Aqueous Film Forming Foam (AFFF).	Not applicable.
An automatic water suppression system with manual hoses and portable extinguisher backup is acceptable, provided:	In addition to the preaction system, each cable spreading room has manual hose and portable extinguisher backup.
(a) At least two remote and separate entrances are provided to the room for access by fire brigade personnel; and	Remote separate entrances are provided.
(b) Aisle separation provided between tray stacks should be at least three feet wide and eight feet high.	Aisle separation generally meets these requirements. The aisles are typically three feet wide and eleven feet high. There are a few cases where the aisles are only 2.5 feet wide.
Alternatively, gas systems (Halon or CO_2) may be used for primary fire suppression if they are backed up by an installed water spray system and hose stations and portable extinguishers immediately outside the room and if the access requirements stated above are met.	Not applicable.
Electric cable construction should, as a minimum, pass the flame test in IEEE	Those cable types that are acceptable for routing in cable trays were tested in accordance

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
Std. 383, "IEEE Standard for Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations."	with the flame test specified in IEEE-383(1974). Other cable types were tested in accordance with those fire resistance tests that were applicable to their specific installation and usage.
Drains to remove fire fighting water should be provided with adequate seals when gas extinguishing systems are also installed.	Drains are provided to remove fire fighting water; there is no gas extinguishing system.
Redundant safety-related cable division should be separated by walls with a 3 hour fire rating.	Redundant safety-related cable divisions are separated by walls with 3 hour fire ratings, or a 1 hour wrap with suppression and detection.
For multiple-reactor unit sites, cable spreading rooms should not be shared between reactors. Each cable spreading room of each unit should have divisional cable separation as stated above and be separated from the other and the rest of the plant by a wall with a minimum fire rating of three hours. (See NFPA 251, "Fire Tests, Building Construction and Materials," or ASTM E-119, "Fire Test of Building Construction and Materials," for fire test resistance rating.)	Not Applicable
The ventilation system to the cable spreading room should be designed to isolate the area upon actuation of any gas extinguishing system in the area. In addition, smoke venting of the cable	There is no gas extinguishing system. Manually actuated smoke venting is provided.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
spreading room may be desirable. Such smoke venting systems should be controlled automatically by the fire detection or suppression system as appropriate. Capability for remote-manual control should also be provided.	
4. Plant Computer Room	
Safety-related computers should be separated from other areas of the plant by barriers having a minimum 3 hour fire resistant rating.	The PNPP computer is not safety-related, but this criterion is met.
Automatic fire detection should be provided to alarm and annunciate in the control room and alarm locally. Manual hose stations and portable water and Halon fire extinguishers should be provided.	Automatic fire detection, manual hose stations and portable fire extinguishers are provided. The fire detection system alarms and annunciates in the control room.
5. Switchgear Rooms	
Switchgear rooms should be separated from the remainder of the plant by minimum 3 hour rated fire barriers, if practicable. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Fire hose stations and portable extinguishers should be readily available.	Safety-related switchgear rooms are separated from the remainder of the plant by walls, floors and ceilings which have 3 hour fire resistance ratings. Automatic fire detection devices, which actuate alarms and annunciate in the control room, are provided. Fire hose and portable fire extinguishers are readily available.
Acceptable protection for cables that pass through the switchgear room is automatic water or gas	Cables in switchgear rooms are routed in both conduit and cable trays. The cables that do not terminate in the Cable

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
agent suppression. Such automatic suppression must consider preventing unacceptable damage to electrical equipment and possible necessary containment of agent following discharge.	Spreading Room are mostly in conduit. The combustible loading due to these cables is low and automatic suppression is not warranted.
6. Remote Safety-Related Panels	
The general area housing remote safety-related panels should be provided with automatic fire detectors that alarm locally and alarm and annunciate in the control room. Combustible materials should be controlled and limited to those required for operation. Portable extinguishers and manual hose stations should be provided.	The general areas housing safety-related panels necessary for safe shutdown are provided with fire detectors which alarm and annunciate in the control room. Portable extinguishers and manual hose stations are provided.
7. Station Battery Rooms	
Battery rooms should be protected against fire explosions. Battery rooms should be separated from each other and other areas of the plant by barriers having a minimum fire rating of 3 hours inclusive of all penetrations and openings. (See NFPA 69, "Standard on Explosion Prevention Systems.") Ventilation systems in the battery rooms should be capable of maintaining the hydrogen concentration well below 2 vol % hydrogen concentration. Standpipe	This criterion is met; see the fire hazards analysis portion of <Appendix 9A.4> for details.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
and hose and portable extinguishers should be provided.	
Alternatives:	
(a) Provide a total fire rated barrier enclosure of the battery room complex that exceeds the fire load contained in the room.	
(b) Reduce the fire load to be within the fire barrier capability of 1-1/2 hours.	
OR	
(c) Provide a remote-manual actuated sprinkler system in each room and provide the 1-1/2 hour fire barrier separation.	
8. <u>Turbine Lubrication and Control Oil Storage and Use Areas</u>	
A blank fire wall having a minimum resistance rating of 3 hours should separate all areas containing safety-related systems and equipment from the turbine oil system.	No safety-related equipment is exposed to the turbine oil storage areas. This area is cut off from the rest of the turbine building by walls with a 3 hour fire resistance.
9. <u>Diesel Generator Areas</u>	
Diesel generators should be separated from each other and other areas of the plant by fire barriers having a minimum fire resistance rating of 3 hours.	The design criterion is met.
Automatic fire suppression such as AFFF foam, or	A total flooding carbon dioxide system is provided. The fire

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
sprinklers should be installed to combat any diesel generator or lubricating oil fires. Automatic fire detection should be provided to alarm and annunciate in the control room and alarm locally. Drainage for fire fighting water and means for local manual venting of smoke should be provided.	detection system alarms and annunciates in the control room and locally.
Day tanks with total capacity up to 1,100 gallons are permitted in the diesel generator area under the following conditions: (a) The day tank is located in a separate enclosure, with a minimum fire resistance rating of 3 hours, including doors or penetrations. These enclosures should be capable of containing the entire contents of the day tanks. The enclosure should be ventilated to avoid accumulation of oil fumes. (b) The enclosure should be protected by automatic fire suppression systems such as AFFF or sprinklers.	The day tank (capacity 550 gallons) is located in the diesel generator room, thereby included in the carbon dioxide suppression system coverage. The tank and supports are coated with a fire retardant material to a thickness which provides a 3 hour rating. The tank is vented directly to the outdoors. There is an oil catch pan below the tank which drains to the floor drain system. Check valves are provided in lines subject to gravity flow.
10. <u>Diesel Fuel Oil Storage Areas</u>	
Diesel fuel oil tanks with a capacity greater than 1,100 gallons should not be located inside the buildings containing safety-related	Diesel fuel for the emergency diesel generators is stored in underground tanks.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
equipment. They should be located at least 50 feet from any building containing safety-related equipment, or if located within 50 feet, they should be housed in a separate building with construction having a minimum fire resistance rating of three hours.	
Buried tanks are considered as meeting the 3 hour fire resistance requirements.	
See NFPA 30, "Flammable and Combustible Liquids Code," for additional guidance.	
When located in a separate building, the tank should be protected by an automatic fire suppression system such as AFFF or sprinklers.	
Tanks, unless buried, should not be located directly above or below safety-related systems or equipment regardless of the fire rating of separating floors or ceilings.	
11. Safety-Related Pumps	
Pumphouses and rooms housing safety-related pumps or other safety-related equipment should be separated from other areas of the plant by fire barriers having at least 3 hour ratings. These rooms should be protected by automatic sprinkler protection unless a fire hazard analysis can	The safety-related pumps are located in the emergency service water pumphouse and the Auxiliary Building. The fire hazards analysis portion of <Appendix 9A.4> outlines fire protection for safety-related pumps. Each pump system is in a cutoff room with adequate separation from other pumps.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
demonstrate that a fire will not endanger other safety-related equipment required for safe plant shutdown. Early warning fire detection should be installed with alarm and annunciation locally and in the control room. Local hose stations and portable extinguishers should also be provided.	
Equipment pedestals or curbs and drains should be provided to remove and direct water away from safety-related equipment.	Safety-related pumps are installed on concrete pads. Adequate water drainage is provided.
Provisions should be made for manual control of the ventilation system to facilitate smoke removal if required for manual fire fighting operation.	Provisions are available for manual smoke removal if required.
12. New Fuel Area	
Hand portable extinguishers should be located within this area. Also, local hose stations should be located outside, but within hose reach of this area. Automatic fire detection should alarm and annunciate in the control room and alarm locally. Combustibles should be limited to a minimum in the new fuel area. The storage area should be provided with a drainage system to preclude accumulation of water.	Hand portable extinguishers and local hose stations are provided for this area. See the fire hazards analysis portion of <Appendix 9A.4> for further details.
The storage configuration of new fuel should always be so maintained as to	The new fuel storage racks are designed to meet this criterion.

preclude criticality for any water density that might occur during fire water application.	
13. Spent Fuel Pool Area	
Protection for the spent fuel pool area should be provided by local hose stations and portable extinguishers. Automatic fire detection should be provided to alarm and annunciate in the control room and to alarm locally.	Hand portable extinguishers and local hose stations are provided for this area. See the fire hazards analysis portion of <Appendix 9A.4> for further details.
14. Radwaste Building	
The radwaste building should be separated from other areas of the plant by fire barriers having at least 3 hour ratings. Automatic sprinklers should be used in all areas where combustible materials are located. Automatic fire detection should be provided to annunciate and alarm in the control room and alarm locally. During a fire, the ventilation systems in these areas should be capable of being isolated. Water should drain to liquid radwaste building sumps.	This criterion is met. See the fire hazard analysis portion of <Appendix 9A.4> for details.
Acceptable alternative fire protection is automatic fire detection to alarm and annunciate in the control room, in addition to manual hose stations and portable extinguishers consisting	

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
of hand held and large wheeled units.	
15. Decontamination Areas The decontamination areas should be protected by automatic sprinklers if flammable liquids are stored. Automatic fire detection should be provided to annunciate and alarm in the control room and alarm locally. The ventilation system should be capable of being isolated. Local hose stations and hand portable extinguishers should be provided as backup to the sprinkler system.	The decontamination area is protected by automatic sprinklers backed up by local hose stations and hand portable extinguishers.
16. Safety-Related Water Tanks Storage tanks that supply water for safe shutdown should be protected from the effects of fire. Local hose stations and portable extinguishers should be provided. Portable extinguishers should be located in nearby hose houses. Combustible materials should not be stored next to outdoor tanks. A minimum of 50 feet of separation should be provided between outdoor tanks and combustible materials where feasible.	See portion of fire hazards analysis <Appendix 9A.4> pertaining to condensate storage tank.
17. Cooling Towers	
Cooling towers should be of noncombustible construction or so located that a fire will not	Cooling towers are of mostly noncombustible construction with a small percentage of PVC fill and other combustibles in the

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
adversely affect any safety-related systems or equipment. Cooling towers should be of noncombustible construction when the basins are used for the ultimate heat sink or for the fire protection water supply.	Unit 1 tower. This tower is located more than 500 ft from any buildings containing safety related equipment and will not present an exposure to these buildings. The basins are not used as the ultimate heat sink or as the permanent fire protection water supply.
18. Miscellaneous Areas	
Miscellaneous areas such as records storage areas, shops, warehouses, and auxiliary boiler rooms should be so located that a fire or effects of a fire, including smoke, will not adversely affect any safety-related systems or equipment. Fuel oil tanks for auxiliary boilers should be buried or provided with dikes to contain the entire tank contents.	This criterion is complied with; see the fire hazards analysis portion of <Appendix 9A.4> for details of individual situations.
G. Special Protection Guidelines	
1. Welding and Cutting, Acetylene - Oxygen Fuel Gas Systems	
This equipment is used in various areas throughout the plant. Storage locations should be chosen to permit fire protection by automatic sprinkler systems. Local hose stations and portable equipment should be provided as backup. The requirements of NFPA 51 and 51B are applicable to these hazards. A permit system should be required to utilize this equipment. (Also refer to 2f herein.)	The company will comply.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
2. Storage Areas for Dry Ion Exchange Resins	
Dry ion exchange resins should not be stored near essential safety-related systems. Dry unused resins should be protected by automatic wet pipe sprinkler installations. Detection by smoke and heat detectors should alarm and annunciate in the control room and alarm locally. Local hose stations and portable extinguishers should provide backup for these areas. Storage areas of dry resin should have curbs and drains. (Refer to NFPA 92M, "Waterproofing and Draining of Floors.")	The resins to be used are the wet type; The company will not be be using dry ion exchange resins at PNPP.
3. Hazardous Chemicals	
Hazardous chemicals should be stored and protected in accordance with the recommendations of NFPA 49, "Hazardous Chemicals Data."	Hazardous chemicals will be controlled by Plant Administrative procedures and instructions.
Chemical storage areas should be well ventilated and protected against flooding conditions since some chemicals may react with water to produce ignition.	The company will comply.

Position For Plants Which Have Application Docketed But Construction Permit Not Received As Of 7/1/76	Applicant Response
4. Materials Containing Radioactivity	
Materials that collect and contain radioactivity such as spent ion exchange resins, charcoal filters, and HEPA filters should be stored in closed metal tanks or containers that are located in areas free from ignition sources or combustibles. These materials should be protected from exposure to fires in adjacent areas as well. Consideration should be given to requirements for removal of isotopic decay heat from entrained radioactive materials.	The company will comply, except where a fixed automatic suppression system has been evaluated adequate for nonmetal containers.

9A.6 POINT-BY-POINT COMPARISON

This section contains a point-by-point comparison with <10 CFR 50, Appendix R>.

Appendix R. Requirements	Applicant Response
II.A, Fire Protection Program	Comply; see <Appendix 9A.5> Pages 9A.5-2 through 9A.5-6. PNPP will follow the fire protection program outlined in the NRC staff supplemental guidance "Nuclear Plant Fire Protection Functional Responsibilities, Administrative Controls and Quality Assurance," dated August 29, 1977.
II.B, Fire Hazards Analysis	Comply; see <Appendix 9A.3>, and <Appendix 9A.4>.
II.C, Fire Protection Features	Comply; see <Appendix 9A.3>, <Appendix 9A.4> and PNPP-FSAR Section 9.5.1 and Section 13.1.
II.D, Alternative or Dedicated Shutdown Capability	Comply; see <Appendix 9A.3> and <Appendix 9A.4.1>.
III.A, Water Supplies for Fire Suppression Systems	A. Two separate fire pumps are provided, taking suction from Lake Erie. The arrangement of the pumps, piping and valves meets the requirements of this section as confirmed by the Safety Evaluation Report.
III.B, Sectional Isolation Valves	B. The arrangement of the sectional isolation valves meets the requirements of this section as confirmed by the Safety Evaluation Report.

Appendix R. Requirements	Applicant Response
III.C, Hydrant Isolation Valves	C. Hydrant isolation valves are provided and meet the requirements of this section as confirmed by the Safety Evaluation Report.
III.D, Manual Fire Suppression	D. Standpipe and hose systems are installed. CEI letters dated August 31, 1982, September 20, 1982, and December 29, 1982, identified the locations of fire hoses and documented hydraulic calculations that justify the use of smaller-than-required pipe sizes for the standpipe system. The standpipe and hose systems meet the requirements of this section as confirmed by Supplement 3 to the Safety Evaluation Report, Item 9.5.1.5.3.
III.E, Hydrostatic Hose Tests	E. The company will comply; hoses will be tested according to Periodic Test Instruction PTI-P54-P00005.
III.F, Automatic Fire Detection	F. Automatic fire detection systems have been provided in all areas containing safety-related systems except for the areas identified in our deviation letters PY-CEI/NRR-0261L, PY-CEI/NRR-0342L, and EPID L-2019-LLA-0292.
III.G, Fire Protection of Safe Shutdown Capability	G. The provision of separation, barriers, fire detection, and fire suppression is in accordance with these requirements with the exception of those deviations which were provided in PY-CEI/NRR-0261L dated June 12, 1985.

Appendix R. Requirements	Applicant Response
III.H, Fire Brigade	H. The company will comply as documented in CEI letter dated April 29, 1982, and March 25, 1985. Fire Brigade Program accepted in August 20, 1985, letter from Youngblood to Edelman.
III.I, Fire Brigade Training	I. The company will comply as documented in CEI letter dated April 29, 1982, and March 25, 1985.
III.J, Emergency Lighting	J. 8-hour battery powered emergency lighting is provided outside the control room in areas necessary for safe shutdown operations by personnel, and access and egress routes to those areas, as documented in our revised response to FSAR Q&R 430.11, documented in PY-CEI/NRR-0320L.
III.K, Administrative Controls	K. The company will comply as documented in CEI letter dated April 29, 1982 <Appendix 9A.5-6>
III.L, Alternative and Dedicated Shutdown Capability	L. <Section 7.4.1.4> of the USAR describes the remote shutdown control panel's design and capability. Analysis has shown that in the event of any control room fire, safe shutdown can be accomplished with a combination of the remote shutdown panel and operator actions as specified in the Capability Report.

Appendix R. Requirements	Applicant Response
III.M, Fire Barrier Cable Penetration Seal Qualification	M. Three hour rated penetration seals tested in accordance with ASTM-E119 are provided as documented in CEI letters dated August 31, 1982, and September 20, 1982. This was confirmed as meeting the requirements of this section in Supplement 3 to the Safety Evaluation Report, Item 9.5.1.4.1. Penetration sealing inside conduit will follow engineering criteria provided in our August 7, 1985, letter PY-CEI/NRR-0304L.
III.N, Fire Doors	N. The provision of fire doors was confirmed as meeting the requirements of this section in the Safety Evaluation Report, Item 9.5.1.4.1. Fire doors associated with safe shutdown fire areas will either be U.L. labeled or tested by a certified laboratory. This program was completed as noted in our September 12, 1985, letter PY-CEI/NRR-0342L.
III.O, Oil Collection System for Reactor Coolant Pump	O. This item is not required for Perry since it is not applicable as confirmed in Item 9.5.1.6.1 of the Safety Evaluation Report.

9A.7 DEVIATIONS FROM REGULATORY GUIDANCE

Deviations from <10 CFR 50, Appendix R>

This section presents the deviations from Sections III.F, III.G and III.J of <10 CFR 50, Appendix R> that were submitted to NRR on June 12, 1985, in PY-CEI/NRR-0261L, including editorial corrections which were subsequently discussed with the staff. The same letter also provided a summary table of all deviations from <10 CFR 50, Appendix R>, including earlier deviation requests which were being withdrawn/corrected. That table is reproduced in this section also as an index for easy reference. Corrections to the table have been included, bringing the table up to current status. Subsequent deviation modifications will be incorporated into this section.

The bases for the approved deviations from Sections III.F, III.G and III.J of <10 CFR 50, Appendix R> are presented on Pages 9A.7 F, 9A.7 G, and 9A.7 J respectively.

Deviations from Branch Technical Position APCSB 9.5-1

Between 1982 and 1985, nine (9) requests for deviation from the requirements of Branch Technical Position APCSB 9.5-1 were submitted to NRR for approval. The acceptance of these deviations has been documented by NRR in their SSER 4, SSER 7, and SSER 8.

A summary table of the granted deviations has been compiled which provides a brief description of the deviation; the specific SSER(s) that accepted the deviation; and the correspondence that provided the technical bases for that deviation. This table is provided as an addendum to the summary table of the <10 CFR 50, Appendix R> deviations.

Deviations Reviewed Under the Perry Operating License Condition

The Perry Operating License Condition 2 C (6) a. states "Energy Harbor Nuclear Corp. may make changes to the approved fire protection program without prior approval of the Commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire." The specific features of the approved program can be altered provided that the changes do not otherwise involve a change in a license condition or result in an unreviewed safety question, and the changes do not result in failure to complete the fire protection program as approved by the Commission. A list of these deviations has been compiled which provides a brief description of the deviation. The list describes the documents that initiated the deviation and analyzed the effects of the change on the fire protection program.

INDEX TO

Deviations from <10 CFR 50, Appendix R>

Section III G - Safe Shutdown

No.	Fire Zone/Area	Deviation	Status	Correspondence
1.	CC-1a, 1b, 1c	1 hour wrap barrier to barrier. Area wide suppression 20 ft separation	Accepted SSER 3/7	6/16/82 letter, Attachment I, PY-CEI/NRR-0261L
2.	CC-2a, 2b, 2c	1 hour wrap barrier to barrier	SSER 7	PY-CEI/NRR-0261L
3.	CC-3e	Suppression	Accepted SSER 3/7	6/16/82 letter, Attachment II, PY-CEI/NRR-0261L
4.	1CC-6	Suppression	Accepted SSER 3/7	6/16/82 letter, Attachment III, PY-CEI/NRR-0261L
5.	(Deleted)			
6.	DG-1d	Suppression	Accepted SSER 3/7	6/16/82 letter, Attachment IV, PY-CEI/NRR-0261L
7.	IB-2,3,4	Lack of 3 hour cutoff. Area wide suppression	Accepted SSER 3/7	6/16/82 letter, Attachment V, PY-CEI/NRR-0261L
8.	ESW-1a	Suppression	Accepted SSER 3/7	6/16/82 letter, Attachment VI, PY-CEI/NRR-0261L
9.	1AB-1b,3a	Suppression	Accepted SSER 7	PY-CEI/NRR-0261L
10.	1AB-1e,3b	Partial Suppression	Accepted SSER 7	PY-CEI/NRR-0261L

INDEX (Continued)

Deviations from <10 CFR 50, Appendix R>
Section III G - Safe Shutdown

No.	Fire Zone/Area	Deviation	Status	Correspondence
11.	1AB-1c,2	Partial Suppression	Accepted SSER 7	PY-CEI/NRR-0261L
12.	1AB-1g	Suppression 20 ft separation of equipment	Accepted SSER 7	PY-CEI/NRR-0261L
13.	1RB-1a, 1b, 1c, 1d	3 hour rated barriers (Not a deviation)	Accepted SSER 7	PY-CEI/NRR-0261L
14.	CC-6	Suppression	Accepted SSER 8	PY-CEI/NRR-0412L

Deviations from <10 CFR 50, Appendix R>
Section III F - Fire Detection

1.	1AB-1a	No Detection	Accepted SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
2.	1AB-1d	No Detection	Accepted SSER 4/7	3/24/83 letter, PY-CEI/NRR-0261L
3.	1AB-1f	No Detection	Accepted SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
4.	IB-1	Partial Detection	Accepted SSER 7	3/24/83 letter, PY-CEI/NRR-0261L
5.	IB-5	Partial Detection	Accepted SSER 7	3/24/83 letter, PY-CEI/NRR-0261L
6.	Steam Tunnel	No Detection	Accepted SSER 4/7	3/24/83 letter, PY-CEI/NRR-0261L
7.	Turbine Bldg.	No Detection	Accepted SSER 4/7	3/24/83 letter, PY-CEI/NRR-0261L
8.	Aux. Boiler	No Detection	Accepted SSER 4	3/24/83 letter, PY-CEI/NRR-0261L

INDEX (Continued)

Deviations from <10 CFR 50, Appendix R>
Section III F - Fire Detection

No.	Fire Zone/Area	Deviation	Status	Correspondence
9.	Heater Bay	No Detection	Accepted SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
10.	1RB-1a	No Detection	Accepted SSER 7	3/24/83 letter, PY-CEI/NRR-0261L
11.	1RB-1b	Partial Detection	Accepted SSER 7	3/24/83 letter, PY-CEI/NRR-0261L
12.	CCSTW	No Detection	Accepted SSER 7	PY-CEI/NRR-0261L
13.	Radwaste	No Detection	Accepted SSER 7	PY-CEI/NRR-0261L
14.	1CC-638/634	No Detection	Withdrawn SSER 4	9/12/85 letter, PY-CEI/NRR-0342L
15.	1DG-1a	No Detection	Withdrawn SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
16.	1DG-1b	No Detection	Withdrawn SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
17.	1DG-1c	No Detection	Withdrawn SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
18.	Offgas Bldg.	No Detection	Withdrawn SSER 4	3/24/83 letter, PY-CEI/NRR-0261L
19.	1RB-1c	No Detection	Accepted Amd. 150	7/9/20 letter, EPID L-2019-LLA-0292

Deviations from <10 CFR 50, Appendix R>
Section III J - Emergency Lighting

1.	1CC-5a (Control Rm)	Emergency DC lighting	Accepted SSER 7	PY-CEI/NRR-0261L

Deviations from Branch Technical Position APCSB 9.5-1

No.	Area	Deviation	Status	Correspondence
1.	All	Plant specific sealing criteria is being used to meet the requirement to provide internal seals for conduits penetrating fire barriers.	Accepted SSER 7	PY-CEI/NRR-0234L PY-CEI/NRR-0278L PY-CEI/NRR-0304L
2.	Turbine Building	Two hour rated exterior fire barrier walls are provided within 50 feet of oil filled trans- formers in lieu of the required three hour rated barrier walls.	Accepted SSER 7	PY-CEI/NRR-0342L
3.	Turbine and Offgas Buildings	A non-UL Listed fire damper assembly is installed in the fire barrier separating the offgas and turbine buildings.	Accepted SSER 8	PY-CEI/NRR-0395L
4.	Turbine Building	Hydrogen piping is routed in the turbine building, which con- tains safety-related circuits.	Accepted SSER 7	PY-CEI/NRR-0342L
5.	NA	The automatic sprinkler system alarm supervisory signals do not distinc- tively indicate the particular trouble function in accordance with NFPA 72D. However, the supervisory system provides a system trouble alarm in the control room, and a distinctive function alarm at the local control panel.	Accepted SSER 7	PY-CEI/NRR-0243L
6.	Drywell	Two hundred feet of fire hose will be used to reach the drywell inside containment.	Accepted SSER 7	PY-CEI/NRR-0342L

INDEX (Continued)

Deviations from Branch Technical Position APCSB 9.5-1

No.	Area	Deviation	Status	Correspondence
7.	Control Room	Carpet (NFPA Class I Interior Floor Finish) is installed in the control room.	Accepted SSER 7	PY-CEI/NRR-0322L
8.	Control Room	Ionization detectors are not provided inside three non safety-related control room cabinets; However, area-wide ionization detection is provided.	Accepted SSER 7	PY-CEI/NRR-0342L PY-CEI/NRR-0356L
9.	Control Complex	Use and Configuration of the Gypsum Board fire barrier walls and ceilings in the control complex.	Accepted SSER 4/7	PY-CEI/NRR-0026L PY-CEI/NRR-0330L

Site Reviewed Deviations from Branch Technical Position APCSB 9.5-1

No.	Area	Deviation	Evaluation
1.	Control Complex Control Room	Reliance on repairs in order to get the plant to Hot Shutdown for a fire in the Control Room. Spurious operation of some valves may require fuse replacement to restore the functions of the valves.	Analysis documented in Calculation SSC-001, "Safe Shutdown Capability Report" Rev. 4. 10 CFR 50.59 Screen 05-05441.
2.	Control Complex Unit 2 Areas	Structural steel supporting fire barriers is not protected to provide fire resistance equivalent to that required of the barrier due to missing sections of pyrocrete.	Analysis documented in Calculation P54-032, "Analysis of Missing Pyrocrete in Control Complex 620' Elevation" Rev. 0. 10 CFR 50.59 Screen S04-01413 for USAR Change Request.

(Deleted)

Deviations to <10 CFR 50, Appendix R>

Sections III F, G and J

Perry Nuclear Power Plant (PNPP)

Introduction

The PNPP fire protection program is described in the Fire Protection Evaluation Report (FPER) which was originally issued on October 28, 1976. Deviation requests pursuant to <10 CFR 50, Appendix R>, Section III F and G had been previously granted based on FPER Revision 2 and our deviation request letters of June 16, 1982, and March 24, 1983, as noted in SSER 4.

In light of subsequent Commission guidelines on safe shutdown contained in <Generic Letter 83-33> and <Generic Letter 84-09>, the safe shutdown analysis was re-evaluated. Compliance with <10 CFR 50, Appendix R> III G was re-analyzed and existing deviation requests were modified or new deviations identified as submitted in PY-CEI/NRR-0261L. These revised/resubmitted deviation requests were accepted as noted in SSER 7.

The PNPP safe shutdown model is summarized in FPER <Appendix 9A.3>, <Appendix 9A.3.2> identifying those systems or portions of systems required for safe shutdown. The model is also represented by <Figure 9A.7-1> of this Introduction. <Appendix 9A.3> lists by fire area all individual components within those systems that are required for safe shutdown. <Appendix 9A.4> provides an area by area Fire Hazards analysis which includes a summary profile of the safe shutdown analysis for that area including how compliance is attained.

Our approach to preparing <10 CFR 50, Appendix R> III G deviation requests was to follow the format originally requested by NRR and to utilize a systematic evaluation technique in identifying each deviation.

After the identification of safe shutdown equipment was compiled the following steps were undertaken:

- Safe shutdown components and circuits within each Fire Area were identified to determine if equipment of both redundant methods of shutdown were located within a common area. Included were associated circuits which could affect operation of safe shutdown equipment.

- Those areas which contained redundant methods of safe shutdown components and/or circuits required for hot shutdown were evaluated for compliance with the separation, suppression and detection requirements of <10 CFR 50, Appendix R> III G.

- Within a fire area containing area redundant components required for cold shutdown, procedural changes were undertaken to compensate for the affects of fire on the circuits or components if they did not comply with <10 CFR 50, Appendix R> III G.

- Plant modifications were undertaken where evaluation indicated that a postulated fire could affect both divisions of redundant equipment. In cases where it was determined that the modifications provided an equivalent level of protection for redundant trains of safe shutdown equipment, although not in strict accordance with <10 CFR 50, Appendix R> III G, a deviation has been requested.

- In cases where it was determined that the existing features provided an adequate level of protection to ensure safe shutdown, a deviation has been requested.

To clarify terminology the following terms are defined as used within the deviation requests:

- Safe shutdown components refers to devices whose function affects the ability to achieve shutdown.

- Safe shutdown circuits refers to electrical cabling for safe shutdown components or those associated circuits which can affect proper function of safe shutdown components.

- Safe shutdown equipment consists of components and circuits required for safe shutdown.

- A Fire Area is defined as an area separated from other areas by barriers with a 3 hour rating.

- A 3 hour rated barrier indicates wall construction is either a 3 hour rated construction or a configuration previously reviewed and accepted as a satisfactory subdivision between areas in SSER Section 4.9.5.1.4.1. Openings in the walls are protected by features with equivalent rating, except for inside conduit penetrations 4 in. or less in diameter.

- A Fire Zone is defined as a subdivision within an area which is separated from other zones by partial barriers or has been defined for analysis purposes.

* Fire suppression systems described within the deviations meet the applicable requirements of NFPA 13. The coverage is provided throughout the area or zone as described. Where partial area or zone coverage is provided, the extent of coverage or exceptions to area wide coverage is indicated in this submittal and <Appendix 9A.4>.

* Fire detection described as "provided throughout a Fire Area" indicates detectors are located and spaced in accordance with NFPA 72E, with the type of detector provided appropriate for the hazard within the Fire Area. For Fire Zones or Areas with partial detection, a deviation has been requested from <10 CFR 50, Appendix R> III F. These areas are indicated and a description of the extent of area coverage is described in the <10 CFR 50, Appendix R> III F deviation requests.

* Fire extinguishers have been provided and are located in accordance with NFPA 10.

* Fire hoses are located within Fire Zones or Fire Areas as noted. The hose station installations are in accordance with NFPA 14, except as noted within deviation descriptions or as accepted in SSER 3 Section 9.5.1.5.3.

* Basically, two redundant channels of equipment for power and control exists throughout the plant. These are referred to as Division 1 and Division 2. There is also a Division 3 train of power and control.

A similar characterization, Method A and Method B, was utilized in the detailed re-examination of safe shutdown as described below:

Method A

Method A utilizes systems powered from Division 1 power sources. For reactor shutdown, Method A will utilize Outputs A and C of the Reactor Protection System (RPS) and the control rod drive system. These systems will be backed by the ability of the operator to manually scram and initiate safe shutdown systems. In terms of <10 CFR 50, Appendix R>, Section III L requirements, reactivity control is provided by the RPS and control rod drive system.

For depressurization and initial core cooling, Method A will utilize a combination of safety relief valves, with either Reactor Core Isolation Cooling System (RCIC) or the Low Pressure Core Spray System (LPCS). Reactor system overpressure control will be provided by the safety relief valves. The RCIC system utilizes containment isolation valves powered from Division 2 power sources. In the event of a fire which disables the Division 2 power sources and associated control circuits to these valves, the Low Pressure Core Spray System (LPCS) would provide reactor coolant inventory control.

For shutdown utilizing RCIC, depressurization is provided initially by steam discharge to the RCIC system. Reactor coolant inventory will be controlled by the RCIC. As the level is restored, shutdown will proceed by operation of the relief valves to reduce reactor system pressure and temperature until RCIC cut-off. If LPCS is utilized for inventory control, depressurization is provided initially by the Automatic Depressurization System/Safety Relief Valves (ADS/SRV). The ADS/SRVs will be manually controlled by the operator, if automatic functioning has not yet taken place, to depressurize the reactor coolant system to LPCS cut in.

During the depressurization process, the suppression pool cooling mode of RHR could be initiated to control suppression pool temperature. At approximately 135 psig, the shutdown cooling mode of RHR would be initiated, thereby achieving cold shutdown. Extended core cooling (decay heat removal) is provided by either the shutdown cooling mode of RHR or the alternate shutdown cooling path for the vessel through the ADS/SRV valves.

Except as noted above, Method A utilizes Division 1 components and circuits. The support system utilized will be the train that is powered from Division 1 sources. Also included are non-divisional circuits which have been analyzed as affecting safe shutdown to associated circuit concerns.

Method B

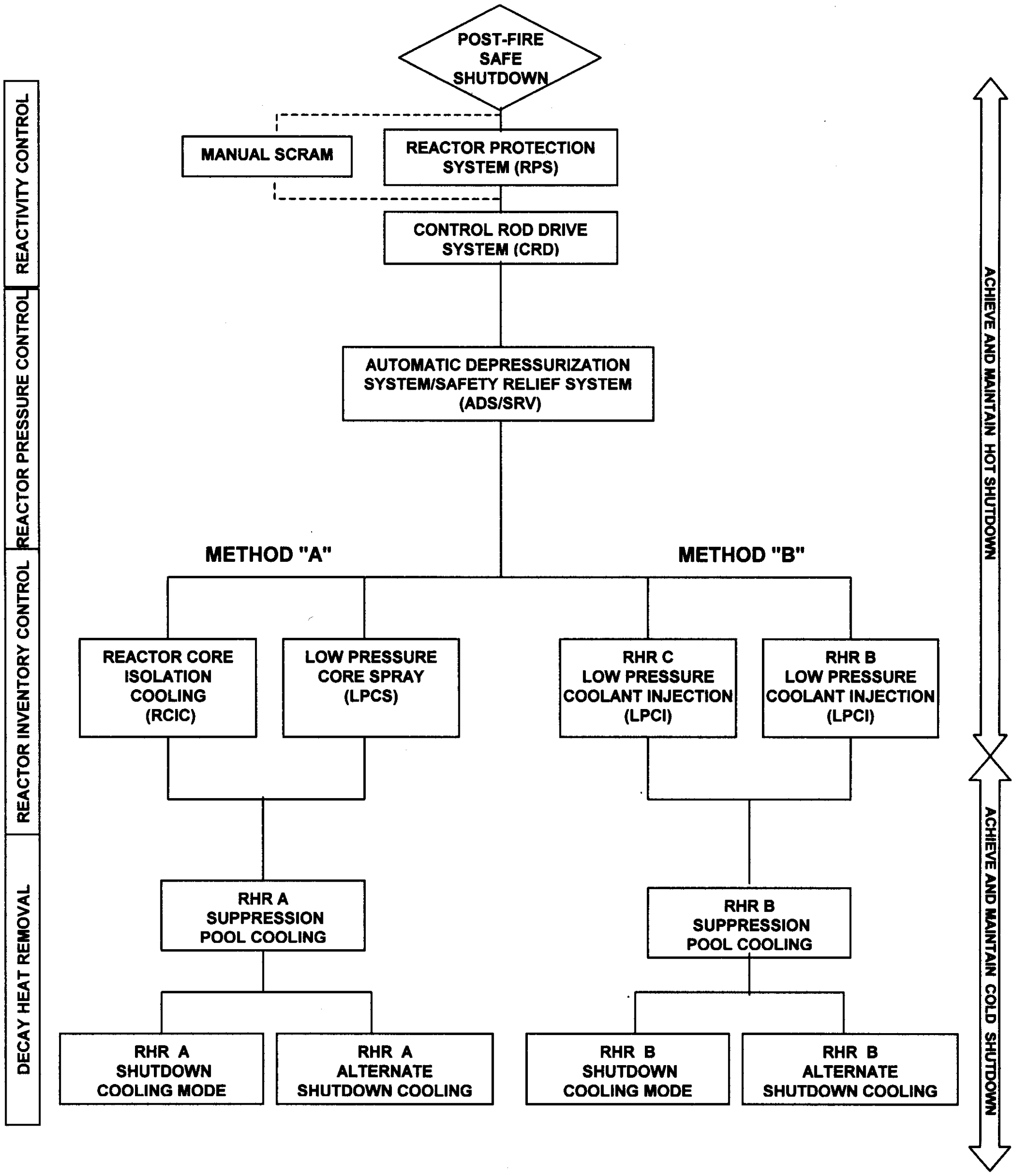
Method B utilizes systems power from Division 2 power sources. For reactor shutdown, Method B will utilize Outputs B and D of the Reactor Protection (RPS) and the control rod drive system. These systems will be backed by the ability of the operator to manually scram and initiate safe shutdown systems. In terms of <10 CFR 50, Appendix R>, Section III L requirements, reactivity control is provided by the RPS and the control rod drive system.

For depressurization and initial core cooling, Method B will utilize a combination of the Automatic Depressurization System (ADS) and the Low Pressure Coolant Injection (LPCI) system. The ADS will be manually controlled by the operator, if automatic functioning has not yet taken place, to depressurize the reactor coolant system to LPCI cut in. Train “C” of RHR will be utilized in the LPCI mode to restore reactor water level. During the depressurization process as level is restored, suppression pool cooling from Train “B” or RHR could be initiated to control suppression pool temperature. For some fire scenarios, which disable the Division 2 power and associated control circuits for LPCI components, the Train “B” of RHR is utilized for reactor inventory control and suppression pool cooling.

As cooldown proceeds, the shutdown cooling mode of RHR would be initiated, thereby achieving cold shutdown. Extended core cooling (decay heat removal) is provided by either the shutdown cooling mode of RHR or the alternate shutdown cooling path for the vessel through the ADS valves.

The support systems utilized will be the train that is powered from Division 2 sources. The Method B systems depend on either Division 2 power sources or non-divisional power sources. Loss of non-divisional sources will result in the respective components failing to a safe position.

Method B utilizes Division 2 components and circuits. The support systems utilized will be the train that is powered from Division 1 sources. Also included are non-divisional circuits which can affect safe shutdown due to associated circuit concerns.



(Rev. 14 10/05)

Safe Shutdown Model

Figure 9A.7-1

DEVIATION TO <10 CFR 50, APPENDIX R>

SECTION III F, AUTOMATIC FIRE

DETECTION FOR PNPP

<10 CFR 50, Appendix R>, Item III F states the requirement for provision of automatic fire detection systems in all areas that contain or present an exposure fire hazard to safe shutdown or safety-related equipment or components. In view of this requirement, CEI has identified all of the areas not presently committed to a detection system that fall in this category. Currently, existing systems provide early warning detection for many of these areas. Also identified were areas where partial detection coverage was provided.

During our evaluation of the Unit 1 areas affected by this requirement, we have identified some areas in which the fire loading and/or the potential of an uncontrolled fire is so low that the addition of a fire detection system would not significantly increase the level of fire safety.

HVAC system detectors are designed and UL listed to function in the high air velocities present in duct installations, and are arranged to give reasonable assurance that a fire would be detected in a timely manner.

Manual hose stations and portable fire extinguishers are provided throughout all areas of the plant.

In addition, fixed suppression systems have been installed over areas or portions of areas with significant combustible loading or fire hazards.

1. Fire Area 1AB-1a

   This area contains process and auxiliary components for the Low Pressure Core Spray (LPCS) System. These components consist of Safety Class 2 piping, a Safety Class 3 HVAC unit and the safety-related circuits in conduit associated with the independent HVAC unit provided for the LPCS system. This fire area is separated from other areas of the building by fire barriers having a 3 hour fire resistance rating. The fire loading in this room is extremely low, approximately 13,000 Btu/ft^2. The safety-related equipment in the room is associated with the LPCS system and is not required for normal plant shutdown. The entire function of the LPCS system could be completed by the RHR system which is located in a separate fire area.

Smoke detectors are provided in the common duct of the supply fans and on the common ductwork on the discharge of the exhaust fans. Upon detection of smoke, these detectors will actuate an alarm in the control room and illuminate the alarm light on the local HVAC control panel.

In addition to the HVAC system smoke detectors already mentioned, this area has thermal sensor protection which alarms on high temperature conditions.

Therefore, because of the extremely low fire loading, a fire severity of less than 15 minutes, the fire rated enclosure, the type of equipment (piping, HVAC unit and wiring in conduit) in the area, and the fire detection and protection already provided, we do not believe that a separate fire detection system is warranted.

2. Fire Area 1AB-1d

This fire area contains process and auxiliary components for the Residual Heat Removal (RHR) "C" System. These components consist of Class 3 piping and safety-related circuits in conduit associated with the independent HVAC unit provided for the RHR "C" pump. This fire area is separated from other areas of the building by fire barriers having a 3 hour fire resistance rating. The fire loading in this area is low, approximately 25,000 Btu/ft^2.

The safety-related equipment in this room is associated with the RHR "C" system. The entire function of this system could be completed by the RHR "A" or RHR "B" systems which are located in separate fire areas.

Equipment in this Fire Area is required for safe shutdown in the event of a fire in the Division 1 systems.

Smoke detectors are provided in the common duct of the supply fans and on the common ductwork on the discharge of the exhaust fans. Upon detection of smoke, these detectors will actuate an alarm in the control room and illuminate the alarm light on the local HVAC control panel.

In addition to the HVAC smoke detection already mentioned, this area has thermal sensor protection which alarms on high temperature conditions.

Therefore, because of the very low fire loading, a fire severity of less than 20 minutes, the fire rated enclosure, the type of equipment (piping, HVAC unit and wiring in conduit) in the area, and the fire detection and protection already provided, we do not believe that a separate fire detection system is warranted.

3. Fire Area 1AB-1f

This area contains process and auxiliary components for the High Pressure Core Spray (HPCS) System. These components consist of safety-related circuits in conduit associated with the independent HVAC unit, Safety Class 2 piping and safety-related Division 3 instrumentation. There is no safe shutdown equipment located in this fire area. This fire area is separated from other areas of the building by fire barriers having a three-hour fire resistance rating. The fire loading in this room is very low, approximately 22,000 Btu/ft^2.

The safety-related equipment in this room is associated with the HPCS system and is not needed for normal plant shutdown. The entire function of the HPCS system could be completed by the RCIC system which is located in a separate fire area.

Smoke detectors are provided in the common duct of the supply fans and on the common ductwork on the discharge of the exhaust fans. Upon detection of smoke, these detectors will actuate an alarm in the control room and illuminate the alarm light on the local HVAC control panel.

In addition to the HVAC smoke detection already mentioned, this area has thermal sensor protection which alarms on high temperature conditions.

Therefore, because of the very low fire loading, a fire severity of approximately 20 minutes, the fire rated enclosure, the type of equipment (piping, HVAC unit and wiring in conduit) in the area, and the fire detection and protection already provided, we do not believe that a separate fire detection system is warranted.

4. Fire Zone IB-1

This fire zone contains equipment for the liquid radwaste, service air, fuel pool cooling and cleanup, and the reactor building chilled water systems. This equipment includes safety-related ductwork, cable trays, wiring in conduit, and Safety Class 3 pipe. There is no safe shutdown equipment located in this area. This fire zone is separated from other areas of the building by fire barriers having a 3 hour fire resistance rating, with the exception of the rattle space at each reactor building interface which is not sealed. The fire loading in the zone is extremely low, approximately 16,000 Btu/ft^2.

The safety-related equipment in this area is not needed for normal plant shutdown.

Fire detectors have been provided over portions of this zone which contain safety-related equipment. This covers about 60-70% of the total zone area and represents coverage of significant fire potential. Combustible cabling is in conduit throughout the area. Portions of the area without detection include the pipe chase and hallway.

Because of the very low fire loading, a fire severity of approximately 15 minutes, the fire rated enclosure, the type of equipment (ductwork, wiring in conduit and piping) in the area, and the fire detection and protection already provided, we do not believe that a zone wide fire detection system is required.

5. Fire Zone IB-5

This zone contains ventilation equipment for the intermediate and the fuel handling building. This equipment includes safety-related Division 1 and Division 2 instrumentation, motor control center and HVAC ductwork. No safe shutdown equipment is located in this area. This fire zone is separated from other areas of the building by fire barriers having a three-hour fire resistance rating with the exception of the rattle space at the reactor building interface which is not sealed. The fire loading in the room is extremely low, approximately 12,000 Btu/ft^2.

The safety-related equipment in this area is not needed for normal plant shutdown.

Fire detection has been provided over the safety-related cable trays between column IB-1 and IB-2, inside the charcoal filter plenums and in the plenum rooms. This provides detection coverage over the significant combustibles in this zone.

Therefore, because of the very low fire loading, a fire severity of less than 15 minutes, the fire rated enclosure, the type of equipment (ductwork, combustible cables, wiring in conduit, and piping) in the area, and the fire detection already provided, we do not believe that area wide fire detection system is warranted for this zone.

6. Steam Tunnel - Unit 1

The steam tunnel houses main steam, feedwater and other major pipes extending from the reactor building. This area contains redundant safe shutdown valving, safety-related Division 1, Division 2, Division 3, and Division 4 instrumentation, safety class piping, and safety-related circuits in conduits. Negligible combustibles exist in this area. This fire area is separated from other areas by fire barriers having a three-hour fire resistance rating with the exception of the turbine building.

The turbine building is open to the north end of the steam tunnel on the 593’ elevation with only a partial missile shield separating the two buildings. There are limited combustibles within 60 feet of the opening, with the majority of the combustible load in the turbine building located in fire rated cut off rooms or in areas remote from this opening. The combustible loading in the steam tunnel is at the south end, 40 ft from the common opening, with a fire load of less than 10,000 Btu/ft^2.

Therefore, because of the negligible fire loading, the fire rated enclosure, the type of equipment found in the area, a fire severity of less than 10 min, and separation from adjacent areas, we do not believe that a separate fire detection system is required.

7. Turbine Building - Unit 1

The building houses the turbine generator and auxiliary systems. This area contains safety-related circuits in conduit, Division 1, Division 2, Division 3, and Division 4 instrumentation and HVAC ductwork. No safe shutdown equipment is located in this building. The turbine building is separated from other buildings by fire barriers having a three-hour fire resistance rating with the exception of the steam tunnel. The turbine building is open at the north end of the steam tunnel on the 593’ elevation with only a partial missile shield separating the two buildings. The safety-related and safe shutdown equipment in the steam tunnel is located at the south and, 60 ft from the common opening. The significant fire hazards in the turbine building are remote from this opening or are located in the fire rated enclosures.

The major fire hazards located in this area are comprised of the oil required for turbine bearing lubrication and cooling, and oil for the generator hydrogen seals. These hazards are effectively protected by various fire protection systems including low pressure carbon dioxide systems, wet pipe sprinkler systems (for all areas below the operating floor) and water spray systems for the hydrogen seal oil unit and turbine generator bearings. With the exception of four pressure transmitters located above Elevation 647’-6”, all safety-related ductwork, instrumentation and circuits are located below the operating floor.

Actuation of the suppression system will result in an alarm to the control room. For the preaction, deluge and CO_2 systems, this is initiated by fire detectors throughout protected area. Portions of the turbine building not provided with suppression systems have a very low combustible loading, which is spread out over a large building area. Most areas have high ceilings, and detectors would not respond to the small fires resulting from the limited fire load.

Therefore, because of the fire detection associated with protection provided for the combustibles in the building, the type of equipment found in the area, and the fire rated enclosure, we do not believe that a separate fire detection system is required.

8. Auxiliary Boiler Building

The auxiliary boiler building houses the auxiliary boiler, piping and other equipment associated with the auxiliary boiler system. There is no safe shutdown equipment located in this area. This area contains HVAC ductwork. The auxiliary boiler building is separated from other buildings by fire barriers having a three-hour fire resistance rating. Combustibles in the area consist of fuel oil and limited combustible cable insulation. An automatic sprinkler system protects the entire building.

Therefore, because of the fire detection and protection provided for the combustibles in the building, the type of equipment found in the area, and the fire rated enclosure, we do not believe that a separate fire detection system is required.

9. Heater Bay - Unit 1

The heater bay contains heaters associated with the condensate, feedwater and building heating systems. This area contains safety-related Division 2, Division 3 and Division 4 instrumentation. There is no safe shutdown equipment located in this area. The heater bay is separated from other buildings by fire barriers having a three-hour fire resistance rating.

Combustibles within the heater bay include cable insulation, motor winding insulation and lubricating oil. Fire suppression equipment for this building consists of a preaction water spray system for the feedwater pump-turbine lubricating oil area.

Therefore, because of the fire detection and protection provided for the combustibles in the building, the type of equipment found in the area, and the fire rated enclosure, we do not believe that a separate fire detection system is required.

10. Reactor Building - 1RB-1a

The annulus, located between the containment vessel steel liner and environmental shield wall, has pipe and electrical cables passing through this area to and from the reactor building to other areas of the plant. The environmental shield wall has a 3 hour fire resistance rating. The steel liner is sealed to maintain the containment pressure boundary. The floor is constructed of reinforced concrete. Electrical cables are located in the area between 219° and 250° and Elevations 636’-0” and 660’-0” with the exception of wiring required for annulus lighting and a power supply for the annulus sump pump. The electrical cabling that passes through the annulus is enclosed in a Type 304 stainless steel support tube/tray system. Electrical cables are arranged such that Division 3 and Division 4 cables are separated from Division 2 and Division 3 cables by a minimum of 12 feet.

A majority of the pipe passes straight through this area. High energy lines are enclosed in guard pipes to prevent annulus pressurization in case of pipe line failure. Since all combustibles (consisting of cables) are located within a stainless steel support system and within a specific area of the annulus, it is not a significant exposure hazard to the pipe penetrations.

Systems that terminate or in some form operate in this area include:

- The MSIV Leakage Control System (E32) has been abandoned in place. The pipe that terminates in this area consists of two 3/4″ drain lines, one 3″ blower exhaust line, two 4″ blower exhaust lines, one 2-1/2″ blowdown line, and one 3″ blowdown line. The piping is capped to maintain boundary integrity of the shield wall.

- A Penetration Pressurization System (P53) which serves as a testing system which measures leakage rates from penetrations after being pressurized with air. A 3/4″ vacuum line is provided for each personnel airlock to maintain leakage control. This vacuum line terminates in the annulus.

- An Integrated Leak Rate Test System (E61) which pressurizes containment and drywell to measure leakage rates from these areas. Four 3/4″ instrument test lines and an 8″ pressurization line terminate in the annulus. These lines are provided for annulus testing.

- An Annulus Exhaust Gas Treatment System (M15) which maintains a negative pressure in the annulus to ensure that any leakage from containment would pass through this system.

- A Liquid Radwaste Sump System (G61) serves as a means to remove any liquids that may occur in the annulus area. The annulus is provided with one 25 gpm sump pump.

There are no process lines which contain combustible or flammable liquids which pass through this area.

The combustible loading for this area is comprised of cable insulation located primarily within the southwest portion of the annulus, with the exception of miscellaneous electrical wiring (as described earlier). Since the cable is contained within stainless steel support tubes, the fire loading is separated from the annulus area. If a fire were to occur, originating from the addition of administratively controlled transient combustibles to this area, smoke detectors located in the discharge ducts of the continuously operating area ventilation system would actuate alarms in the control room if smoke is detected.

Therefore, due to the location and encasement of cabling which comprises the fire loading within this area, and the fire detection already provided, we do not believe that a separate fire system is required.

11. Reactor Building 1RB-1b Above Elevation 689’-6”

This area is intended to be used during shutdown as a refueling laydown area. Safety-related systems and components located in this area include containment spray system, containment temperature elements and radiation monitors, combustible gas control systems, containment vessel and drywell purge ventilation systems.

Minimal fire loading exists in this area. Combustibles located in this area consist of approximately 259 lbs of cable insulation, 45 lbs of motor winding insulation, 68.5 gallons of lubricating oil, 239 lbs of miscellaneous supplies and 960 lbs of control panel wiring insulation. This total Btu content of 25,422,000 Btu is contained in the 7,914 ft^2 floor area. Total fire loading for this portion of the Fire Zone is approximately 3,214 Btu/ft^2 or a fire severity of less than 5 minutes.

All areas beneath the platform at 689'-6" are provided with smoke detectors. Approximately 30% of the area at Elevation 689'-6" consists of an open refueling pool which poses no fire hazard and acts as a partial fire break between the east and west laydown area.

The reactor building HVAC system design consists of six air handling units, three located on the west at Elevation 664'-7" and three located on the east at Elevation 642'-0". Each of these systems is designed to draw the return air directly into the unit without the use of ductwork. Additionally, supply air is circulated above the operating floor at 712'-3" and 742'-0" elevations. This design causes air circulation above the 689'-6" to be drawn down to the lower elevations where the air handling units are located. If a fire occurred above the 689'-6" elevation, due to the large amount of open grating that makes up this platform, smoke would pass through the grating by the natural air circulation, where detectors mounted on the underside of the 689'-6" and 664'-7" platforms would detect a fire.

Therefore, because of the extremely low fire loading, a fire severity of less than 5 minutes, the type of equipment in the area, and the fire detection and protection already provided, we do not believe that a separate fire detection system is required.

11a. Reactor Building 1RB-1c Elevations 583’, 589’, 629’

The NRC staff evaluated the proposed change to the PNPP FPP against the recommended guidelines in BTP CMEB 9.5-1, Section C.6.a and Section C.6.e, and finds abandoning the drywell general area heat detection system acceptable because:

- there are two other systems capable of detecting abnormal temperature increase within the drywell, thus defense in depth is maintained;
- there are no changes to the fire protection administrative controls, and the off-normal procedures remain the same for an investigation of a heat detector alarm in the drywell; and;
- the abandoned in place general area heat detection system is not credited in this fire zone to protect safe shutdown components and circuits.

Therefore, the NRC staff concludes that the change to the PNPP FPP has minimal impact on the three echelons of defense-in-depth: preventing fires from starting; quickly detecting and suppressing fires to limit their damage; and not preventing essential plant safety functions from being performed despite a fire considerable time laid out in BTP CEMB 9.5-1. Thus, PNPP’ FPP still satisfies defense-in-depth principles. Consequently, the staff finds that the proposed change to the PNPP FPP is acceptable because analyses and evaluations demonstrate that the safety functions of the FPP will continue to be accomplished, consistent with the requirements of 10 CFR 50.48(a)(1).

12. Fire Area CC-STW

This area consists of the stair tower in the northwest corner of the control complex. The stair tower contains safe shutdown circuits inside metal conduit at the 599’ Elevation. There are no other combustibles in this area. The combustible load is minimal. With the 100 ft elevation difference between these cables and the top of the stair tower, detection of a fire would be ineffective. Fire severity is less than 5 minutes. Due to the extremely low fire loading, severity detection is not warranted in this area.

13. Radwaste Building

The radwaste building houses equipment used in the storage and processing of liquid and solid radioactive waste.

Barriers separating adjacent buildings have 3 hour fire resistance ratings.

There is no safe shutdown equipment located in the radwaste building.

Fire detection equipment for this building consists of smoke detectors for the radwaste control room. Heat detection is provided within the charcoal filters.

The major combustibles within the radwaste building are due to chemical storage, radwaste storage, cable, and charcoal. A conservative estimate of these combustibles results in a low fire loading for the entire building. The radwaste storage area which comprises the highest combustible load is protected by a wet sprinkler system. The charcoal is contained in the filter plenums and is protected by a manual actuated deluge system.

The remaining areas have resins which are of a wet, noncombustible type and other noncombustible contents.

Actuation of the wet sprinkler system would alarm in the control room. This, along with detectors in the control room and charcoal filters provide detection capabilities in all areas with combustibles.

Due to the existing detection capabilities and extremely low combustible loading in other areas, we do not believe that additional detection is warranted.

14. Fire Area 1CC-638/654

Fire Area 1CC-638/654 is shown on <Figure 9A-15>. It consists of the elevator vestibule area at 638’-6” elevation, adjacent to the northwest stairwell in the control complex. The west wall is reinforced concrete, and the remaining walls are drywall. Walls, floor and ceiling are 3 hour rated. Doors are Class A, except for the Class B elevator door.

Safe shutdown equipment consists of nonsafety circuits which can affect safe shutdown.

Fire suppression equipment consists of water and CO_2 hose stations, and fire extinguishers, located in adjacent fire areas.

Combustibles in this fire area consist of cable insulation, totaling 2,503 lbs, and having a Btu content of 25,030,000 Btu. This material is located in three cable trays located at the north end. Combustibles contained within the 445 ft^2 floor area, yields a fire loading of 56,248 Btu/ft^2 for this fire area. The overall fire loading is not significant and does not present an exposure to other areas. There are no ignition sources in the area. Therefore, for these reasons, a separate fire detection system is not warranted.

Conclusion

Based on our evaluation, we conclude that the installation of fire detectors in the subject fire zones or areas would not significantly increase the level of fire safety for the safe operation of Perry Nuclear Power Plant, Unit 1. Therefore, we respectfully request a deviation from <10 CFR 50, Appendix R>, Section III F for the above zones or areas.

Deviations to <10 CFR 50, Appendix R>,

Section III G, Fire Protection of

Safe Shutdown Capability for PNPP

Building – Control Complex Elevation 574’10”

Fire Zone	FPER Drawing
CC-1a	<Figure 9A-6>
CC-1b	
CC-1c	

Deviations

Redundant safe shutdown components and circuits exist in the fire area and also within each zone composing the fire area. Cables of one or both divisions are wrapped so that exposed circuits of redundant divisions are separated by more than 20 ft with no intervening combustibles. However, the wrap does not extend to the fire area barriers.

There are two cases where components of one train of safe shutdown equipment cannot be separated from components and circuits of the other division by the required 20 ft. To protect these components, additional suppression in the form of fast response sprinkler heads will be provided directly over these components and the intervening area. (Note that modifications to the facility have physically removed components and/or spared in place circuits rendering the valve(s) only capable of manual operation. In these cases (Fire Zone CC-1c), the dedicated protection via fast response sprinkler heads is no longer required.)

In addition, suppression will be provided in the area over the safe shutdown systems, approximately 45% of the total floor area. The remaining portions of this fire area have very low combustible loading and do not expose safe shutdown systems.

A. Area Description –

Zone	Floor Area	Ceiling Height	Volume
CC-1a	2,948	23'6"	69,278
CC-1b	2,192	23'6"	51,512
CC-1c	13,632	23'6"	320,352

Ventilation	Supply cfm	Recirculation cfm	Exhaust cfm	No. of Registers Supply & Return
CC-1a	11,000	11,000	0	10
CC-1b	11,000	11,000	0	10
CC-1c	10,000	8,000	2,000	5

This fire area is bounded on the north by the radwaste building, on the east by the intermediate building, and is below grade on the west and south with no building interfaces. Boundary walls are constructed of reinforced concrete. The ceiling is reinforced concrete over steel deck with 3 hour protected frame.

This fire area is divided into three fire zones. Fire Zones CC-1a and CC-1b are separated by a non-continuous 3 hour design gypsum fire wall and are open to Zone CC-1c at the north. Zone CC-1b is also open to CC-1c at the west boundary. Fire Zone CC-1c comprises the remainder of the fire area and houses the control complex water chillers and nonsafety-related service and instrumentation air system components. Each redundant control complex chiller is separated by a non-continuous 3 hour rated reinforced concrete fire wall. The only doorway to an adjacent building is to the intermediate building from Fire Zone CC-1a, and is equipped with a Class A fire door.

The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The floor is 3 hour fire rated, the ceiling is only 2 hour fire rated because the rebar cover thickness of 1-1/4" is not uniform throughout, though at least 1" in all places.

It is judged that because of the concrete construction and the presence of a suppression system, the ceiling of this area provides an equivalent level of fire protection as specified in <10 CFR 50, Appendix R>, Section III G.2 and no interactions between the first and second levels of the Control Complex will be assumed.

Ventilation air for this fire area is supplied by one of the redundant HVAC units serving the controlled access area located in the HVAC equipment room. The ducts supplying the air penetrate the ceiling of Fire Zone CC-1c and are provided with 3 hour rated fire dampers. During an emergency, or whenever the emergency closed cooling pumps are actuated, the corresponding air handling unit at Elevation 587'0" is automatically started and provides cooling by recirculating the air in the zone.

B. Safe Shutdown Capabilities

Zone 1CC-1a contains circuits for Method A and components and circuits for Method B. Zones 1CC-1b & 1c contain components and circuits for both Methods A and B. The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in zones CC-1a, CC-1b and CC-1c.

Deleted

Deleted

The larger area, comprised of Fire Zones CC-a, CC-b and CC-c contains both Method A and B components and circuits. The partial 3 hour wall, dividing Zones CC-1a from CC-1b, provides a separation distance of at least 40 ft between Method A and B components and cables within each zone. There is no continuity of combustibles between these zones. The suppression, detection and partial barrier provide adequate separation of components and circuits of the redundant system on the opposite side of the barrier.

Zone CC-1a contains Method B components and circuits and Method A circuits. Raceways for Method A circuits in this zone are protected with a 1 hour wrap on a path from the penetration entering the zone at ceiling level to the barrier at CC-4. This includes Raceways 106, 609 and 1655.

There are redundant instruments located within 20 ft of each other along the east wall of the area, with Method A (1P45N252, 1P45N051A) in Zone CC-1c and the redundant Method B (1P45N051B) component in Zone CC-1a. These instruments are separated by 10 ft. There are no in situ combustibles in the intervening area that could expose the redundant instruments. Additional protection in the form of fast response heads are installed over these instruments to provide quick extinguishment of any fire due to transient combustibles. In the event that a fire disables the Division 1 (Method A) flow transmitters for remote indication of emergency service water flow through the 1A ECC heat exchanger, alternative means of verifying flow would be available.

Zone CC-1b contains Method A components and circuits and Method B circuits. There are also two Method B components in this zone. Method B Emergency Closed Cooling pump discharge flow instrument (1P42N041B) has Raceway 1R33R2159B wrapped from Tray 1083 to the instrument. Method B circuits are contained in Trays 255, 1308 and 1803, which are wrapped from the barrier at CC-4 to the tray termination or the zone boundary column line at CC-C. In addition fast response type sprinkler heads provide coverage for the area immediately around the location.

The cable wrap is all 1 hour wrap. The wrap as described above results in Method A cables needed for safe shutdown being protected by 1 hour wrap in Zone CC-1a and north of Column Line CC-D in Zones CC-1b and CC-1c. Method B circuits are protected by a 1 hour wrap south of Column Line CC-C in Zones CC-1b and CC-1c. This arrangement provides 20 ft separation of Method A and B circuits from redundant equipment within the area even though the wrap does not extend barrier to barrier.

C. Fire Protection

Fire Detection Systems: Smoke detectors provided throughout area.

Fire Extinguishing Systems: A wet sprinkler system is provided throughout Zone CC-1a. Partial coverage is provided in CC-1b and CC-1c to cover areas between Column Line CC-3 to 4 and CC-C to E and in Columns Lines CC-2 to 3 and CC-B to E. In addition, fast response type heads are provided over and between redundant components which cannot be separated by 20 ft or wrapped.

- Hose stations: Yes
- Extinguishers: Yes
- 1 hour Cable wrap: Yes

For cases where redundant components do not have adequate separation, special protection is provided in the form of fast response type sprinkler heads located within 6-8 ft of the components and covering the surrounding area. These are in addition to the overhead protection. Although there are no onsite combustibles in the area of the components, fires involving transient combustibles located close to these components could cause temperatures to exceed that which the component can tolerate before ceiling level sprinklers can operate. The fast response heads will provide rapid extinguishment of a fire in close proximity of the equipment or cooling of the equipment for exposing fires. The equipment involved is not susceptible to water damage.

D. Fire Hazard Analysis

Types of combustibles:

Zone CC-1a

Combustibles within this fire zone consist primarily of cable insulation, raceway fire barrier material, and pump motor winding insulation. Most of the cable insulation is located in the middle of the zone. Total fire loading contained in the 3,082 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

Zone CC-1b

Combustibles within this fire zone consist primarily of cable insulation, raceway fire barrier material, panel combustibles, motor winding insulation, and lubricating oil. Total fire loading contained in the 2,192 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

Combustibles within this zone consist primarily of cable insulation, raceway fire barrier material, motor winding insulation, lubricating oil, panel combustibles and combustible materials in maintenance shop and office area (i.e., electrical equipment, supplies and tools). Total fire loading contained in the 13,632 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

In both Zones CC-1a and CC-1b, the combustibles are almost all located in the south half of the zone, over 30 ft from the common opening into Zone CC-1c to the north and the safe shutdown instruments along the east wall of fire zone CC-1b.

Within Zone CC-1c, combustibles in portions containing safe shutdown equipment consist mainly of lubricating oil, cable in conduit and panels. In the area immediately around redundant valves, the combustibles are mostly cables in steel conduit. Sprinkler protection will be provided over this portion.

The remaining areas of Zone CC-1c contain a run of cable trays near the east and north walls, and some compressor motors. Overall combustible loading is extremely low and does not present an exposure to safety-related and safe shutdown equipment. Therefore, suppression is not warranted in these portions of the zone.

- Ease of ignition & propagation: Low

- Heat release rate potential: Moderate

- Suppression damage to equipment: No automatic suppression damage expected since equipment not susceptible to water damage

- Area continuously manned: No

- Traffic: Low

- Accessibility: Yes

Conclusion

Although a single division of circuits is not wrapped throughout the area, the protection of safe shutdown circuits with a 1 hour wrap has been arranged so that at least one method of shutdown will be available given a fire in any part of the area. Greater than 20 ft separation with no intervening combustibles has been achieved.

The suppression systems provide adequate coverage for protection of redundant trains of safe shutdown components and circuits given the low combustible loading in the remaining area.

Redundant components separated by less than 20 ft will be able to function in the event of fire due to the quick response and cooling effect of the rapid response sprinkler heads, if required. Therefore, safe shutdown can be achieved.

Building - Control complex Elevation 599’

Fire Zone	FPER Drawing
CC-2a	<Figure 9A-7>
CC-2b	
CC-2c	

Deviation

The fire area composed of Zones CC-2a, CC-2b and CC-2c have both Method A and B safe shutdown circuits separated by less than 20 ft in some portions of the area. One hour cable wrap has been provided to protect one division of circuits from the redundant division by wrapping parts of the cable raceways that are less than 20 ft from the redundant raceways. The wrap does not extend barrier to barrier. Due to potential problems with cable derating, it was necessary to protect different methods in Zone CC-2a and CC-2b.

A. Area Description

Zone	Floor Area	Ceiling Height	Volume
CC-2a	6,072 sq ft	20’	121,440 cu ft
CC-2b	6,099 sq ft	20’	121,980 cu ft
CC-2c	6,370 sq ft	20’	127,400 cu ft

This fire area is bounded on the north by the radwaste building, on the east by the intermediate building, on the south by the service building, and is below grade on the west and south with no building interfaces. All walls are constructed of reinforced concrete. The area is also bounded by Fire Area CC-STW, the stairwell in the northwest corner of the control complex. The stairwell is 3 hour rated with Class A fire doors.

The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. The ceiling is 3 hour fire rated, but the floor is only 2 hour rated because the rebar cover thickness of 1-1/4” is not uniform throughout, though at least 1” in all places.

It is judged that because of the concrete construction and the presence of a suppression system, the floor of this area provides an equivalent level of fire protection as specified in <10 CFR 50, Appendix R>, Section III G.2 and no interactions between the first and second levels of the control complex will be assumed.

Fire Zone: CC-2a

Fire Zone CC-2a is located in the eastern portion of the second level (Elevation 599’-0”) of the control complex. This zone houses miscellaneous mechanical equipment common to Unit 1 and Unit 2, and Division 1 and Division 2 power and control cables for both units.

The north, east and south walls are constructed of reinforced concrete; the west wall, which borders Zones CC-2b and CC-2c, is constructed of drywall. Walls and ceilings have a 3 hour rating, except for the center corridor walls which have only a 2 hour rating. Penetrations are sealed to at least the rating of the respective wall, floor or ceiling.

Ventilation is supplied through a ductwork system that passes through the vertical cable chases. Duct penetrations are protected with 3 hour rated fire dampers with standard 160°F fusible links.

Floor drains are provided for this fire zone. Access to the zone is through Class A fire doors from the intermediate building and Class B fire doors from the center corridor.

Fire Zone: CC-2b

Fire Zone CC-2b is the northwest portion of the second floor level (Elevation 599’-0”) of the control complex. It houses general offices and laboratories common to Unit 1 and Unit 2.

The north and west walls are 3 hour fire rated reinforced concrete. The east and south walls, which border Zones CC-2a and CC-2c respectively, are 2 hour fire rated drywall construction with Class B doorways. Penetrations are sealed to at least the fire rating of the respective wall, floor or ceiling. The elevator along the western wall has only a Class B door, which is either a 1-1/2 or 1 hour rating. A noncombustible suspended ceiling is provided at the 10 ft level.

Ventilation is supplied through a ductwork system that passes through the vertical cable chases. Duct penetrations are protected with 3 hour rated fire dampers with standard 160°F fusible links.

Floor drains are provided for this fire zone.

Fire Zone: CC-2c

Fire Zone CC-2c is the southwest portion of the second floor level (Elevation 599’-0”) of the Control Complex. It houses general offices and laboratories common to Unit 1 and Unit 2.

The south and west walls are 3 hour fire rated reinforced concrete. The east and north walls, which border Zones CC-2a and CC-2b respectively, are 2 hour fire rated drywall construction with Class B doorways. Penetrations are sealed to at least the fire rating of the respective wall, floor or ceiling. The elevator along the western wall has only a Class B door, which is a 1-1/2 or 1 hour rating. A noncombustible suspended ceiling is provided at the 10 ft level.

Ventilation is supplied through a ductwork system that passes through the vertical cable chases. Duct penetrations are protected with 3 hour rated fire dampers with standard 160°F fusible links.

Floor drains are provided for this fire zone.

B. Safe Shutdown Capabilities

There are no safe shutdown components in the fire area; however, both Method A and B circuits are in Zones CC-2a and CC-2b. Zone CC-2c contains no safe shutdown circuits for Unit 1.

Fire Zone: CC-2a

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in zone CC-2a.

The nonsafety circuits of shutdown Method B in this zone provides power to the MSIVs. Loss of power would cause these valves to go to their safe position. These circuits, therefore, do not have to be protected.

The RHR drain to Radwaste Valve, 1E12-F040, Method A & B, is only needed for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. This operation is included in the plant procedures.

Method A and Method B circuits are found in this zone. Where the circuit for both Methods are within 20 feet of each other, the Method B raceways are wrapped with a one-hour fire rated barrier. Together with the installed automatic suppression system, this raceway wrap provides acceptable protection such that safe shutdown utilizing Method A will be ensured. The following raceways are wrapped from Column Line CC/D to CC/B:

255	290
268	291
269	1308
270	1803

Fire Zone: CC-2b

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in zone CC-2b.

Method A and Method B circuits are found in this zone. Where the circuits for both Methods are within 20 feet of each other, the Method A raceways and conduits are wrapped with a one hour fire rated barrier, so that safe shutdown utilizing Method A will be ensured. The following conduits and raceways are wrapped throughout the zone:

125
126
1R22H4A 1R33H1A

These are located between Column Lines CC-1 and CC-2. For the larger fire area composed of Zones CC-2a, CC-2b and CC-2c, any raceways for one train of safe shutdown that are not protected by a 1 hour wrap are separated by more than 20 ft from raceways of the redundant train that are not protected by a 1 hour wrap. Therefore, separation of more than 20 ft between safe shutdown circuits is achieved.

C. Fire Hazards Analysis

Type of combustibles:

Zone CC-2a

The combustibles contained in this fire zone consist primarily of cable insulation, electrical panels, motor windings, raceway fire barrier material and combustible material storage. Total fire loading contained in the 6,072 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Zone CC-2b

Combustibles contained within this fire zone consist primarily of cable insulation, raceway fire barrier material, and combustible material storage. Total fire loading contained in the 6,099 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Zone CC-2c

Combustibles contained within this fire zone consist primarily of cable insulation, charcoal, and miscellaneous combustibles and material storage. Total fire loading contained in the 6,370 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Ease of ignition and propagation - Low due to partioning.

Heat release potential - Low.

Suppression damage to equipment - Safety-related equipment in area is not susceptible to water damage. Safe shutdown equipment consists of cables only.

Area continuously manned - No

Traffic - High

Fire fighting accessibility - Yes

Redundant raceways, which are not protected by a 1 hour wrap run east to west in the north half of the areas. The tray runs are separated by 30-40 ft. Intervening combustibles, in the form of cable trays running parallel to the redundant divisions, are located near the north side. However, there is more than 20 ft between the intervening combustibles and the redundant tray to the south. Combustibles in this 20 ft space consists of some conduits and a few circuits in the protected space above the suspended ceiling. The fire load could not propagate fire from one division to the redundant division. The occupancy below the suspended ceiling is office and locker rooms. The low combustible loading along with partitioning and suppression would prevent a fire from spreading to both divisions of safe shutdown cables.

D. <u>Fire Protection</u>

Fire Detection Systems - Fire detection system provided throughout area, above heat detections also provided in charcoal filters and below ceiling.

Fire Extinguishing System - Wet type sprinkler provided throughout area above and below ceiling except hallway.

Hose stations - Yes, coverage throughout area.

Extinguishers - Yes, provided throughout area.

Cable wrapping - Raceways containing method circuits required for safe shutdown are protected by a 1 hour wrap.

Conclusion

At least one train of safe shutdown equipment will be protected from fire damage by distance separation or 1 hour wrap given a postulated fire within any part of the fire area. Therefore, an equivalent level of protection as described in <10 CFR 50, Appendix R> III G.2 is provided.

Building - Control Complex Elevation 620’6”

Fire Zone	FPER Drawing
1CC-3e	<Figure 9A-11>

Deviation

Redundant safe shutdown related cable trays existing in the elevator and stairwell vestibule have the divisional separation recommendation by <10 CFR 50, Appendix R>, Section III G. However, automatic suppression is not provided.

A. Area Description

Area 1CC-3e

Floor Area	Ceiling Height	Volume
816 ft^2	17’6”	14,280 ft^3

Ventilation

Fire Zone	Supply cfm	Recirculation cfm	Max Exhaust cfm	No. of Supply/ Return Registers
Elev.	0	0	0	0
Stairwell/	0	0	0	0

Fire Area 1CC-3e is shown on <Figure 9A-11> and consists of the access corridor at the west side of the Unit 1 Control Complex. This area is bounded on the east by Fire Areas 1CC-3a and 1CC-3c, on the north by the access stair, on the south by the control complex elevator shaft, and on the west by the diesel generator building.

All walls of this area are constructed of drywall except for the west wall which is reinforced concrete. Doors to the stair, elevator and rooms are Class A fire doors. The east wall is a bullet resistant design with at least 1 hour 45 minutes fire resistance.

The floor and ceiling are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floor and ceiling have a 3 hour fire resistance rating. All penetrations have 3 hour fire rated seals.

B. Safe Shutdown Capabilities

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Area 1CC-3e.

This area contains Method A and B safe shutdown circuits.

Division 1 raceways containing Method A safe shutdown circuits are 109, 612 and 1657. These are wrapped in a 1 hour fire rated barrier.

The remaining Method A raceways contain circuits for the control room HVAC system. Loss of these circuits in the control room HVAC system would result in the dampers failing to a safe position. Therefore, these circuits need not be protected.

C. Fire Protection

Fire Detection Systems - Yes, throughout area

Fire Extinguishing System - No

Hose stations - Yes, provided in stairwell adjacent to zone

Extinguishers - Yes, provided in stairwell

Cable Wrapping - Division 1 raceways which contain circuits required for Method A safe shutdown systems are wrapped in a 1 hour barrier.

D. Fire Hazard Analysis

The primary combustible contained within this fire area consists of cable insulation. This is contained within a floor area of 320 ft^2, which yields a fire loading of less than 40,000 Btu/ft^2 for this fire area.

Ease of ignition and propagation - Low

Heat release potential - Moderate

Suppression damage to equipment - No automatic suppression system provided. Hose only. Cables not susceptible to damage.

Area continuously manned - No

Traffic - Med.

Fire fighting accessibility - Yes

Conclusion

A smoke detection system is provided for the elevator and stairwell vestibule. Also, a 1 hour cable tray wrap is provided for Division 1 safe shutdown related cable trays. This fire protection arrangement does not fully meet the recommendations of <10 CFR 50, Appendix R>, Section III G, however, the protection provided is justified considering the low combustible loading (under 30 minutes), the absence of concentration of in situ combustibles and the 25 foot separation of the redundant cable trays of safe shutdown related cable. This area also has a lack of transient storage capability, since the area must be kept clear to avoid impending pedestrian movement. Therefore, the addition of automatic suppression is not warranted.

Building - Control complex Elevation 679’6”

Fire Zone FPER Drawing

1CC-6 <Figure 9A-19>

Deviation

This area contains circuits for redundant trains of safe shutdown equipment. A 1 hour wrap and detection is provided but there is no automatic suppression system in the area.

A. Area Description

Area 1CC-6

Floor Area	Ceiling Height	Volume
8,251 ft^2	27’8”	227,728 ft^3

Mechanical ventilation is not provided in this area.

Fire Area 1CC-6 is shown on <Figure 9A-19>. It is located at Elevation 679’-6” above the Unit 1 control room. The ceiling is at the control complex roof elevation of 707’-2”. It is bounded on the south and west by outside walls, on the south by Fire Area 2CC-6, and on the east by Fire Areas 1CC-4b, 1CC-4f (cable chases) and CC-6.

The north and west walls of this area are constructed of reinforced concrete. South and east walls are constructed of drywall. Doorways are equipped with Class A fire doors. Floor and ceiling (roof) are constructed of reinforced concrete over steel form deck and 3 hour protected framing. Walls, floor and ceiling have 3 hour fire resistance ratings or 3 hour design. Wall and floor penetrations have 3 hour fire rated seals. Floor drains are provided for this fire area.

There is extensive supply and return ductwork in this Fire Area, including transfer grilles in the wall separating Fire Areas 1CC-6 and 2CC-6. Duct penetrations are provided with 3 hour fire dampers.

B. Safe Shutdown Capabilities

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Area 1CC-6.

This area contains circuits and components needed for Method B of safe shutdown and circuits needed for Method A.

Deleted

Deleted

Fire Area 1CC-6 contains Method B components and circuits and Method A circuits. The Method A circuits needed for safe shutdown are protected with a 1 hour wrap so that shutdown could be achieved for a fire in this area.

Various listed nonsafety circuits supply power to HVAC components. These components fail to safe position on loss of power. The following Method A power circuits, therefore, do not need protection:

Method A

1R25B131X
1R25B378X
1R25B379X

The following circuits are associated with Method A. Protection is not required since potential spurious actions do not affect Method A System operation.

1M24C14X	1M25C37A	1R33C2463A
1M24C15X	1R33C3276A	

Division 1 safety-related circuits required for safe shutdown Method A are located in the following raceways:

135	1R33C5460X
625	
1696	

These raceways are wrapped in a 1 hour wrap throughout the area.

C. <u>Fire Protection</u>

Fire Detection Systems - Fire detection system provided throughout area. Heat detections also provided in charcoal filters.

Fire Extinguishing System - Manually activated deluge systems are provided over the charcoal filters.

Hose stations - Yes, inside area.

Extinguishers - Yes, inside area.

Cable wrapping - Raceways containing Method A circuits required for safe shutdown are protected by a 1 hour wrap.

D. Fire Hazards Analysis

Type of combustibles

Combustibles within this area consist primarily of cable insulation, electrical panels, charcoal, raceway fire barrier material and motor windings. Total fire loading contained in the 8,251 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Ease of ignition and propagation - Moderate

Heat release potential - Moderate

Suppression damage to equipment - No area wide suppression, hoses only, no damage potential. Manual suppression in charcoal filters would affect safety-related function but redundant filters available in another area.

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

The charcoal is contained within the filter plenums and is protected. The cable and other combustibles represent a load which is representative of the area with a fire severity of 6 minutes.

Conclusion

A fixed suppression system is provided for the charcoal filters, which are the only concentrated combustible loads in this area. The area wide combustible loading is low and this factor combined with high ceilings and large area volume would limit the fire hazard potential. The 1 hour wrap of redundant circuits required for safety shutdown will provide adequate protection of shutdown capabilities. Addition of area wide suppression is not warranted for the low fire hazard.

Section 9A.7 G 5

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Building - Diesel Generator Elevation 620’6”

Fire Zone	FPER Drawing
DG-1d	<Figure 9A-11>

Deviation

Redundant safe shutdown related cables exist in Fire Zone DG-1d and have the divisional separation recommendation by <10 CFR 50, Appendix R>, Section III G. However, automatic suppression is not provided.

A. Area Description

Floor Area	Ceiling Height	Volume
1,968 ft^2	25’6”	50,184 ft^3

Ventilation

Fire Zone	Supply cfm	Recirculation cfm	Max Exhaust cfm	No. of Supply/ Return Registers
DG-1d	0	0	0	0

Fire Area DG-1d serves as a common connecting corridor below the control complex, service building and the diesel generator rooms, thereby providing access to the diesel generators. The area is bounded on the north by the radwaste building, on east by Fire Areas 1CC-3 and 2CC-3 of the control complex, on the south by the service building, and on the west by Fire Areas and 2DG-1A, 2DG-1B, 2DG-1c.

Wall, floor and ceiling construction for this area is of reinforced concrete. The walls have a 3 hour fire resistance rating.

Doorways are equipped with Class A fire doors. Wall penetrations are sealed to provide a 3 hour rating. Access to this area is through Class A fire doors from the control complex, service building and the diesel generator rooms.

B. Safe Shutdown Capabilities

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Area DG-1d.

This area contains Method A and B safe shutdown circuits.

The nonsafety circuit to the control room HVAC supplies power to fan vane controllers. Loss of power to these controllers causes them to fail in the safe position. Circuit 1R25B131X supplies nonsafety power to Panel H51-P177A. Loss of power to the nonsafety components causes them to fail in a safe position. Circuit 1R25B131X will not be protected. No nonsafety circuits need be protected.

Safety-related Division 2 raceways in this area contain circuits required for Method B safe shutdown systems. These raceways are wrapped in a 1 hour fire barrier.

285
1358
1837

C. <u>Fire Protection</u>

Fire Detection Systems - Yes

Fire Extinguishing System - No

Hose stations - Yes

Extinguishers – Yes

Cable wrapping - Division 2 raceways which contain circuits required for Method B safe shutdown systems are wrapped in a 1 hour barrier.

D. Fire Hazard Analysis

The only combustible material in this area is cable insulation. This insulation, contained within the 1,968 ft^2 floor area, yields a fire loading of less than 80,000 Btu/ft^2 for this fire area.

Ease of ignition and propagation - Low

Heat release potential - Moderate

Suppression damage to equipment - No automatic suppression system provided.

Area continuously manned - No

Traffic - Med.

Fire fighting accessibility – Yes

Conclusion

Fire Area DG-1d has an area wide fire detection system, convenient access for manual fire fighting, hose stations and 3 hour rated boundaries. No automatic fire suppression systems are provided, however. The fire load of less than 80,000 Btu/ft^2 is considered to be moderate, however, the wrapping of one train of cables reduces this fire load to a lower level. Therefore, the addition of an automatic fire suppression system would not significantly enhance the level of fire protection for this zone.

Building - Intermediate building

Fire Zone	Elevation	FPER Drawing
IB-2	599	<Figure 9A-8>
IB-3	620’6”	<Figure 9A-12>
IB-4	654’6”	<Figure 9A-16>

Deviation

The floors between Fire Zones within the intermediate building are not complete 3 hour barriers and, therefore, do not provide subdivision for redundant equipment on floors as described in <10 CFR 50, Appendix R>. Also, suppression is provided over redundant trains within a zone (IB-3), but is not provided throughout the Fire Area.

A. Area Description

Zone	Floor Area	Ceiling Height	Area Volume
IB-1	12,778	24’	306,672
IB-2	12,778	21’	268,338
IB-3	10,778	32’	253,883
IB-4	12,778	28’	357,784
IB-5	12,778	24’	268,338

The intermediate building is a five-story building with reinforced concrete walls and floors. This fire area is divided into five Fire Zones: Fire Zone IB-1 is Elevation 574’-10”; Fire Zone IB-2 is Elevation 599’-0”; Fire Zone IB-3 is Elevation 620’-6”; Fire Zone IB-4 is Elevations 654’-6” and 665’-0”; Fire Zone IB-5 is Elevation 682’-6”. Each level is separated from others by a reinforced concrete floor with 3 hour fire resistance. Stairways are protected with 3 hour rated concrete enclosures or 3 hour design gypsum board walls. Penetrations, door openings and ventilation ducts between zones are protected with an equivalent rating to the barrier.

The intermediate building is considered a Fire Area since each floor communicates via a three-inch rattle space at the reactor building. This rattle space is covered by a 1/4-inch steel cover. However, it does not qualify as a 3 hour barrier.

B. Safe Shutdown Capabilities

Redundant Safe Shutdown System components and circuits are described by Fire Zones.

Fire Zones IB-1 and IB-5 do not contain safe shutdown equipment or cables.

Fire Zone IB-2

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone IB-2.

Circuits for Components 1E12-C002, 1E12-F040, 1B21-F065B are located in this zone. The circuits for Component 1E12-C002B, the RHR B pump, provides an interlock from the Division 1 RHR shutdown cooling suction valve. The interlock logic circuit provides a stop signal to the pump if one of the suction valves for the pump is not available. Loss of power or signal from these circuits will not stop the pump. Therefore, only a spurious signal will impact pump operation. The interlock circuits include signals from the Division 2 suction valves. The Division 1 supply valve is needed for cold shutdown only. Therefore, in order to initiate shutdown cooling, the operator would need to isolate the circuit if a spurious signal existed. Isolation could be provided by a repair to the circuit. A procedure is available to provide guidance to the operator.

In addition, Valves 1E12-F040 and 1B21-F065B are only needed for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. The above operations will be included in the plant procedures.

Thus, damage to the circuits for Method B system located in this zone, would not prevent safe shutdown. Therefore, these circuits need not be protected in accordance with <10 CFR 50, Appendix R> Section III G.2.

Fire Zone IB-3

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone IB-3.

Loss of circuits for RHR Valve 1E12-F049, CRD Valve 1C11-F182 and power to Panel 1H22-P018 would not prevent safe shutdown. The RHR valve is only needed for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. This operation will be included in the plant procedures. Loss of the power circuits including the circuit for the CRD valve, will fail components in a safe position. Therefore, these circuits need not be protected in accordance with <10 CFR 50, Appendix R> Section III G.2.

Because of the spatial separation between the trays containing required Division 1 and Division 2 safe shutdown circuits, low fire exposure hazard presented by the intervening combustibles, and ceiling height in excess of 30 feet, a fire in the corridor area of Fire Zone IB-3 would not be expected to involve both trains of safe shutdown. It is judged that the existing fire detection system and automatic and manual fire protection features will provide adequate protection for the redundant trains of safe shutdown equipment in this area.

Fire Zone IB-4

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone IB-4.

C. Fire Protection

Fire Detection Partial Detection IB-1, IB-5 complete Detection IB-2, IB-3, IB-4. Heat detectors also provided within Charcoal Filter Banks IB-3 and IB-5.

Fire Extinguishing Systems - Manual deluge system on charcoal filters Fire Zones IB-3, IB-5.

Automatic sprinkler system has been installed throughout Zone IB-2. Partial sprinklers have been installed over safety-related cables in Zone IB-3, between Column IB1 and IB3 and Columns IBA and IBP. Also, combustible storage areas of IB-1 have been protected by wet pipe sprinkler system.

Hose stations - Provided in all zones

Extinguishers - Provided in all zones

D. Fire Hazards Analysis

Fire Zone IB-1

The combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil, grease, electrical panels, component insulation, motor windings and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release rate potential - Low

Suppression damage to equipment - Only hoses, no damage potential.

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Fire Zone IB-2

Combustibles contained within this fire zone consist primarily of cable insulation, electrical panels, power transformers, and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release rate potential – Low

Suppression damage to equipment - automatic sprinkler system - Only safe shutdown cables in area, water would not affect. Drainage provided.

Area continuously manned - No

Traffic - Moderate

Fire fighting accessibility - Yes

Fire Zone IB-3

Combustibles contained within this fire zone consist primarily of cable insulation, electrical panels, transformers, raceway fire barrier material, charcoal and combustible materials storage. Total fire loading contained in the 10,778 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release rate potential - Moderate

Suppression damage - Automatic sprinklers. Cover cables only, not affected by suppression. Have drainage. Deluge systems to safety-related charcoal filters would affect function of one division but redundant filter would be available.

Area continuously manned - No

Traffic - High

Fire fighting accessibility - Yes

Fire Zone IB-4

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil and grease, electrical panels, charcoal, H2 bottles and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Ease of ignition - Low

Heat release - Low

Suppression damage - Only hoses, would not affect safe shutdown cables in area. Deluge systems to safety-related charcoal filters would affect function of one division only and redundant filter would be available.

Area continuously manned - No

Traffic - Low

Fire fighting accessibility – Yes

Fire Zone IB-5

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil and grease, electrical panels, charcoal, and combustible materials storage. Total fire loading contained in the 12,778 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Ease of ignition - Low
Heat release   - Low

Suppression damage - Deluge systems in charcoal filter would affect safety-related function but have redundant diversion. Hoses in area, would not affect equipment. Draining provided.

Area continuously manned - No

Traffic - Low
Accessibility - Yes

The location of combustibles within each zone does not expose the rattle space to a fire which could propagate between zones. Where cable insulation composes a large portion of the combustible load it is located at ceiling level in the zone between columns IB-1&2, this is 15 ft from the rattle space at the closest and is generally more than 20 ft away. Charcoal is contained within the plenum. The filter plenums are enclosed in concrete radiation barriers which do not abut the rattle space. Lubricating oil is present only on IB-1, the lowest elevation and would not present a potential for spread between zones. The only combustibles in proximity to the rattle space are panels mounted on the reactor building wall in Fire Zones IB-1, IB-2, IB-3, and IB-5. These are metal cabinets which encase the combustibles and are located near floor level at about 3-6 ft. With the high ceiling and the limited combustibles associated with each panel, a fire would not be expected to expose zones above or below via the rattle space.

Fire Zone IB-3 has suppression provided over the area containing safe shutdown cables. The portion of IB-3 where suppression is not installed house the charcoal filters. These are cut off from the protected areas by radiation barrier which extend to the ceiling. The charcoal is protected by a manual deluge system. This is the only significant fire load in the area of concern. Therefore, additional suppression is not warranted in remaining portions of the zone.

The combustible loading in Fire Zones IB-1, IB-4 and IB-5, excluding the protected charcoal filters, is less than 20,000 Btu/ft^2 and does not warrant suppression.

Conclusion

The intermediate building is considered a single Fire Area as defined by <10 CFR 50, Appendix R> III G. Circuits for both trains of redundant equipment are located in this area. The existing separation between zones is considered adequate for the fire hazard in each zone. A fire would not be expected to propagate through the three-inch rattle space and breach the separation. Therefore, the existing separation provides an equivalent level of protection for the Fire Zones IB-2 and IB-4. The suppression in Fire Zone IB-3 along with suppression in IB-2 and the charcoal filters provides an adequate level of protection for significant combustibles in the Fire Area and additional suppression is not warranted.

Building - Emergency Service Water   Elevation 586’-6”

Fire Zone	FPER Drawing
Pumphouse ESW-1a	<Figure 9A-34>

Deviation

Redundant safe shutdown components exist in Fire Zone ESW-1a separated by less than 20 ft and automatic suppression is not provided as described in <10 CFR 50, Appendix R>.

A. Area Description

The Emergency Service Water Pumphouse is a single story, rectangular building constructed of reinforced concrete shown on <Figure 9A-34>. It is an isolated structure located north of the main plant area with the Service Water Pumphouse as the closest building. This building houses pumps and associated equipment required to supply cooling water for safe shutdown systems.

Fire Area ESW-1a comprises the entire Emergency Service Water Pumphouse, except for the diesel fire pump room located in the northeast corner of the main floor (Elevation 586’-6”). It is also bounded on the southeast and southwest by Fire Zones ESW Duct Bank No. 1 and No. 2 (electrical duct banks). This area houses equipment for the ESW system including pumphouse traveling screens/motors, screen wash pumps, ESW pumps, discharge strainers, and associated control equipment.

Walls, floor and ceiling are constructed of reinforced concrete. Walls to Fire Area ESW-1b have a 3 hour fire resistance rating and are equipped with Class A fire doors. Wall penetrations have 3 hour fire rated seals. Floor drains are configured with a header on the east side and another on the west side of the floor which carry drainage to the sump. Access to the area is provided from the outside by doors at grade.

Floor Area: 5,244 ft^2 Ceiling Height: 61’ Volume: 319,884 ft

Ventilation:

Fire Zone	Supply cfm	Recirculation cfm	Max Exhaust cfm	No. of Supply/ Return Registers
ESW-1a	80,000	64,000	16,000	4

B. Safe Shutdown Capability

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone ESW-1a.

This area has both Method A and B safe shutdown components and circuits.

Deleted

Deleted

Deleted

The separation between redundant equipment is from 21 to 46 feet with the exception of the traveling screen motors (P49D001A and 49D001B) which have only 8 foot separation. The screen wash system, which includes the traveling screens, motor-operated strainers and screen wash pumps, provides for removal of debris from the traveling screens so that Lake Erie water is filtered before it enters the ESW pumps. In the event the screen wash strainers become inoperable, they can be manually turned and cleaned to prevent any suction water flow problems. The system is Safety Class 3, Seismic I. Separation greater than 20’ is provided.

The water inlet is located more than one quarter mile offshore and submerged more than 15’ below the surface of the lake. Referring to <Figure 3.8-65>, <Figure 3.8-66>, <Figure 3.8-67>, <Figure 3.8-68>, <Figure 3.8-69>, and <Figure 3.8-70>, it can be seen that in order for debris to enter the ESW pumphouse, the debris would have to be submerged to the elevation of the intake heads, travel approximately 100’ vertically downward, travel approximately 3,000’ almost horizontally and then rise vertically approximately 100’ to the ESW pumphouse. Also, the intake system is designed for an approach velocity of 0.5 fps which diminishes the uptake of debris.

Because of the design features of the intake/discharge structures, it is highly unlikely that any significant amount of debris will enter the ESW pumphouse and clog the screens. Additionally, routine inspections of the screen wash and screens will be conducted, preventing any unnoticeable debris accumulation. During a two month period (October/November) of 1984, the ESW pumps were operated without the availability of the traveling screens. During that time no noticeable DP increase across the screens was experienced. Therefore, for the 72-hour period of concern, it is assumed that no loss of flow occurs due to debris-clogged screens. It's estimated that even with a 50% blockage, operation of the ESW pumps would not be impaired.

It should also be noted that in addition to the low combustible loading for Fire Zone ESW-1a and the large distance between the floor level (586'-6") and the high ceiling (648'-0"), the redundant cable trays will not be subjected to an unacceptable temperature or heat flux.

C. Fire Protection

- Fire Detection Systems: Yes
- Fire Extinguishing Systems: No
- Hose stations: Yes
- Extinguishers: Yes
- Radiant Heat Shields: No

D. Fire Hazard Analysis

The combustibles contained within this fire area consist primarily of cable insulation, lubricating oil and grease, electrical panels, raceway fire barrier material and motor windings. Total fire loading contained in the 5,244 ft^2 floor area of this fire zone is less than 40,000 Btu/ft^2.

- Ease of ignition and propagation: Low
- Heat release rate potential: Moderate
- Suppression damage to equipment: No automatic suppression system provided. Equipment not susceptible to hose stream damage.
- Area continuously manned: No

  Traffic: Low

  Fire fighting accessibility: Yes

The cable insulation, the most significant combustible loading, is located along the south east and north walls. The combustible load within the area containing the safe shutdown components is very low.

Also, the ceiling height is in excess of 40 feet and the room has a large volume which would serve as a significant heat sink. The redundant safe shutdown components are located on the floor. The major part of this area is open without intervening combustibles. The entrance to the building is at the top and has an egress route down a set of stairs. Therefore, it is unlikely that a significant transient fire would result in this area.

The protection provided is justified, considering the low combustible loading (under 1/2 hour) and the absence of a concentration of in situ combustibles.

E. Conclusion

Protection of the pump room traveling screen motors is not necessary as loss of these motors would not prevent safe shutdown.

The low fire loading (less than 1/2 hour) in this area coupled with extra high ceilings, very large volumes and noncombustible building construction create a low fire hazard potential. Plant experience and design information indicates extended periods of inoperable traveling screens would not affect safe shutdown. Detection, hose stations and low fire loadings ensure an acceptable level of protection.

Building - Auxiliary building

Fire Area composed of Fire Zones 1AB-1b and 1AB-3a

Fire Zone	FPER Drawings
1AB-1b	<Figure 9A-2> <Figure 9A-5> <Figure 9A-10>
1AB-3a	<Figure 9A-10>

Deviation

Redundant trains of safe shutdown equipment are in Zone 1AB-1. Also, Fire Zones 1AB-1b and 1AB-3a form a larger fire area due to the lack of a complete 3 hour cutoff between zones. Automatic suppression is not provided throughout the area or zones.

A. Area Description

Zone	Floor Area	Ceiling Height	Volume
1AB-1b	1,298 ft^2	83’8”	108,591 ft
1AB-3a	3,334 ft^2	32’6”	108,355 ft

Fire Zone 1AB-1b

Fire Zone 1AB-1b includes, in addition to the Floor 1 location, identical regions directly above on Floor 2 (Elevation 599’-0”) and Floor 3 (Elevation 620’6”). It is bounded on the north by Fire Area 1AB-1g (Elevation 568’-4”), Fire Zone 1AB-2 (Elevation 599’-0”) and Fire Zone 1AB-3a (Elevation 620’-6”); on the east by Fire Area 1AB-1a, Fire Zone 1AB-2 (Elevation 599’0”) and Fire Zone 1AB-3a (Elevation 620’6”); on the south by the Unit 1 reactor building; on the west by Fire Zone 1AB-1c, Fire Zone 1AB-2 (Elevation 599’-0”) and the steam tunnel (Elevation 620’-6”).

Walls, floor and ceiling (roof) for this fire zone are constructed of reinforced concrete. Doorways are equipped with a Class A fire door at Elevation 568'-4", a Class A fire door at Elevation 599'-0" and a Class A door at Elevation 620'-6". Walls have 3 hour fire resistance ratings, except for the wall containing the pressure relief openings from Elevation 620'-6" to 652'-0" (roof). Wall penetrations have 3 hour fire rated seals, except for the walls from 620'-6" to 652'-6" where unsealed pressure relief openings exist in the wall to the Fire Zone 1AB-3a. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone.

In addition, a fan coil unit is provided to cool and circulate air within the zone when the RHR "A" pump is operating.

The ventilation ductwork provides supply and exhaust to the zone. Ventilation duct penetrations are protected with 3 hour rated fire dampers with standard 160°F fusible links, except as noted above on the third floor level.

Fire Zone 1AB-3a

Fire Zone 1AB-3, comprises the eastern half of Floor 3 (Elevation 620'-6") of the auxiliary building, with the exception of the upper portion of the Fire Zone 1AB-1b and the steam tunnel. It is bounded on the south by the Unit 1 reactor building, and on the west by the steam tunnel and Fire Zone 1AB-1b; the north and east walls are exposed to grade.

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and floor have 3 hour fire resistance rating except for walls adjacent to Fire Zone 1AB-1b. Wall and floor penetrations have 3 hour fire rated seals, except for pressure relief openings in the wall to Fire Zone 1AB-1b.

The ventilation ductwork provides supply and exhaust to the zone. Unprotected vent ductwork penetrations in this zone communicate with Fire Zone 1AB-1b.

COMMON FIRE AREA

Fire Zone 1AB-1b, forms a larger fire area with Fire Zone 1AB-3a due to unprotected pressure relief openings and ventilation ducts without fire dampers in walls at the third floor level [Elevation 620'-6" to 652'-0" (roof)].

B. Safe Shutdown Capabilities

Zone 1AB-1b has Method A components and circuits and Method B circuits. Zone 1AB-3a has Method B components and circuits.

Zone 1AB-1b

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-1b.

Deleted

Deleted

Deleted

Method B circuits within this zone include circuits for RHR valves. 1E12-F040 and 1B21-F065B, which are only needed for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. The above operations are included in the plant procedures.

The circuits for Component 1E12-C002B, the RHR B pump, provides an interlock from the Division 1 RHR shutdown cooling suction valve (1E12-F008). The interlock logic circuit provides a stop signal to the pump if all of the suction valves for the pump are closed. Loss of circuit power or signal for this interlock will not stop the pump. Therefore, only a spurious signal will impact pump operation. The interlock circuits include signals from the Division 2 suction valves. The Division 1 supply valve is needed for cold shutdown only. In order to initiate shutdown cooling, the operator would need to isolate the circuit if a spurious signal existed. Isolation could be provided by a repair to the circuit. A procedure is available to provide guidance to the operator.

The remaining Method B circuit in this zone is located in Conduits 1P57F2B and 1R33F1051B. However, a fire induced fault on this circuit would not result in a spurious closure of valve 1P57-F015B.

Zone 1AB-3a

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-3a.

FIRE AREA

Fire Zones 1AB-1b and 1AB-3a form one fire area. The connection between these two zones is in the form of an unprotected pressure relief opening and HVAC duct penetrations without fire dampers. These connections exist in a common wall between the two zones. The unprotected pressure relief opening is the largest and the dominant communicating pathway.

There is more than 20 ft between Method B safe shutdown components and circuits within Zone 1AB-3a, and Method A components and circuits in Zone 1AB-1b. There are no intervening combustibles which would transmit fire through the opening and affect redundant trains.

C. Fire Suppression

Fire Detection - area detection in Zones 1AB-1b and 1AB-3a. Smoke detectors in supply and discharge HVAC ducts.

Fixed Extinguishing System - None

Hose stations - located within Zone 1AB-3a have hose coverage available for all levels of Zone 1AB-1b from adjacent areas.

Extinguishers - Provided in both zones.

D. <u>Fire Hazard Analysis</u>

Zone 1AB-1b

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil and grease, raceway fire barrier material and motor windings. Total fire loading contained in the 1,298 ft^2 floor area of this fire zone is less than 25,000 Btu/ft^2.

This is representative of the area.

Ease of ignition and propagation - Low

Heat release potential - Low

Suppression damage to equipment - only hoses, no damage potential

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Zone 1AB-3a

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil, electrical panels and motor windings. Total fire loading contained in the 3,334 ft^2 floor area of this fire zone is less than 6,500 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release potential - Low

Suppression damage to equipment - only hoses, no damage potential

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

The cable insulation is concentrated along the north wall of this zone, remote from the unprotected opening and over 40 ft from the Method B equipment required for safe shutdown.

Conclusion

The separation between Method A components in Zone 1AB-1b and Method B components in Zone 1AB-3a, provides an adequate level of protection for redundant trains of safe shutdown equipment.

The low fire load in each zone coupled with high ceilings, large volumes and noncombustible walls, ceiling and floor, create a low fire hazard potential. The unprotected openings are located away from combustibles and would only pass smoke, and low heat energy. The fire hazard is such that it can be reasonable judged that a fire would not breach the common wall between Zone 1AB-3a and 1AB-1b. Therefore, a fire in either zone would not impact safe shutdown components in the other zone. A fire occurring within Zone 1AB-1b would be small and easily extinguished by the plant fire brigade. Extensive zone damage would not result. Additional protection in the form of automatic suppression is not warranted. Separation and limited combustibles will ensure that one division of redundant safe shutdown equipment is free of fire damage.

Building - Auxiliary building

Fire Area composed of Fire Zones 1AB-1e and 1AB-3b

Fire Zone	FPER Drawing
1AB-1e	<Figure 9A-2> <Figure 9A-5> <Figure 9A-10>
1AB-3b	<Figure 9A-10>

Deviation

Redundant trains of safe shutdown equipment are in Zone 1AB-1e. Also Fire Zones 1AB-1c and 1AB3b form a larger fire area due to the lack of a complete 3 hour cutoff between zones. Automatic suppression is not provided throughout the area or zones.

A. Area Description

Zone	Floor Area	Ceiling Height	Volume
1AB-1e	1,298 ft^2	83’8”	108,591 ft
1AB-3b	4,555 ft^2	32’6”	148,036 ft

Fire Zone 1AB-1e

Fire Zone 1AB-1e is shown on <Figure 9A-2>, <Figure 9A-5>, and <Figure 9A-10>. It includes, in addition to the Floor 1 location, identical regions directly above on Floor 2 (Elevation 599’-0”) and Floor 3 (Elevation 620’6”). It is bounded on the north by Fire Area 1AB-1g (Elevation 568’-4”), Fire Zone 1AB-2 (Elevation 599’-0”) and Fire Zone 1AB-3b (Elevation 620’-6”); on the east by Fire Area 1AB-1d, Fire Zone 1AB-2 (Elevation 599’-0”) and the steam tunnel (Elevation 620’-6”); on the south by the

Unit 1 reactor building; on the west by Fire Area 1AB-1f, Fire Zone 1AB-2 (Elevation 599'-0") and Fire Zone 1AB-3b (Elevation 620'-6").

Walls, floor and ceiling (roof) for this fire zone are constructed of reinforced concrete. Doorways are equipped with a Class A fire door at Elevation 568'-4", a Class A fire door at Elevation 599'-0", and a Class A door at Elevation 620'-6". Walls have 3 hour fire resistance ratings, except for the wall containing the pressure relief openings from Elevation 620'-6" to 652'-0" (roof). Wall penetrations have 3 hour fire rated seals, except for the walls from 620'-6" to 652'-6" where unsealed pressure relief openings exist in the wall to Fire Zone 1AB-3b. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone.

In addition, a fan coil unit is provided to cool and circulate air within the zone when the RHR "B" pump is operating.

The ventilation ductwork provides supply and exhaust to the zone. Ventilation duct penetrations are protected with 3 hour rated fire dampers with standard 160°F fusible links, except as noted above on the third floor level. A fan coil unit is provided to cool and circulate air within the zone when the RHR "B" pump is operating.

Zone 1AB-3b

Fire Zone 1AB-3b, comprises the western half of Floor 3 (Elevation 620'-6") of the auxiliary building, with the exception of the upper portion of Fire Zone 1AB-1e and the steam tunnel. It is bounded on the south by the intermediate building and Fire

Area 1AB-1f, on the east by the steam tunnel and Fire Zone 1AB-1e, on the north by the turbine power complex, and on the west by the radwaste building.

Walls, floor and ceiling (roof) of this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and floor have 3 hour fire resistance ratings except for walls adjacent to Fire Zone 1AB-1e. Wall and floor penetrations have 3 hour fire rated seals, except for pressure relief openings in the wall to Fire Zone 1AB-1e. The exterior wall at the northwest corner is 3 hour rated due to the adjacent transformer.

The ventilation ductwork provides supply and exhaust to the zone. Unprotected vent ductwork penetrations in this zone communicate with Fire Zone 1AB-1e.

COMMON FIRE AREA

Fire Zone 1AB-1e, located in the auxiliary building, forms a larger fire area with Fire Zone 1AB-3b due to unprotected pressure relief openings in walls at the third floor level [Elevation 620'-6" to 652'-0" (roof)]. Ventilation ducts without fire dampers also penetrate the wall between these zones at this level.

B. Safe Shutdown Capabilities

Zone 1AB-1e contains components and circuits for Method B.

Zone 1AB-3b contains only circuits for Method A and B.

Zone 1AB-1e

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-1e.

Deleted

Method A circuits within this zone include the circuits for RHR Valves 1E12-F040 and 1E12-F049. These are only needed for shutdown cooling (cold shutdown) operation of the RHR and could be manually operated. These operations are included in the plant procedures.

Zone 1AB-3b

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-3b.

Method A circuits within this zone include the circuits for ADS/SRV, CRD, RHR, and power systems which need not be protected. The circuits for the ADS/SRV system provide MSIV trip on low pressure. The circuits for MSIV trip on reactor water level are not located in this fire area. Additionally, the capability for the operators to close the MSIV's from the control room is not affected by a fire in this zone. The power system circuits provides power to dampers in both divisions of the control room HVAC system. These dampers fail to a safe position on loss of power. The circuit for the CRD system provides power to the "A" solenoid valve operating the scram discharge volume isolation valve. Loss of power resulting from a fire would fail the solenoid to the safe position. In addition, redundancy is provided by other solenoid valves not located in this fire area.

The circuits for RHR Valve 1E12-F049 need not be protected. This valve is only needed for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. This operation is included in the plant procedures.

Raceway 1E51F49B also runs through this zone. This contains circuits for the RCIC System. Components and circuits for the LPCS system (Division 1) are not located in this fire zone, and LPCS would be available to provide Reactor Inventory Control.

FIRE AREA

Fire Zones 1AB-1e and 1AB-3b form one fire area. The connection between these two zones is in the form of unprotected pressure relief opening and HVAC duct penetrations without fire dampers. These connections exist in a common wall between the two zones. The unprotected pressure relief opening is the largest and the dominant communicating pathway. The radiation barrier separating redundant circuits in Zone 1AB-3b also separates these circuits from this common opening. Therefore, adequate protection is provided from the Method B circuits in Zone 1AB-1e.

C. Fire Protection

Fire Detection Systems - Fire detection is provided in both Zone 1AB-1e and 1AB-3b. Smoke detectors are provided in the supply and exhaust ducts of the ventilation systems.

Fire Extinguishing System - A manually activated deluge system is provided in the charcoal filters. Automatic sprinkler protection will be provided in the part of Zone 1AB-3b outside the radiation barrier.

Hose stations - located within Zone 1AB-3b have hose coverage available for Zone 1AB-1e from adjacent areas.

Extinguishers - In both zones.

D. Fire Hazard Analysis

Zone 1AB-1e

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil and grease, and motor windings. Total fire loading contained in the 1,298 ft^2 floor area of this fire zone is less than 50,000 Btu/ft^2.

Combustible load is representative of this zone.

Ease of ignition and propagation - Low

Heat release potential - Low

Suppression damage to equipment - only hoses, no damage potential

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Zone 1AB-3b

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil and grease, electrical panels, charcoal, raceway fire barrier material, H2 bottles, motor windings and combustible materials storage. Total fire loading contained in the 4,555 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2.

Ease of ignition and propagation - Moderate

Heat release rate potential - Moderate

Suppression damage - Proposed automatic sprinklers cover safe shutdown cables only, these are not affected by suppression. Have drainage. Deluge systems to safety-related charcoal filters would affect function but redundant filter would be available.

Area continuously manned - No

Traffic - Moderate

Fire fighting accessibility - Yes

The cables are located in the west part of this zone and will be protected by the suppression system. The charcoal is inside the filter plenum and is protected. Remaining combustible loading is minimal and protection is not warranted.

Conclusion

The provision of three hour separation for Method A circuits required for the LPCS system would provide adequate protection of these circuits and insure shutdown capability. Due to the low fire load, high ceiling and large volume, the fire hazard potential in this zone is low and suppression not warranted.

In Zone 1AB-3b, combustible loading within the radiation barrier consists of the charcoal filters, which have a suppression system provided. This is adequate to prevent a fire within the barrier from spreading outside the barrier. Also, automatic suppression provided in the zone outside this barrier would control a fire in this part of the zone and prevent it from affecting circuits inside the barrier or breaking the opening into Zone 1AB-1e. The suppression systems are adequate protection and area wide suppression is not warranted.

Building - Auxiliary building

Fire Area composed of Fire Zones 1AB-1c and 1AB-2

Fire Zone	FPER Drawing
1AB-1c	<Figure 9A-2>
1AB-2	<Figure 9A-5>

Deviation

Redundant trains of safe shutdown equipment are in Zone 1AB-2. Also Fire Zones 1AB-1c and 1AB-2 form a larger fire area due to the lack of a complete 3 hour cutoff between zones. Automatic suppression is not provided throughout the area or in Zone 1AB-2.

A. Area Description

Zone	Floor Area	Ceiling Height	Volume
1AB-1c	560 ft^2	32’6”	18,200 ft^3
1AB-2	9,685 ft^2	20’	193,700 ft^3

Fire Zone 1AB-1c

Fire Zone 1AB-1c, shown on <Figure 9A-2>, is located in the right center portion of Floor 1 of the auxiliary building. This zone is bounded on the north by Fire Area 1AB-1g, on the east by Fire Zone 1AB-1b, on the south by the Unit 1 reactor building, and on the west by Fire Zone 1AB-1d.

Walls, floor and ceiling (roof) for this fire zone are constructed of reinforced concrete. The doorway has a Class A fire door. Walls have 3 hour fire resistance ratings. Wall penetrations have 3 hour fire rated seals. A portion of the ceiling has grating for pressure relief. Floor drains for this zone are routed to a sump located within the room. The sump is discharged to the auxiliary building sump through a line that is valve operated from outside the zone.

Ventilation supply and exhaust ductwork service the zone. Ventilation duct penetrations through the floor/ceiling to Fire Zone 1AB-2, are provided with 3 hour rated fire dampers with standard 160°F fusible links. There is also a fan coil unit for cooling and circulation when the RCIC pump is operating.

Zone 1AB-2

Fire Zone 1AB-2, shown on <Figure 9A-5>, comprises the entire Floor 2 (Elevation 599’-0”) of the auxiliary building, with the exception of portions of Fire Zones and Areas 1AB-1b, 1AB-1e and 1AB-1f which originate on Floor 1. It is connected on the north to the turbine power complex, on the south to the Unit 1 reactor building and intermediate building and on the west to the radwaste building; the east side is an outside wall.

Walls, floor and ceiling for this fire zone are constructed of reinforced concrete. Doorways are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance ratings. Wall, floor and ceiling penetrations have 3 hour fire rated seals, except for the small floor area above the RCIC room on Floor 1 (Fire Zone 1AB-1c) which is provided with grating for pressure relief.

Ventilation supply and exhaust ductwork service the zone. Ventilation duct penetrations, except penetrations through the floor/ceiling to Fire Zone 1AB-1c below, are provided with 3 hour rated fire dampers with standard 160°F fusible links.

COMMON FIRE AREA

Fire Zone 1AB-2 is part of a larger fire area with Fire Zone 1AB-1c (first floor level) due to unprotected grating for pressure relief in the floor/ceiling between the two zones. There are also unprotected ventilation ductwork penetrations in the floor above the RCIC pump room (Zone 1AB-1c). This zone contains instrument and control panels, and process equipment for the RWCU system and turbine building cooling system.

Fire Zone 1AB-1c

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-1c.

This zone contains only Method A components and circuits.

Fire Zone 1AB-2

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-2.

Deleted

Within Zone 1AB-2 there are Method A and B components and circuits.

Circuits for RHR Valve (1E12-F049) Method A systems are presently routed in raceways containing Method B circuits. However, this valve is needed for the shutdown cooling operation of RHR and could be manually operated.

Method B circuits for the RHR Valve (1B21-F065B) need not be protected since this valve is only needed for shutdown cooling operation of the RHR and could be manually operated. These operations are included in the plant procedures.

The circuits for Component 1E12-C002B, (the RHR B pump), provide an interlock from the Division 1 RHR shutdown cooling suction Valve (1E12-F008). The interlock logic circuit provides a stop signal to the pump if all of the suction valves for the pump are closed. Loss of circuit power or signal will not stop the pump. Therefore, only a spurious signal will impact pump operation. The interlock circuits include signals from the Division 2 suction valves. The Division 1 supply valve is needed for cold shutdown only. In order to initiate shutdown cooling, the operator would need to isolate the circuit if a spurious signal existed. Isolation could be provided by a repair to the circuit. A procedure is available to provide guidance to the operator.

Within Zone 1AB-2, there are Method A and B Emergency Closed Cooling System Pump Room Cooling System components. The redundant components are located at opposite ends of the zones. There is more than 20 ft separation between Method B components and any Method A circuits required for safe shutdown. Since natural circulation cooling can be induced by opening the door to the RHR B room located on the 574’ elevation to provide adequate room cooling without the Method B cooler in service, loss of these circuits will not prevent safe shutdown.

Method B circuits associated with RHR C (LPCI) operation are routed in 1AB-2. In the event a fire results in loss of this Method B system, a means of providing for reactor inventory control and shutdown cooling utilizing RHR "B" will be available to support safe shutdown. In addition, a fire induced fault on the circuit associated with valve 1P57-F015B would not result in a spurious closure of the valve.

COMMON FIRE AREA

Fire Zones 1AB-1c and 1AB-2 form one larger fire area. The larger fire area contains components and circuits for Method A systems and only circuits for Method B systems. The common opening between zones is located behind a concrete radiation barrier. This provides adequate protection for Method B equipment within the area for the Method A equipment in Zone 1AB-1c.

C. Fire Protection

Fire Detection Systems - Fire detection in Zones 1AB-1c and 1AB-3a. Smoke detectors in the supply and discharge ducts for HVAC system serving zones.

Fire Extinguishing System - Automatic sprinkler system throughout Zone 1AB-1c. No suppression in Zone 1AB-2.

Hose stations - located within Zone 1AB-2 have hose coverage available for Zone 1AB-1c from adjacent areas.

Extinguishers - Provided in both zones.

D. Fire Hazard Analysis

1AB-2

Combustibles contained within this fire zone consist primarily of cable insulation, hydraulic fluid, lubricating oil, electrical panels, raceway fire barrier material, component insulation and motor windings. Total fire loading contained in the 9,685 ft^2 floor area of this fire zone is less than 60,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release potential - Low - Moderate

Suppression damage to equipment - only hoses, no damage potential

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Zone 1AB-1c

Combustibles contained within this fire zone consist primarily of cable insulation, motor windings, lubricating oil and grease. Total fire loading contained in the 560 ft^2 floor area of this fire zone is less than 20,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release rate potential - Low

Suppression damage - Automatic sprinkler system, equipment in area not susceptible to water damage

Area continuously manned - No
Traffic - Low
Fire fighting accessibility - Yes

Cable insulation is located along north section of this zone, more than 20 ft from any Method B.

Conclusion

In the event a fire results in the loss of Method B circuits and components located in 1AB-2, a means of providing safe shutdown using Method B systems will remain available.

Fire Zone 1AB-2 has a 20 foot ceiling and a low fire loading. The addition of an automatic fire suppression system would not significantly enhance the level of fire protection for this zone.

Building - Auxiliary building

Fire Zone	FPER Drawing
1AB-1g	<Figure 9A-2>

Deviation

Area 1AB-1g contains components and circuits for both methods of safe shutdown. Automatic suppression is not provided in the area.

A. Area Description

Area 1AB-1g

Floor Area	Ceiling Height	Volume
4,856 ft^2	30 ft	145,680 ft^3

Fire Zone 1AB-1g, shown on <Figure 9A-2>, is the common corridor for Floor 1 of the auxiliary building. It provides access to Fire Areas and Zones 1AB-1a through 1AB-1f, and to the intermediate building. This area connects on the north to the turbine power complex, on the south to the intermediate building and on the west to the radwaste building; the east side is an outside wall. The turbine power complex pipe tunnel runs beneath the floor on the west side of the area and opens to the pipe chase in the southwest corner.

Walls, floor and ceiling for this fire zone are constructed of reinforced concrete. The doorway to the intermediate building and the doorways to the other Floor 1 zones and fire areas are equipped with Class A fire doors. Walls and ceiling have 3 hour fire resistance rating. Wall and ceiling penetrations have 3 hour rated seals.

B. Safe Shutdown Capabilities

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1AB-1g.

This zone has both Method A and B safe shutdown components and circuits.

Deleted

This fire area can be analyzed in two separate parts because of the separation distances of approximately 75 feet, and the fact that the corridor contains a 90° corner which acts as a heat shield.

One portion of the fire area is the corridor outside the ECCS pump room. This portion of the corridor has an approximate ceiling height of 30 feet. The corridor contains instrument and logic panels for both Method A and Method B systems. These panels are separated by approximately 60 feet. In addition, the corridor between the redundant panels contains a partial height concrete wall. The separation of redundant equipment is such that Method A system is located east of this partial barrier and Method B system is located west of the partial barrier except as noted below.

The west side of the barrier contain conduits for RHR Valve 1E12-F040. The circuits for this valve need not be protected. This valve is needed only for shutdown cooling (cold shutdown) operation of RHR and could be manually operated. This operation will be included in the plant procedures.

The redundant A and B panels are separated by approximately 60 feet and a partial height concrete barrier that obstructs approximately half the corridor width. In the event of a fire occurring in this area, heat and smoke will be moved into the high ceiling area. Radiant heat at the floor level will be blocked by the partial wall between the panels. Two floor drains are provided between the panels; any flammable liquid spills would not spread between the panels.

The Method B RHR panel contains instrumentation which could affect operation of the RCIC (Method A) system. The circuits to these instruments and the instruments do not require protection from potential fire involving Method B equipment, since circuits and components for the LPCS system are located on the Division 1 panels with other Method A equipment. These panels are separated by 60 feet as described above.

The second portion of this area is the northwest corridor, which house suppression pool level transmitters for both Method A and Method B systems. The circuits for the redundant transmitters are separated by approximately 25 feet. Because of a high ceiling, low fuel load and lack of intervening combustibles, it is unlikely that a fire would disable redundant transmitters. However, in the event these transmitters are disabled, additional suppression pool indication not located in this area would be utilized for safe shutdown.

C. Fire Protection

Fire Detection Systems - Fire detection provided throughout area.

Fire Extinguishing Systems - None

Hose stations - Areawide coverage

Extinguishers - Located in area

D. Fire Hazard Analysis

Combustibles contained within this fire area consist primarily of cable insulation and electrical panels. Total fire loading contained in the 4,856 ft^2 floor area of this fire zone is less than 15,000 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release potential - Low

Suppression damage to equipment - only hoses, no suppression damage to redundant trains of equipment

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Conclusion

Based on the separation distance of approximately 60 feet between redundant instrument panels with the heat shielding and approximately 25 feet between redundant suppression level transmitter, the level of fire protection regarding separation is equivalent to the guidelines of <10 CFR 50, Appendix R>, Section III, G.2. The very low fire load, high ceiling heights, fire resistive construction, fire detection system, and accessibility for manual fire fighting associated with this fire area is adequate, therefore, the installation of a fire suppression system would not enhance the level of fire protection.

Building - Reactor building

Fire Zones	FPER Drawings
1RB-1a, 1RB-1b, 1RB-1c, 1RB-1d	<Figure 9A-2>, <Figure 9A-5>, <Figure 9A-10>, <Figure 9A-14>, <Figure 9A-18>, <Figure 9A-22>, <Figure 9A-29>

Deviation

Fire Zones 1RB-1a, 1RB-1b and 1RB-1c contain redundant divisions of safe shutdown equipment. The barriers separating the zones do not qualify as 3 hour related fire barriers due to unprotected openings in the concrete wall between 1RB-1b. These barriers give an equivalent level of protection as a radiant energy shield as described in <10 CFR 50, Appendix R> III G.2 and provide adequate separation between zones for redundant trains of safe shutdown equipment.

A. Area Description:

The reactor building is one fire area. The outside wall and ceiling (dome) is of 3 hour fire rated reinforced concrete construction. The access to the auxiliary building (Elevation 620’-6”), fuel handling building (Elevation 620’-6” and 689’-6”) and intermediate building (Elevation 599’-9” and 689’-6”) are protected by 3 hour rated fire doors. Penetrations are sealed to maintain a 3 hour rating.

Within the fire area are secondary barriers constructed to maintain radiation doses within specified limits. These barriers divide the fire area into four concentric zones.

Zone 1RB-1a

Zone 1RB-1a extends in 5 ft from the reactor building wall to the steel containment vessel wall (welded steel), which forms the outer boundary of Zone 1RB-1b. Zone 1RB-1a extends from Elevation 599' to the top of the reactor building at 796'-5". This zone is maintained at a negative air pressure relative to the outside.

Zone 1RB-1b

Zone 1RB-1b extends in 19 ft from the containment vessel wall to the drywell wall.

The outside wall and ceiling (dome) of this fire zone are constructed of steel. The inside wall and floor are constructed of reinforced concrete. Doors consist of double-doored steel/concrete personnel access hatches and equipment hatches. Wall and ceiling penetrations have 3 hour fire rated seals, (including 3" rattle space at the hatch areas) except for the suppression pool vents on the inside which are under water. The drywell wall is rated 3 hours above the suppression pool to the reactor head cover.

The cooling system for this zone operates primarily to provide cooling only for the containment vessel. This system uses 25 percent capacity air handling units, located in the containment vessel, which supply cooled recirculated air to various areas of the containment vessel through distribution ductwork.

The purge supply system provides filtered and heated outside air to the containment vessel. This system consists of two 50 percent capacity supply plenums and two 50 percent capacity supply fans.

The purge exhaust system draws air from the containment vessel and drywell area (refueling operations only), exhausting it through the plant vent after it passes through the charcoal filters. Two 50 percent capacity charcoal filter trains with exhaust fans are provided for this system.

Fire Zone 1RB-1c

This zone extends from the drywell wall to the reactor and is about 37 ft in diameter.

Walls, floor and ceiling of this fire zone are constructed of reinforced concrete. Wall doors consist of double-doored steel/concrete personnel access hatches and an equipment hatch. Wall penetrations have 3 hour fire rated seals, except for the suppression pool vents which are underwater. The drywell wall is rated 3 hours above the suppression pool to the reactor head cover. Unprotected openings in this wall are below the suppression pool water surface.

The drywell cooling system operates primarily to provide cooling only for the drywell area. This system uses three 100 percent capacity fan cooler assemblies, each with a supply plenum and two supply fans located in the drywell. The fan cooler units supply recirculated, cooled air to the drywell area through distribution ductwork.

During the drywell purge mode (refueling operations only), the two 50 percent capacity drywell purge supply fans (located within the containment vessel) direct supply air from the containment vessel into the drywell area. This supply air is then circulated by the drywell cooling system.

The purge exhaust system for this fire zone is the same as for Fire Zone 1RB-1b.

Fire Zone 1RB-1d is shown on <Figure 9A-2>, <Figure 9A-5>, and <Figure 9A-29>. It is the region directly below the reactor vessel and inside the vessel pedestal. This zone contains the control rod drives, neutron monitoring equipment and other under-vessel servicing equipment.

Walls and floor of this fire zone are constructed of reinforced concrete. Ventilation air is circulated through this zone by vents in the pedestal wall.

Safe Shutdown Capabilities

Zone 1RB-1a contains the penetration assemblies containing both Method A and B redundant circuits required for safe shutdown. Electrical penetration assemblies for all divisions are located in the southwest portion (Quadrant 3) of the annulus. Penetrations are arranged in vertical and horizontal rows such that Division 1 and Division 4 penetrations are separated from Division 2 and Division 3 penetrations by a minimum of 12 feet. The penetration cables are installed in enclosed raceways in the zone. These enclosed raceways, consisting of stainless steel tubes, act as radiant energy shields surrounding the cables. Each electrical penetration assembly provides at least 3 hour fire protection for the cable penetration.

The physical separation, along with the shielding affect on the enclosures, would protect one division of safe shutdown circuits from any potential fire which would damage the redundant division.

FIRE ZONE 1RB-1b

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1RB-1b.

Deleted

Deleted

Deleted

Deleted

The safe shutdown equipment in Zone 1RB-1b is separate from redundant equipment in Zone 1RB-1a (the penetration assemblies mentioned above by the containment wall). Redundant divisions are in close proximity only in Quandrant 3, where the redundant safe shutdown trains exit the penetration assemblies in Zone 1RB-1b. The containment wall and the stainless steel penetration raceway would separate a fire in one division of one zone from the redundant division in the other zone.

FIRE ZONE 1RB-1c

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1RB-1c.

Deleted

The redundant divisions in Zones 1RB-1c and 1RB-1a are separated by the 5 ft thick reinforced concrete drywell wall. The only openings in this wall are below the suppression pool water level and fire would not propagate through these openings. Therefore, the barrier provides an equivalent level of protection to the redundant trains on each side of the barrier.

Fire Protection

Fire Detection Systems - Heat and smoke detectors are provided throughout Zones 1RB-1c and 1RB-1d. Detectors are provided in all levels of Zone 1RB-1b except the dome above (Elevation 689’-6”), detection not provided in Zone 1RB-1a. A deviation has been requested for lack of detection in these zones. In addition smoke detectors are provided in the HVAC discharge duct.

Fire Extinguishing Systems - A CO_2 system protects the recirculation pumps in Zone 1RB-1c. The control room must open the normally closed, motor operated, outboard containment isolation valve for the carbon dioxide to reach the reactor recirculation pumps.

Hose stations - Hose stations are provided within Zone 1RB-1b with additional hose lengths to reach into Zone 1RB-1c.

Extinguishers - A complement of fire extinguishers is located at the entrance to containment in a cabinet. These extinguishers are to be carried in during emergency fire situations. During shutdown, a supply of fire extinguishers will be taken into and kept in containment during maintenance operations.

Fire Hazard Analysis

Zone 1RB-1a

Combustibles contained within this fire zone consist primarily of cable insulation and lubricating oil. Total fire loading contained in the 1,963 ft^2 floor area of this fire zone is less than 15,000 Btu/ft^2.

Ease of ignition and propagation - Very Low

Heat release rate potential - Low

Zone 1RB-1a (Continued)

Suppression damage to equipment - only hoses, no damage potential

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Low, only 1 point of access

Since electrical penetration assemblies are located in a 35 foot segment of Quadrant 3, special consideration was given to the concentrated fire loading of 104.000 Btu/ft^2 in this region. The cables composing the combustible load are contained within the penetration assemblies, there are no other in situ combustibles.

Due to the limited accessibility, it would be difficult to bring sufficient quantities of transient combustibles into the area to expose redundant divisions of penetrations. It is also unlikely that a fire would start inside the penetration assembly, and there would be insufficient combustible loading for a fire to spread from one assembly to a redundant assembly.

Zone 1RB-1b

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil, electrical panels, motor windings, hydraulic fluid, grease and component insulation. Total fire loading contained in the 6,382 ft^2 floor area of this fire zone is less than 80,000 Btu/ft^2. Combustible loading on the refueling floor elevation is limited to less than 6,500 Btu/ft^2. This combustible loading is distributed over the five levels of the area. The fire loading exposing safe shutdown equipment in any part of the area would be less than 1/2 hour.

Fire Hazard Analysis

Ease of ignition and propagation - Low

Heat release rate potential - Low

Suppression damage to equipment - Hose streams only. Damage to susceptible electrical equipment would be limited to one division due to separation distances and shielding.

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Yes

Zone 1RB-1c

Combustibles contained within this fire zone consist primarily of cable insulation, lubricating oil, hydraulic fluids, grease, electrical panels, lead blankets, and motor windings. Total fire loading contained in the 2,603 ft^2 floor area of this fire zone is less than 52,000 Btu/ft^2.

Since combustibles are concentrated in the area of the recirculation pump, special consideration was given to the potential for a fire in this region. However, fire detection and suppression systems are provided to minimize any damage in this fire zone.

Ease of ignition and propagation - Low

Heat release rate potential - Low

Suppression damage to equipment - only hoses, no damage potential

Area continuously manner - No

Traffic - Low

Fire fighting accessibility - Limited - 1 access door

Zone 1RB-1d

The primary combustibles in this fire zone consists of cable insulation. This material, contained in the 301 ft^2 floor area, yields a fire loading of less than 90,000 Btu/ft^2 for this fire area.

Ease of ignition and propagation - Low

Heat release rate potential - Low

Suppression damage to equipment - hose only, safe shutdown cables in area water would not be affected. Drainage provided. Carbon dioxide would not affect recirc pumps.

Area continuously manned - No

Traffic - Low

Fire fighting accessibility - Low

CONCLUSION

The low overall combustible loading, along with the high ceilings, would limit the potential of a postulated fire to cross the zone boundaries described. Therefore, the zone boundaries provide adequate separation of redundant trains in adjacent zones.

Building - Control complex

Fire Zone	FPER Drawing
CC-6	<Figure 9A-19>

Deviation

Area CC-6 contains circuits for both methods of safe shutdown. An automatic suppression system is not provided in the area.

A. Area Description

Area CC-6

Fire Area CC-6 is shown on drawing <Figure 9A-19>. It houses Unit 1 and Unit 2 ventilation ducts and comprises the horizontal chase in the upper east section of the control complex at Elevation 693’-2”. The ceiling is at the control complex roof Elevation 707’-2”. This area is bounded on the north and south by the outside wall, on the west side by Fire Areas 1CC-6 and 2CC-6, and on the east by the intermediate building.

The north, east and south walls of this area are constructed of reinforced concrete. The west wall is constructed of drywall. The floor is constructed of gypsum plank and drywall. Ceiling (roof) construction is reinforced concrete over steel form deck and three-hour protected framing. Walls and ceiling have three-hour fire resistance ratings. The floor provides adequate separation from other areas. Wall and floor penetrations have three-hour fire rated seals. Access to this area is through access panels from Fire Areas 1CC-6 and 2CC-6.

B. Safe Shutdown Capabilities

The safe shutdown analysis identifies the safe shutdown related components, circuits and raceways that could be affected by a fire in Fire Zone 1RB-1b.

Safe shutdown equipment for this fire area consists of HVAC ductwork for the systems, and Unit 1, Division 1 and Division 2 power control cables.

Fire Area CC-6 contains circuits for shutdown Method A and Method B. For this fire area, safe shutdown could be achieved utilizing Method A systems and equipment. The conduit for Method A system (1M23R9A) is separated from the redundant cables on the order of 100 feet with an absence of intervening in situ combustibles.

C. Fire Protection

Fire detection equipment for this area consists of smoke detectors.

Fire suppression equipment for this area consists of manual fire extinguishers and hose station locations in adjacent Areas 1CC-6 and 2CC-6 which would be used in this area.

D. Fire Hazard Analysis

Type of combustibles

This area is occupied by HVAC ducts. The only combustible loading in this area is from cable insulation concentrated on the north side of the area in three Division B cable trays that are approximately 10% full. There are also conduits to smoke and heat detectors in the fire area.

The primary combustible contained in this 3,836 ft^2 floor area is cable insulation. The amount is insignificant; hence, the fire loading is negligible (less than 6,500 Btu/ft^2.

Ease of ignition and propagation - Low

Heat release potential - Low

Suppression damage to equipment - Ductwork and cables not susceptible to damage

Area continuously manned - No

Traffic - Very low

Fire fighting accessibility - Area has low accessibility; however, the safe shutdown circuits are located near the access doors.

Conclusion - Due to the extremely low combustible loading and 100 feet separation of the redundant circuits within this area, the level of protection provided by the detection system and manual suppression available is adequate to ensure that one division of safe shutdown equipment will remain free of fire damage.

DEVIATION TO <10 CFR 50, APPENDIX R>

SECTION III J, EMERGENCY LIGHTING

PERRY NUCLEAR POWER PLANT (PNPP)

Building - Control complex   Elevation 654’-6”

Fire Zone   FPER Drawing

1CC-5a, Control Room   <Figure 9A-19>

Deviation

<10 CFR 50, Appendix R>, Section III J states that 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. Based upon our safe shutdown analysis, 8 hour emergency dc lighting is being provided in all areas outside of the control room required for safe shutdown operations, including access and egress to those areas. The control room is provided with ac emergency lighting supplied from either the Division 1 or Division 2 emergency diesel generators.

Description

Emergency lighting will be locally powered from either of two lighting panels located in the Unit 1 Control Room, Fire Area 1CC-5a. Illumination will be provided directly over the horseshoe and other areas of the control room that may be required for safe shutdown. Adequate illumination is provided for operations personnel to perform safe shutdown.

In the event of a loss of offsite power, provisions have been made to supply each lighting panel in the control room with a separate source of power from one of the emergency diesel generators. Each method of power supply is described in the analysis section and shown on the attached sketch. The two sources of power were analyzed to ensure that in the event of a fire in any fire area outside the control room, at least one complete source of power for the lighting in the control room would be available. The independence of the power sources was determined as follows:

- The location of equipment utilized for a division of power was identified by Fire Area/Zone, as described in <Appendix 9A.4>.

- The routing of the circuits between equipment, from the diesel generator to the lighting panel was traced to determine which Fire Areas/Zones would affect a division.

- Also analyzed in the same methods were any interlocks which could effect the availability of the power source. Circuits which were fed from the motor control center were evaluated for breaker coordination.

- Systems required to support operation of the diesel generators were identified. The Division 1 and Division 2 diesel generators and their safety-related support systems are required for safe shutdown. The equipment and circuits had been evaluated in the safe shutdown analysis and the redundant divisions were protected from the effects of a fire in a common zone/area as part of compliance with <10 CFR 50, Appendix R> III G.

- Fire Areas containing equipment or circuits required for or affecting both divisional sources of power were evaluated to determine if one source would be available given a fire in the area. Additional protection in the form of a 1-hour wrap is provided, if required, to ensure that one division is free of fire damage.

Analysis

Division 1 Source

Emergency lighting in the control room will be provided by a single lighting transformer (R71S083) and distribution panel (R71P083). The normal power source for the lighting transformer will be the Division 1 Class 1E, 480V motor control center (EF1B08). The power supply to the motor control center is from a 480V bus (EF1B) supplied via a transformer (EHF-1-B) by the 4.16 kV bus (EH11), which is powered by the Division 1 diesel generator. The transformer is located on the 679' Elevation of the control complex (2CC-6), and the lighting panel is located in the Unit 1 control room at the 654' Elevation (1CC-5a). The 480V motor control center, transformer and busses are located on the 620' Elevation of the control complex (1CC-3c) and the diesel generator is located in the diesel generator building (DG-1c).

The circuits for the above power source are routed through the following Fire Areas:

1CC-5a	1CC-3c
1CC-6	DG-1d
2CC-6	2DG-1c
1CC-4f	DGBD
1CC-3e	1CC-2b

The Division 1 480V MCC is required for safe shutdown and has been analyzed for breaker coordination. Associated circuits routed in any of the above zones have been coordinated or are protected from the effects of a fire by a 1 hour wrap.

Interlocks which could affect this divisions power supply in the event of a fire are located in the following Zones/Areas:

1CC-3c   1CC-4e   1CC-4f   1CC-5a   1RB-1b

The support systems required for operation of the Division 1 diesel generator include:

1R-43	Standby Diesel Generators and Support Systems (SDG)
1R-45	SDG Fuel Oil Storage and Transfer
1P-45	Emergency Service Water (ESW)
1P-47	Control Complex Chilled Water System (CCCS)
1P-49	Emergency Service Water Screen Wash
1M-23/24	MCC, Switchgear & Battery Room HVAC
1M-32	ESW Pumphouse HVAC
1M-43	SDG Room HVAC

Switchgear

480V Load Centers
480V Motor Control Centers
DC Power System

The components and or circuits for the required systems are located in the following Fire Zones/Areas:

CC-1a	1CC-5a
CC-1b	1CC-6
CC-1c	2CC-6
CC-2a	ESW-1a
CC-2b	ESW Duct Bank - 1
1CC-3c	FH-2a
1CC-3d	FH-3
1CC-3e	IB-3
1CC-4c	1DG-1c
1CC-4f	1DG-1d
1CC-4g	1DGDB
1CC-4h	

Division 2 Source

Emergency lighting in the control room will be provided by a single lighting transformer (R71S085) and distribution panel (R71P085). The normal power source for the lighting transformer will be a nonsafety, 480V motor control center (F1B08). On loss of offsite power, the power supply to the motor control center will automatically transfer to a 480V bus (XF-1-A) supplied by the Division 2 stub bus (XH1Z), via a step down transformer (XHF-1-A). The Division 2 stub bus is fed by the 4.16 kV safety-related bus (EH12) which is powered by the Division 2 diesel generator.

The transformer is located on the 679' Elevation of the control complex (1CC-6) and the lighting panel is located in the Unit 1 control room at the 654' Elevation (1CC-5a). The Division 2 stub bus, transformer 480V bus and motor control center are located on the 620' Elevation of the turbine power complex (TPC). The 4.16 kV Division 2 bus is located on the 620' Elevation of the control complex (1CC-3a), and the diesel generator is located in the diesel generator building (1DG-1a).

The circuits for the above power source are routed through the following Fire Areas:

1CC-5a	TPC
1CC-6	1AB-2
1CC-5c	IB-2
1CC-638/654	CC-2a
1CC-3e	CC-2b
DG-1d	CC-STW
DG-1e	1DG-1a
Radwaste 620 Elev.	Outdoor Tray

All electrical switchgears for the Division 2 480V supply required for safe shutdown has been analyzed for breaker coordination. Associated circuits routed in any of the above zones have been coordinated. The nonsafety portions of the power supply were also evaluated for associated circuit concerns.

The interlocks which could affect this divisions power supply are located in the following areas;

1CC-4a   1CC-4b   1CC-5a   1RB-1b   1CC-3a support systems required for operation of the Division 2 diesel generator include:

1R-43	Standby Diesel Generators and Support Systems (SDG)
1R-45	SDG Fuel Oil Storage and Transfer
1P-45	Emergency Service Water (ESW)
1P-47	Control Complex Chilled Water System (CCCS)
1P-49	Emergency Service Water Screen Wash
1M-23/24	MCC, Switchgear & Battery Room HVAC
1M-32	ESW Pumphouse HVAC
1M-43	SDG Room HVAC

Switchgear

480V Load Centers
480V Motor Control Centers
DC Power System

The components and or circuits for the required systems are located in the following Fire Zones/Areas:

CC-1a	1CC-4a	ESW-1a
CC-1b	1CC-4b	ESW Duct Bank - 2
CC-1c	1CC-4c	1DG-1a
CC-2a	1CC-4d	DG-1e
CC-2b	2CC-4b	DG-1d
1CC-3a	1CC-5a	
1CC-3e	1CC-5c	
1CC-STW	1CC-638/654	
	1CC-6	
	CC-6	

Evaluation:

The Fire Area comprised of Fire Zones CC-1a, CC-1b and CC-1c contain components and circuits for both Division 1 and Division 2 diesel support systems. However, there are circuits or components directly supplying power to the lighting in this area. As discussed in Part 1 of Attachment 2, circuits and components of concern are redundant trains required for safe shutdown and have been protected so that at least one train will be free of damage given a fire in the area. Therefore, at least one source of power for lighting is available.

Fire Zones IB-2 and IB-3 are part of the larger Fire Area encompassing the entire intermediate building. These zones are separated by a 3 hour rated barrier, with the exception of a 3 in. rattle space. Zone IB-2 contains circuits for the Division 2 power supply to the stub bus and Zone IB-3 contains circuits for the Division 1 ESW systems required for support of the Division 1 diesel. As described in Part 7 of Enclosure 2, the zone separation provides adequate protection of the circuits in one zone from a fire in an adjacent zone. Therefore, at least one source of power for lighting would be available given a fire in either zone.

Fire Areas DG-1d, 1CC-3e and 1CC-4c contain circuits required for the Division 1 diesel generator operation. The Division 2 power supply for lighting and support system circuits for the Division 2 diesel generator are also located in these zones. The circuits needed for the Division 1 diesel generator support systems are protected, as required, with cable wrap in these areas.

In Fire Area 1CC-6, the conduit containing circuits from the Division 1 lighting transformer is wrapped in a 1 hour wrap throughout the zone. In the Fire Area composed of Fire Zones CC-2a, CC-2b and CC-2c, the Division 2 lighting circuit is wrapped with a 1 hour wrap throughout the zone.

Conclusion:

At least one complete source of backup ac power for the control room lighting will be available in the event of a loss of offsite power and a fire in any area of the plant outside the control room. Therefore, 8 hour dc battery powered emergency lighting is not necessary for operation of equipment to achieve safe shutdown.

ONE LINE DIAGRAM - <10 CFR 50, APPENDIX R> LIGHTING REQUIREMENT
PERRY NUCLEAR PLANT PGCC