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CHAPTER 9.0 - AUXILIARY SYSTEMS

9.1 FUEL STORAGE AND HANDLING

LaSalle must comply with 10CFR50.68(b) for criticality accident requirements as described in Reference 13

9.1.1 New Fuel Storage

The purpose of the new fuel storage facility is to receive and safely store new (i.e., unirradiated) fuel prior to installation in the reactor core.

9.1.1.1 Design Bases

9.1.1.1.1 Safety Design Bases

The new fuel storage racks are designed and maintained with sufficent spacing between the new fuel assemblies to assure that the array, when racks are fully loaded, is subcritical by at least 10% ΔK in order to prevent fuel barrier damage caused by overheating.

The new fuel storage racks, when containing a full complement of fuel assemblies, are designed to withstand the seismic loads (Reference 28 and 29) in order to prevent damage to the structure of the racks and to maintain the rack's arrangement while fully loaded during an SSE.

9.1.1.1.2 Power Generation Design Bases

The new fuel storage racks are designed to hold approximately 81% of a full core fuel load; i.e., 620 fuel assemblies. The new fuel storage racks act as a common storage facility for both Units 1 and 2.

9.1.1.2 Facilities Description

The location of the single, common new fuel storage facility for the station is shown in Drawing Nos. M-5 and M-6. Each new fuel storage rack (shown in Figure 9.1-1) holds up to 10 channeled or unchanneled assemblies in a row spaced nominally 7 inches apart center to center. All racks are designed such that they can be arranged in rows on a nominal 12.25-in. center-to-center spacing. New fuel storage racks are provided for the 620 fuel assemblies or approximately 81% of the reactor core load. 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 while enclosed in a protective plastic wrapping. Sufficient guides are provided to preclude damage to the fuel assemblies. The spacers and the upper tie plate of the fuel element rest 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 side flanges on adjacently installed racks. 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 rackbase.

A floor drain is provided for the new fuel storage facility which maintains the facility in a dry condition. Any accumulation of water or condensation will drain from the facility to the radwaste system. The floor drain is designed to prevent the backflow of water, or highly aerated water, into the facility.

The northwest section of the vault (section Z, racks 9 through 16) will be used for storage of miscellaneous refuel equipment when fuel is not present in this or adjacent rack sections (Figure 9.1-7).

9.1.1.3 Safety Evaluation

The calculations of k_{eff} are based upon the geometrical arrangements of the fuel array. The arrangement of the fuel assemblies in the fuel storage racks results in k_{eff} below 0.90 in a dry condition. In an abnormal condition, if the most reactive fuel array were flooded with water, k_{eff} would not exceed 0.95. For GE fuel, the new fuel storage vault storage criteria will be satisfied if the uncontrolled lattice k_{∞} calculated in the normal reactor core configuration meets the following criteria: $K\infty$ incore (evaluated at 20 degrees Celsius) $\leq$ 1.31. Compliance with this criterion ensures that the in-rack Keff limits previously described for the dry and flooded conditions will not be exceeded (to a temperature of 100 degrees Celsius) for regular new fuel vault storage racks with an inter-rack spacing of $\geq$ 10.50 inches. Calculational uncertainty should be addressed for the new fuel vault if the vault ever becomes limiting for GE fuel. For AREVA fuel, ATRIUM-9B and ATRIUM-10 fuel assemblies can be safely stored in the LaSalle Units 1/2 new fuel storage vault and meet the criteria of k_{eff} less than 0.90 dry and 0.95 fully flooded. These conditions will be met, if for any enriched lattice in the assembly, the maximum enrichment is 5.0 w/o U-235 and the minimum gadolinia loading is 6 gadolinia rods at 3.0 w/o Gd_2O_3 (natural uranium blankets are excluded). If the above criteria is not met for ATRIUM-9B fuel, lattice physics calculations must be performed to demonstrate that the k_{∞} with in-core geometry for any axial lattice in the assembly is less than 1.304 at BOL. If the above criteria are not met for ATRIUM-10 fuel, lattice physics calculations must be performed to demonstrate that the k_{oo} with in-rack geometry for any axial lattice in the assembly is less than 0.891 at BOL. The calculations should be performed at 20 degrees Celsius fuel temperature, 100 degrees Celsius moderator temperature, and xenon free conditions. (Reference 8 and 30) Information on radiation monitoring of the new fuel storage vaults is provided in Section 7.6.

In addition, controls have been implemented to further reduce the probability of a criticality occurrence, i.e., the storage array will be in a moderation controlled area. A moderation control area limits the amount of hydrogenous material in the area. Administrative controls as generally defined in SIL 152 (Reference 10) have been incorporated for the area.

The new fuel storage vault will be covered during periods when construction or maintenance activities are underway on the refueling floor.

The new fuel storage racks are designed to meet Seismic Category I requirements (Chapter 3.0). Stresses in a fully loaded rack do not exceed stresses specified by the ASTM standards for aluminum alloys when subjected to the seismic loads (References 28 and 29).

The storage rack structure is designed to withstand the impact resulting from a falling weight possessing 2000 ft-lb of kinetic energy. Tests using a simulated fuel bundle of the correct weight and size have been conducted to verify that the rack casting can withstand the impact from a bundle dropped from a maximum allowable height above the array. The rack casting failed when a drop of 6.17 feet (4314 ft-lb) was made at midspan. Procedural fuel handling requirements and equipment design dictate that no more than one bundle at a time can be handled over the storage racks and at a maximum height of 2 feet above the upper rack. The structural arrangement is such that no lateral displacement of the fuel occurs; therefore, subcritical spacing is maintained.

The new fuel racks are designed to be restrained by holddown bolts to assure that rack spacing does not vary during an SSE.

The storage rack structure is so designed that the height of the rack is less than the length of the fuel bundle. Therefore, the upper tie plate of the bundle cannot pass below the top cross member of the rack. Also, the fuel bundle insertion spaces in the top casting of the rack have lead in (chamfer) on the upper and lower surfaces. These design features prevent any tendency of the fuel bundle to jam during insertion into or removal from the rack.

The new fuel storage racks are made of aluminum. Materials used for construction are specified in accordance with applicable ASTM specifications (B108, B179, B209, B211, and B221). 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 300-series stainless steel are relatively close together insofar as their coupled potential is concerned. The use of stainless fasteners in aluminum to avoid detrimental galvanic corrosion is a recommended practice and has been used successfully for many years by the aluminum industry.

The use of section Z, racks 9 through 16, for storing miscellaneous refuel items has been evaluated. These items will be stored on top of grating, independent of the racks and support structure. Administrative controls will ensure that storage of items in the vault is done in a safe manner.

9.1.1.4 Testing and Inspection

The new fuel storage racks are passive components and do not require any special testing or inspection during plant operation. Inspection of the racks and corresponding support structure is required prior to storing new fuel in any section of the vault used for miscellaneous storage when fuel is not present.

9.1.2 Spent Fuel Storage

The purpose of the spent fuel storage facilities is to provide storage of irradiated fuel in a safe manner. The spent fuel storage facilities are designed to accept irradiated fuel and new fuel from both reactor cores (Unit 1 and Unit 2).

9.1.2.1 Unit 1 Spent Fuel Pool

9.1.2.1.1. Design Bases

9.1.2.1.1.1 Safety Design Bases

The Unit 1 spent fuel storage facilities are designed to provide the following:

a. The fuel array in the fully loaded spent fuel racks is subcritical, by at least 5% ΔK.

b. The spent fuel storage racks, containing their full complement of 3986 fuel assemblies including fuel in the 4 defective fuel storage locations, are designed to withstand the seismic loadings of the Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE) in order to minimize distortion of the fuel storage arrangement (References 16 through 19).

c. The flooded spent fuel pool provides a water barrier which ensures sufficient shielding to protect plant personnel from exposure to radiation in excess of 10CFR20 guidelines.

d. The spent fuel storage facility is designed to prevent missiles generated by high winds from damaging the fuel.

9.1.2.1.1.2 Power Generation Design Bases

Spent fuel storage space is supplied in the Unit 1 spent fuel storage pool for approximately 520% of the full core load; i.e., 3986 fuel assemblies.

9.1.2.1.2 <u>Facilities Description</u>

The location of the spent fuel storage facility within the plant is shown in Drawing Nos. M-5 and M-6. The spent fuel storage pool for Unit 1 is shown in Figure 9.1-2d. The arrangement of the storage facility will allow for the storage of 3986 fuel assemblies (including 4 defective fuel assemblies), 39 control rods, 20 fuel channels, and 4 control rod guide tubes.

The arrangement of the refueling area has been designed to preclude the movement of heavy loads over the spent fuel pool. Interlocks and travel restriction devices prevent crane use over the spent fuel pool when transferring heavy loads.

The fuel storage racks are free-standing in the spent fuel storage pool. A typical fuel assembly storage rack is shown in Figure 9.1-2a. There is no gap between the racks as they butt against each other in all four directions. The racks are designed to comply with Category I requirements in accordance with Regulatory Guide 1.29. Loads and load combinations are in accordance with Standard Review Plan (SRP) Section 3.8.4, for steel structures. Analysis results show an adequate safety margin for all earthquake conditions. The acceptance criteria is in accordance with Appendix D of SRP Section 3.8.4. The spent fuel storage facility is designed to prevent severe natural phenomena, including missiles generated from high winds, from causing damage to the spent fuel.

9.1.2.1.3 <u>Safety Evaluation</u>

The high density racks consist of 21 individual racks that have capacity for 3986 fuel assemblies and 43 special storage cells. The fuel storage cells consist of 3982 normal fuel storage cells and four defective fuel storage cells. The special storage cells consist of 39 control rod storage cells (1 rack of 18 and 1 rack of 21), and four control rod guide tube storage cells. The existing channel storage racks will remain intact.

The spent fuel racks are designed to maintain the stored spent fuel in a space geometry that precludes the possibility of criticality. The racks will maintain this subcritical array when subjected to maximum earthquake conditions, dropped fuel assembly accident conditions, and any uplift forces generated by the fuel handling equipment.

Based upon the analysis below, it is concluded that the spent fuel storage arrangement meets its safety design basis.

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9.1.2.1.3.1 Rack Design

The poison wall rack design is a honeycomb array of identical stainless steel boxes. They are made of full length 0.090 inch thick sheets which provide smooth wall storage cells. The boxes are 6x6x169 inches. The racks have a nominal 6.26 inch center-to-center distance between fuel assemblies placed in the storage racks. A 0.079 inch thick sheet of neutron poison material with a B-10 loading of 0.022 grams per square centimeter is physically captured between the side walls of each box and sheathing welded to the sides of the box.

The boxes are welded together along the corner edges. The Boral sheets are axially centered on the active fuel region of the stored fuel assemblies and extend to the ends of the natural uranium end caps. Each sheet is contained vertically by the sheathing. No poison material is provided on the periphery of the rack array.

Each storage cell is welded to the rack baseplate which has tapered holes that support the stored fuel assemblies. The fuel assembly is positioned in this hole which provides for water flow through and around the stored fuel assembly.

Each rack is supported on the pool floor by four or five pedestal structures welded to the bottom of the rack. A screw adjustable pad is provided in the pedestals to be used for rack leveling. Leveling adjustments may be made from the surface through the cells over the pedestals, if necessary.

The height of the bottom of the rack above the pool floor, resulting from the necessary vertical dimension of the pedestal structure, provides adequate underneath space for cooling water flow.

9.1.2.1.3.2 Criticality Control

The design of the spent fuel storage racks provides for a subcritical multiplication factor K_{eff} of less than or equal to 0.95 for normal and abnormal storage conditions. Analyses have been performed for each type of fuel stored in the spent fuel pool to assure compliance with the K_{eff} criteria. Critical parameters have been established to evaluate minor variations in the neutronic design of actual bundles of each fuel type. For each new bundle design, these critical parameters are reviewed to ensure the bundle design complies with the criticality analysis for the fuel type.

The spent fuel pool criticality analyses complies with Section 9.1.1 of the Standard Review Plan.

9.1.2.1.3.2.1 GE 8x8 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing GE 8x8 fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Fuel density and enrichment manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. A fuel assembly positioned adjacent to a loaded fuel rack.

g. Dropped fuel assembly.

h. Fuel rack lateral movement.

i. Channel bulge.

j. Clean and unborated water is in the spent fuel pool.

k. Pool water temperature corresponding to highest reactivity.

l. Pool water temperature and density variation..

Standard lattice methods, CASMO-3, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The cross section input to KENO.Va was taken from the 27-energy group data library as adjusted using the NITAWL code to perform resonance correction. The lattice method was used as the primary analysis method and to evaluate the reactivity effects of manufacturing tolerances. The Monte Carlo technique was used to independently verify the lattice based in-rack results and analyze the accident condition.

In support of the criticality safety calculations, CASMO-3 has been verified against Monte Carlo calculations and cold critical data. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in the radial direction. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 5 provides the details of the criticality analysis performed for the GE 8x8 fuel (Unit 1 cycles one to eight and Unit 2 cycles one to seven). This analysis demonstrates that channeled or unchanneled GE 8x8 fuel with a maximum nominal enrichment of 3.75 w/o U-235 can be safely stored in the spent fuel pool. Additionally, Reference 5 provides alternate criteria for safely storing GE 8x8 fuel.

9.1.2.1.3.2.2 ATRIUM-9B Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing ATRIUM-9B fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Bundle design manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. Missing Boral plate.

g. A fuel assembly lying horizontally across the top of loaded fuel racks.

h. Clean and unborated water is in the spent fuel pool.

i. Pool water temperature corresponding to highest in-rack reactivity.

j. Pool water density variations.

Standard lattice methods, CASMO-3G, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The lattice method is used to evaluate peak in-core reactivity and provide an alternate in-rack k criteria for confirming compliance with the criticality analysis.

CASMO-3G with the 40-group "H" neutron library and 10-group gamma library for cross-section input was used in the calculation. The cross section input to KENO.Va was taken from the 16-energy group Hansen-Roach data library as adjusted using the BONAMI and NITAWL codes to perform resonance correction.

In support of the criticality safety calculations, CASMO-3G has been verified against Monte Carlo calculations and cold critical data. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were effectively taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 6 provides the details of the criticality analysis performed for the ATRIUM-9B fuel. This analysis provides a procedure for demonstrating that channeled or unchanneled ATRIUM-9B fuel a maximum nominal enrichment of 4.60 w/o U-235 and a minimum of 8 gadolinia-bearing rods at 3.0 w/o Gd_2O_3 can be safely stored in the spent fuel pool. Additionally, Reference 6 provides alternate criteria for safely storing ATRIUM-9B fuel.

9.1.2.1.3.2.3 GE14 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing GE14 fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Fuel enrichment manufacturing tolerance.

e. Spent fuel storage rack manufacturing tolerances.

f. Missing Boral plate.

g. Dropped fuel assembly.

h. Clean and unborated water is in the spent fuel pool.

i. Pool water temperature and density variations.

j. Fuel rack lateral movement.

Standard lattice methods, TGBLA06, and Monte Carlo techniques, MCNP01A, were employed in the calculations to assure that the design criteria are met. All in-rack calculations were performed using the Monte Carlo technique. The lattice method was used to determine the in-core k-eff critieria for confirming compliance with the criticality analysis.

MCNP01A is a continuous energy code and uses ENDF/B-V evaluated nuclear data.

A set of critical experiments were analyzed using MCNP01A to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 34 provides the details of the criticality analysis performed for the GE14 fuel. This analysis demonstrates that channeled or unchanneled GE14 fuel with a maximum nominal enrichment of 4.90 w/o U-235 and an in-core cold k-infinite <= 1.3392 from TGBLA06 can be safely stored in the spent fuel pool.

9.1.2.1.3.2.4 ATRIUM-10 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing ATRIUM-10 fuel:

a. Normal positioning and orientation in the spent fuel storage array.

b. Eccentric positioning and orientation in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Bundle design manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. Missing Boral plate.

g. A fuel assembly lying horizontally across the top of loaded fuel racks.

h. Clean and unborated water is in the spent fuel pool.

i. Pool water temperature corresponding to highest in-rack reactivity.

j. Pool water density variation.

Standard lattice methods, CASMO-3G, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The lattice method is used to evaluate peak in-core reactivity and provide an alternate in-rack k criteria for confirming compliance with the criticality analysis.

CASMO-3G with the H-library for cross-section input was used in the calculation. The cross section input to KENO.Va was taken from the 27-energy group data library as adjusted using the BONAMI and NITAWL codes to perform resonance correction.

In support of the criticality safety calculations, CASMO-3G has been verified against Monte Carlo calculations and critical experiments. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in the radial direction. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 31 provides the details of the criticality analysis performed for the ATRIUM-10 fuel. This analysis demonstrates that channeled or unchanneled ATRIUM-10 fuel with a maximum nominal enrichment of 4.70 w/o U-235 and a minimum of 10 gadolinia-bearing rods at 3.0 w/o Gd_2O_3 can be safely stored in the spent fuel pool. Additionally, Reference 31 provides alternate criteria for safely storing ATRIUM-10 fuel.

9.1.2.1.3.3 Control of Other Hazards

The fuel rack system was also evaluated for the inadvertent droppage of a fuel assembly onto it. The cases evaluated are a straight drop of the fuel assembly on top of the rack and a straight drop of the fuel assembly into the cell of the rack. The fuel assembly was located 30 inches above the top of the rack in each case. The results show that damage would not occur to the active fuel region of the stored assembly when an assembly impacted the top of a rack, and the liner plate would not be perforated when an assembly impacted the cells bottom plate. The NRC has accepted such deformations under this type of accident.

Transfer of fuel assemblies between the new fuel vault and the water filled storage pool (Unit 1 and 2 spent fuel storage pools) and also within the storage pool, transfer pool, and cask well vault is performed with the fuel handling equipment. The fuel grapple or the auxiliary fuel hoist is used depending on the transfer operation. The grapple and hoist provided with load sensing and limiting devices are designed to the load limits specified in Table 9.1-5.

The load limiting features of the platform fuel grapple and auxiliary hoist will prevent damage to the fuel racks during fuel transfer operation. These load limits provide a redundant safety feature since the fuel handling grapples cannot be lowered below the upper fuel rack. They interface with the fuel bail only.

Accidental droppage of heavy objects into the pool is precluded by the use of administrative procedures, electrical interlocks to limit the crane travel over the spent fuel pool, and the use of guardrails around the spent fuel to prevent the falling of fuel pool handling equipment into the pool.

Each unit's spent fuel storage pool is a Seismic Category I structure which is lined with stainless steel in order to minimize leakage and reduce corrosion product formation in the pool. The design of the spent fuel pool cooling and cleanup system is such that the failure of any component in the system would not drain the fuel pool or uncover the fuel. There are no drains in the fuel pool. All piping which enters the pool, such as diffusers, is equipped with a vacuum breaker, thereby preventing the possibility of siphoning the pool.

A seismic Category I, Quality Group C leak detection system is provided for the collection of possible leakage behind the pool's liner plate. The liner is segregated into quadrants which collect leakage at independent sumps located under each corner of the pool. Flow from the sumps is monitored by flow switches equipped with alarms. In addition, leak detection systems are provided for all volumes which communicate with the fuel pool during refueling or fuel shipment activities and are also designed as Seismic Category I, Quality Group C. Thus, a means of leak detection is available at all times during normal and abnormal conditions and is used to monitor any flow paths which could reduce the level of the pool from its normal level.

Both Units 1 and 2 share a common spent fuel cask well which accepts the spent fuel shipping cask and accommodates underwater fuel transfer to the cask from either Unit 1 or Unit 2 spent fuel pools through their respective transfer canals. All movements of the cask while present on the refueling floor are controlled by the critical "L" path control system of the reactor building crane as explained in Special Report Number 2 to the PSAR entitled, "Supplemental Crane Design Features and Fuel Cask Drop Analysis," and Subsection 9.1.4 of the LSCS-UFSAR.

The original design of the Reactor Building Overhead Crane (RBOC) was not single failure proof and Special Report Number 2 required that a 6 inch height restriction be enforced when a fuel cask is being moved over the "L" path in the Reactor Building. NRC RIS 2005-25 specifically addressed the acceptability of upgrading of cranes to meet single failure proof requirements for dry cask storage movement. The RBOC was upgraded to a single failure proof design in accordance with NRC requirements given in NUREG-0554, NUREG 0612 and ASME NOG-1. The LaSalle RBOC has been upgraded to meet the requirements as stated in the RIS and as such meets the NUREG 0612 requirements without the imposition of the 6 inch height restriction.

[Historical Information]

The evaluation of the consequences of postulated accidental drops of a spent fuel cask were discussed along with certain supplemental plant design features within Reference 1. These design features were incorporated to ensure that the consequences of a fueling cask drop are minimal. The safety conclusion is that drops do not cause gross structural failures; hence, the loss of critical safety-related functions is precluded. The consequences of various drops, including the most adverse cask drop from the refueling floor through the ground level floor to the base slab, showed that adequate physical separation of equipment exists to allow safe reactor shutdown and maintenance in a safe shutdown condition.

[End Historical Information]

The capability of the spent fuel pool storage facility to prevent missiles generated by high winds from contacting the fuel is discussed in Subsection 3.5.2.

Fuel pool cooling is discussed in Section 9.1.3.

Provisions to limit potential offsite exposures in the event of significant release of radioactivity from the spent fuel have been provided. These features include a ventilation exhaust system, isolation of the secondary containment on high radiation, and a charcoal filter exhaust system capable of maintaining the secondary containment at a 1/4-inch H_2O negative pressure with respect to the outside ambient. Each feature is discussed in more detail in Subsection 9.4.2.

Activated Low Level Waste (LLW) hardware processing and storage applies a stepped approach using a combination of in-pool and dry storage methods. Storage racks and equipment have been designed to process and store the hardware in the cask well until enough volume is available to load a dry cask. This equipment has been designed to not impact the Spent Fuel Pool liner during a seismic event. The next activity involves packaging the components into specially designed waste liners, eleven (11) of which would fit inside one (1) Holtec container design having some design features similar to the existing dry waste storage system. This activity involves using the existing equipment used for dry fuel storage loading and movement to place the hardware on a pad adjacent to the ISFSI storage pad.

Based upon the above analysis, it is concluded that the Unit 1 spent fuel storage arrangement meets its safety design basis.

9.1.2.1.4 Testing and Inspection

A long-term Boral Coupon in-pool surveillance program will be conducted. A procedure will also be implemented after a seismic event, equivalent to an Operating Basis Earthquake (OBE), to walkdown and inspect rack modules, their displacements and assess the damage, if any, to adjacent structure and components.

9.1.2.1.5 Summary of Radiological Considerations

The safety design bases of the spent fuel storage arrangement are satisfied. The flooded spent fuel pool provides a water barrier which ensures sufficient shielding to protect plant personnel from exposure to radiation in excess of 10CFR20 guidelines. In the event of a release of radioactivity from stored fuel, the spent fuel storage facility, including the reactor building, is capable of limiting off-site exposure to a small fraction of 10CFR100 guidelines. Further details of radiological considerations for the spent fuel storage arrangement are presented in Chapter 12.0.

9.1.2.2 Unit 2 Spent Fuel Pool

9.1.2.2.1 Design Bases

9.1.2.2.1.1 Safety Design Bases

The Unit 2 spent fuel storage facilities are designed to provide the following:

a. The fuel array in the fully loaded spent fuel racks is subcritical, by at least 5% ΔK.

b. The spent fuel storage racks, containing their full complement of fuel (4078 fuel assemblies, including fuel in the 5 defective fuel storage locations), are designed to withstand the seismic loadings of the Operating Basis Earthquake (OBE) and the Safe Shutdown Earthquake (SSE) in order to minimize distortion of the fuel storage arrangement(References 20 through 27).

c. The flooded spent fuel pool provides a water barrier which ensures sufficient shielding to protect plant personnel from exposure to radiation in excess of 10CFR20 guidelines.

d. The spent fuel storage facility is designed to prevent missiles generated by high winds from damaging the fuel.

9.1.2.2.1.2 Power Generation Design Bases

Spent fuel storage space is supplied in the Unit 2 spent fuel storage pool for approximately 530% of the full core load; i.e., 4073 fuel assemblies.

9.1.2.2.2 Facilities Description

The location of the spent fuel storage facility within the plant is shown in Drawing Nos. M-5 and M-6. The spent fuel storage pool for Unit 2 is shown in Figure 9.1-2c. The arrangement of the storage facility will allow for the storage of 4073 fuel assemblies, 35 control rods, 20 fuel channels, 5 defective fuel assemblies and 3 control rod guide tubes.

The arrangement of the refueling area has been designed to preclude the movement of any heavy loads over the spent fuel pool. Interlocks and travel restriction devices prevent crane use over the spent fuel pool when transferring heavy loads.

The fuel storage racks are free-standing in the spent fuel storage pool. A typical fuel assembly storage rack is shown in Figure 9.1-2b. There is no gap between the racks as they butt against each other in all four directions. The racks are designed to comply with Category I requirements in accordance with Regulatory Guide 1.29. Loads and load combinations are in accordance with Standard Review Plan (SRP) Section 3.8.4, for steel structures. Analysis results show an adequate safety margin for all earthquake conditions. The acceptance criteria is in accordance with Appendix D of SRP Section 3.8.4. The spent fuel storage facility is designed to prevent severe natural phenomena, including missiles generated from high winds, from causing damage to the spent fuel.

9.1.2.2.3 Safety Evaluation

The high density racks have capacity for 4073 fuel assemblies (contained in 20 racks) and 43 special storage cells. The special storage racks consist of 35 control rod storage cells (1 rack of 18 and 1 rack of 17), five (5) defective fuel storage cells and three (3) control rod guide tube storage cells. The existing channel storage rack will remain intact.

The spent fuel racks are designed to maintain the stored spent fuel in a space geometry that precludes the possibility of criticality. The racks will maintain this subcritical array when subjected to maximum earthquake conditions, dropped fuel assembly accident conditions, and any uplift forces generated by the fuel handling equipment.

Based upon the analysis below, it is concluded that the spent fuel storage arrangement meets its safety design basis.

9.1.2.2.3.1 Rack Design

The poison wall rack design is a honeycomb array of identical stainless steel boxes. They are made of full-length 0.090 inch thick sheets which provide smooth wall storage cells. The boxes are 6x6x168 inches. The racks have a nominal 6.26 inch center-to-center distance between fuel assemblies placed in the storage racks. A nominal 0.075 inch thick sheet of Boraflex neutron poison material with a nominal B-10 loading of 0.0238 grams per square centimeter is physically captured between the side walls of all adjacent boxes (Reference 38). To provide space for the poison sheet between boxes, a double row of matching flat round raised areas are coined in the side walls of all boxes. The raised dimension of these locally formed areas on each box wall is half the thickness of the poison sheet. The boxes are fused together at all these local areas. The poison sheets are scalloped along their edges to clear these areas. The sheets are axially centered on the active fuel region of the stored fuel assemblies. Each sheet is contained vertically by a stop plate at the bottom of the poison. The plate is welded on one of the adjacent box walls. A 0.031 inch thick sheet of stainless steel which is welded to the box intermittently all around, between adjacent racks at the East-West and North-South walls. No poison material is provided on the periphery of the rack array.

Neutron-absorbing inserts have been placed in all cells accessible by fuel in the Unit 2 spent fuel pool. These rack inserts are chevron in shape, and held in place by the force of the insert against the stainless steel wall of the cell. The inserts provide the pool neutron-absorbing criticality control to maintain the Unit 2 spent fuel pool subcritical by at least 5% ΔK (References 43, 44, 45, and 46) without the credit of Boraflex. Each storage cell has a welded-in bottom plate with a tapered central hole that supports the stored fuel assembly. The fuel assembly is positioned in this hold which provides for water flow through and around the stored fuel assembly.

Each rack is supported on the pool floor by five pedestal structures welded to the bottom of the rack. A screw adjustable pad is provided in the four corner pedestals to be used for rack leveling. Leveling adjustments may be made from the surface through the cells over the pedestals if necessary.

The height of the bottom of the rack above the pool floor, resulting from the necessary vertical dimension of the pedestal structure, provides adequate underneath space for cooling water flow.

9.1.2.2.3.2 Criticality Control

The design of the spent fuel storage racks provides for a subcritical multiplication factor K_{eff} of less than or equal to 0.95 for normal and abnormal storage conditions. Analyses have been performed for each type of fuel stored in the spent fuel pool to assure compliance with the K_{eff} criteria. Critical parameters have been established to evaluate minor variations in the neutronic design of actual bundles of each fuel type. For each new bundle design, these critical parameters are reviewed to ensure the bundle design complies with the criticality analysis for the fuel type.

The spent fuel pool criticality analyses complies with Section 9.1.1 of the Standard Review Plan.

An analysis has also been performed (Reference 46) to ensure that with the reference bounding assembly (Atrium-10 fuel assembly), complete Boraflex degradation, and a neutron absorbing NETCO Snap-in insert in each storage cell, the pool K_{eff} remains below the 0.95 K_{eff} acceptance criterion established by the NRC.

9.1.2.2.3.2.1 GE 8x8 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing GE 8x8 fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Bundle design manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. A fuel assembly positioned adjacent to a loaded fuel rack.

g. Dropped fuel assembly.

h. Missing Boraflex panel.

i. Fuel assembly bowing.

j. Clean and unborated water is in the spent fuel pool.

k. Pool water temperature corresponding to highest reactivity.

l. Boraflex degradation.

Standard lattice methods, CASMO-3, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The cross section input to KENO.Va was taken from the 27-energy group data library as adjusted using the NITAWL code to perform resonance correction. The lattice method was used as the primary analysis method and to evaluate small incremental reactivity effects. The effect of Boraflex gaps was determined using the Monte Carlo technique.

In support of the criticality safety calculations, CASMO-3 has been verified against Monte Carlo calculations and cold critical data. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 36 provides the details of the criticality analysis performed for the GE 8x8 fuel (Unit 1 cycles one to eight and Unit 2 cycles one to seven). This analysis provides a procedure for demonstrating that channeled or unchanneled GE 8x8 fuel can be safely stored in the spent fuel pool for a range of enrichment loadings, gadolinia loadings, and Boraflex degradation.

9.1.2.2.3.2.2 ATRIUM-9B Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing ATRIUM-9B fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Bundle design manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. Missing Boraflex panel.

g. A fuel assembly positioned adjacent to a loaded fuel rack.

h. A fuel assembly lying horizontally across the top of loaded fuel racks.

i. Dropped fuel assembly.

j. Fuel assembly bowing.

k. Clean and unborated water is in the spent fuel pool.

l. Pool water temperature corresponding to highest in-rack reactivity.

m. Boraflex degradation.

Standard lattice methods, CASMO-3G, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The lattice method was used as the primary analysis method and to evaluate small incremental reactivity effects. The effect of Boraflex gaps was determined using the Monte Carlo technique.

CASMO-3G with the 40-group "H" neutron library and 10-group gamma library for cross-section input was used in the calculation. The cross section input to KENO.Va was taken from the 27-energy group data library as adjusted using the NITAWL code to perform resonance correction.

In support of the criticality safety calculations, CASMO-3G has been verified against Monte Carlo calculations and cold critical data. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were effectively taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 7 provides the details of the criticality analysis performed for the ATRIUM-9B fuel. This analysis provides a procedure for demonstrating that channeled or unchanneled ATRIUM-9B fuel can be safely stored in the spent fuel pool for a range of enrichment loadings, gadolinia loadings, and Boraflex degradation.

9.1.2.2.3.2.3 GE14 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing GE14 fuel:

a. Normal positioning in the spent fuel storage array.

b. Eccentric positioning in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Fuel enrichment manufacturing tolerance.

e. Spent fuel storage rack manufacturing tolerances.

f. Missing Boraflex panel.

g. A fuel assembly positioned adjacent to a loaded fuel rack.

h. Dropped fuel assembly.

i. Clean and unborated water is in the spent fuel pool.

j. Pool water temperature variations.

k. Boraflex degradation.

l. Fuel rack lateral movement.

Standard lattice methods, TGBLA06, and Monte Carlo techniques, MCNP01A, were employed in the calculations to assure that the design criteria are met. All in-rack calculations were performed using the Monte Carlo technique. The lattice method was used to determine the in-core k-eff critieria for confirming compliance with the criticality analysis.

MCNP01A is a continuous energy code and uses ENDF/B-V evaluated nuclear data.

A set of critical experiments were analyzed using MCNP01A to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 35 provides the details of the criticality analysis performed for the GE14 fuel. This analysis provides a procedure for demonstrating that channeled or unchanneled GE14 fuel can be safely stored in the spent fuel pool for a range of enrichment loadings, gadolinia loadings, and Boraflex degradation.

9.1.2.2.3.2.4 ATRIUM-10 Fuel

To ensure that the spent fuel pool design criteria of K_{eff} less than or equal to 0.95 is met, the following conditions were analyzed for the spent fuel pool storage racks containing ATRIUM-10 fuel:

a. Normal positioning and orientation in the spent fuel storage array.

b. Eccentric positioning and orientation in the spent fuel storage array.

c. Fuel racks fully loaded with fuel at most reactive burnup.

d. Bundle design manufacturing tolerances.

e. Spent fuel storage rack manufacturing tolerances.

f. A fuel assembly positioned adjacent to a loaded fuel rack.

g. Missing Boraflex panel.

h. A fuel assembly lying horizontally across the top of loaded fuel racks.

i. Dropped fuel assembly.

j. Fuel assembly bowing.

k. Clean and unborated water is in the spent fuel pool.

l. Pool water temperature corresponding to highest in-rack reactivity.

m. Boraflex degradation.

Standard lattice methods, CASMO-4, and Monte Carlo techniques, KENO.Va, were employed in the calculations to assure that the design criteria are met. The lattice method is used to evaluate small incremental reactivity effects that would otherwise be lost in the statistical approach of the Monte Carlo technique.

CASMO-4 with the 70-group "L" neutron library and 18-group gamma library for cross-section input was used in the calculation. The cross section input to KENO.Va was taken from the 27-energy group data library as adjusted using the BONAMI and NITAWL codes to perform resonance correction.

In support of the criticality safety calculations, CASMO-4 has been verified against Monte Carlo calculations and critical experiments. Additionally, a set of critical experiments were analyzed using KENO.Va to provide a definitive determination of the methodology bias. The critical experiments included a wide range of compositions and geometries that are representative of spent fuel rack designs.

For the spent fuel pool, it was assumed that the storage array is infinite in all directions. Since no credit was taken for leakage, the reported effective neutron multiplication factors are in reality infinite multiplication factors. The biases between the calculated results and the experimental results, as well as the uncertainty involved in the calculations, were taken into account as part of the calculational procedure to assure that the specified K_{eff} limits were met.

Reference 33 provides the details of the criticality analysis performed for the ATRIUM-10 fuel. This analysis provides a procedure for demonstrating that channeled or unchanneled ATRIUM-10 fuel can be safely stored in the spent fuel pool for a range of enrichment loadings, gadolinia loadings, and Boraflex degradation.

9.1.2.2.3.3 Control of Other Hazards

The original seismic analysis of the free standing racks was based on the two dimensional single rack seismic analysis for two horizontal direction and the equivalent static loads obtained from the vertical response spectra. Later, additional confirmatory analyses were performed considering three components of postulated earthquake, acting simultaneously, and bounding coefficients of friction of 0.2 and 0.8. The results of the confirmatory analyses were used by NRC staff in the evaluations documenting the adequacy of the rack system. Based on the results, reinforcing plates were provided to protect potentially vulnerable portions of each rack from significant deformations caused by impact loads.

The fuel rack system was also evaluated for the inadvertent droppage of a fuel assembly onto it. The cases evaluated are a straight drop of the fuel assembly on top of the rack and a straight drop of the fuel assembly into the cell of the rack. The fuel assembly was located 30 inches above the top of the rack in each case. The results show that damage would not occur to the active fuel region of the stored assembly when an assembly impacted the top of a rack, and the liner plate would not be perforated when an assembly impacted the cells bottom plate. The NRC has accepted such deformations under this type of accident.

For a discussion of the following topics, refer to the Unit 1 safety evaluation (Subsection 9.1.2.1.3), the features are identical between units: fuel transfer paths; load capacity and limiting features of the fuel grapple and auxiliary hoist; administrative controls and electrical interlocks pertaining to crane travel over the fuel pool, and accidental droppage of fuel handling equipment, fuel pool design features regarding its seismic design, accidental drainage, and leakage detection; protection against missiles; and protection against radiological releases.

Based upon the above analyses, it is concluded that the spent fuel storage arrangement meets its safety design bases.

9.1.2.2.4 Testing and Inspection

A long-term neutron-absorbing insert coupon in-pool surveillance program will be conducted. A procedure will also be implemented after a seismic event, equivalent to an Operating Basis Earthquake (OBE), to walkdown and inspect rack modules, their displacements and assess the damage, if any, to adjacent structure and components.

9.1.2.2.5 Summary of Radiological Considerations

The safety design bases of the spent fuel storage arrangement are satisfied. The flooded spent fuel pool provides a water barrier which ensures sufficient shielding to protect plant personnel from exposure to radiation in excess of 10CFR20 guidelines. In the event of a release of radioactivity from stored fuel, the spent fuel storage facility, including the reactor building, is capable of limiting off-site exposure to a small fraction of 10CFR100 guidelines. Further details of radiological considerations for the spent fuel storage arrangement are presented in Chapter 12.0.

9.1.2.3 Dry Cask Storage

A Dry Cask Storage (DCS) system and the Independent Spent Fuel Storage Installation (ISFSI) provide the means for interim onsite storage of LaSalle Unit 1 or 2 spent nuclear fuel. The DCS system is the HI-STORM 100S Cask System. The ISFSI reinforced concrete pad with engineered fill beneath is located in the northeast corner of the Protected Area (PA) and has a capacity for 90 HI-STORM 100S casks. Use of the ISFSI for storage and handling of spent nuclear fuel is granted upon compliance with the conditions of the General License issued under 10 CFR 72, Subpart K and the conditions contained in the Certificate of Compliance (CoC) for the cask system. Use of the ISFSI for storage and handling of spent fuel will be in accordance with the LaSalle County Station Units 1 & 2 10 CFR 72.212 Evaluation Report (Reference 42).

9.1.3 Fuel Pool Cooling and Cleanup System (FPCCS)

The Fuel Pool Cooling and Cleanup System (FPCCS) removes the decay heat released from spent fuel assemblies (SFAs) offloaded and stored in the spent fuel pool (SFP), maintains the water level above the top of the SFAs and maintains fuel pool water temperature, water purity, and water clarity. This section describes the SFP filters and demineralizers, and then discusses the SFP cooling functions. Additional discussion is provided to describe the emergency SFP cooling provided by the "B" Residual Heat Removal system pump and heat exchanger, and the emergency fuel pool makeup provisions provided by the core standby cooling system-equipment cooling water system (CSCS-ECWS).

9.1.3.1 Spent Fuel Pool Cooling Filters and Demineralizers

9.1.3.1.1 Design Bases

9.1.3.1.1.1 Safety Design Bases

There are no safety design bases identified for the Spent Fuel Pool Cooling Filters and Demineralizers portion of the FPCCS.

9.1.3.1.1.2 Power Generation Design Bases

The fuel pool filter demineralizer portion of this system is designed to provide water for the pool with a design objective water quality as specified below:

Suspended solids	5 ppb	
Total dissolved solids	25 ppb	(as SiO_2)
Total iron	5 ppb	(as Fe)
Total copper	3 ppb	(as Cu)
Sodium	5 ppb	(as Na)
Chloride	2 ppb	(as Cl)
Specific conductivity	0.1 µmho/cm at 25° C	
pH	6.0 to 7.5 at 25 °C	

This design objective water quality allows adequate clarity and purity to permit efficient fuel handling activities during normal plant operations and to minimize radiological effects upon operating personnel.

9.1.3.1.2 System Description

Each unit is provided with two 50% powder-type fuel pool filter-demineralizer units. These units are located in the solid radwaste building and controlled from a local panel near the filter-demineralizers. The system is fed directly from the fuel pool cooling pumps with one-half of the 3000-gpm flow bypassing the filter-demineralizer that is in service and the remainder being processed. While one unit is in service the other is either in a standby mode or undergoing recharging.

If necessary, both filter-demineralizers can be placed in service to meet the design objective water quality as stated in Subsection 9.1.3.1.1.2.

If the inlet water temperature should exceed 150°F, the filter-demineralizer system is bypassed completely in order to prevent degradation of the demineralizing and filter media in the vessels. A full-flow bypass line is available in the system during this mode of operation.

9.1.3.1.3 Safety Evaluation

There is no safety evaluation identified for the Spent Fuel Pool Cooling Filters and Demineralizers portion of the FPCCS.

9.1.3.2 Spent Fuel Pool Cooling

9.1.3.2.1 Design Bases

9.1.3.2.1.1 Safety Design Bases

During normal operation of the plant (i.e., no refueling operations being conducted), the SFP cooling system safety design bases are as follows

a. Maintain the SFP water level at elevation 842 feet 6 inches. This is approximately 22 feet above the top of the spent fuel storage racks. SFP water level makeup is provided from the cycled condensate system.

b. Maintain the SFP water temperature at or below 140 °F.

During refueling conditions, the SFP cooling system safety design bases are as follows:

a. Maintain the SFP water temperature at or below 140 °F for normal refueling offloads. This assumes a Service Water System (i.e., FPCCS heat exchanger inlet) water temperature of 100° F. A "normal" refueling operation can include a batch offload or a full core offload.

b. Maintain the SFP water temperature below boiling for an "emergency" full core offload. This assumes a Service Water System water temperature of 100° F.

c. Maintain the SFP water level at elevation 842 feet 6 inches.

These SFP water temperature refueling design bases conform to the guidance provided in the NRC Standard Review Plan (SRP) 9.1.3, "Spent Fuel Pool Cooling and Cleanup System." The analytical bases and assumptions for the normal and emergency refueling offloads are discussed in section 9.1.3.2.3, "Safety Evaluation," below.

9.1.3.2.2 System Description

Each unit possesses its own fuel pool cooling system as shown in Drawing Nos.

M-98 and M-144 (relevant fuel pool cooling data appears in Table 9.1-3). Under normal plant operating conditions, the FPCCS, which consists of two pumps and two heat exchangers arranged in parallel, takes suction from the fuel pool surge tanks and subsequently pumps water through the filter-demineralizer system and then to the heat exchangers. Heat from the fuel pool water is rejected by the heat exchangers to the service water system. From the heat exchangers, the cooled fuel pool water is supplied to the fuel pool which is used to provide a circulating flow of cooled water in the pool. The fuel pool is provided with an adjustable weir plate and scuppers which control the level of the pool and provide a flow path for the fuel pool water to the surge tanks. From the surge tanks the water enters the cooling system and then flows back to the diffusers located in the reactor well.

During refueling operations, when the reactor well and the dryer-separator storage pit have been filled, additional scuppers and a weir provide flow paths for water to enter the surge tank.

During spent fuel shipment activities, when the fuel transfer canals and cask storage well are filled, scuppers and a diffuser provide a circulation path to and from either Unit 1 or Unit 2 fuel pool cooling system depending upon which unit is experiencing shipment activities.

Normal makeup to the fuel pool cooling system is provided through the use of cycled condensate which is added in the surge tank; the amount of which is based upon makeup requirements as deemed necessary by operating personnel in order to compensate for evaporation and leakage losses. The level in the pool is monitored both in the control room and locally with high and low alarming annunciators located in the control room.

After refueling has been completed, water used to fill the reactor well and the dryer-separator storage pit is returned to the cycled condensate storage tank or to the suppression pool (Subsection 9.2.11) as necessary.

The temperature of the pool water is monitored via the plant process computer in the control room both at the discharge of the fuel pool surge tanks and at the discharge of the fuel pool heat exchangers, thus providing a profile of temperature trends affecting the overall temperature of the pool.

9.1.3.2.3 Safety Evaluation

9.1.3.2.3.1 Introduction and Background

The heat loads, and therefore the heat removal capabilities of the FPCCS, are dependent on the previous inventory (decay heat load) already in the SFP, the SFP shell side temperature, the Service Water tube side inlet temperature, the irradiation history of the batch or core to be offloaded, and the time since reactor shutdown until the offload commences. The NRC Standard Review Plan (SRP) 9.1.3, "Spent Fuel Pool Cooling and Cleanup System," discusses a "maximum normal heat load" (MNHL), considered to be a batch offload during a normal refueling, and an "abnormal maximum heat load," whereby some "emergency" requires that a full core must be offloaded into a SFP which already contains a batch offload from a prior refueling. The "abnormal maximum heat load" is also called by LaSalle an "emergency heat load" (EHL). The SRP 9.1.3 review criteria for these two cases is as follows:

a. Assuming only one train of FPCCS is operating, the SFP water temperature should be less than or equal to 140° F for the MNHL case.

b. Assuming both trains of FPCCS are operating, the SFP water temperature should be kept below boiling for the abnormal maximum heat load (or EHL) case.

The SRP 9.1.3 acceptance criteria of 140°F for a batch offload, and of no pool boiling for an "emergency" full core offload, were the NRC Staff's acceptance criteria for the rerack submittals and the power uprate project (References 14 and 15), and are the current FPCCS criteria. Since the MNHL and EHL are dependent on the assumptions made, a "bounding" analysis is presented herein, which is intended to encompass any future refueling scenarios and heat loads, and which is intended to envelope any conservative assumptions that may be made.

9.1.3.2.3.2 Analysis Assumptions

The LaSalle SFP capacities are 4078 cells in the Unit 2 SFP, and a Unit 1 SFP capacity of 3986 cells (including fuel stored in the defective fuel storage locations). For a bounding analysis, the Unit 2 SFP capacity is analyzed, assuming an initial inventory of (4078 - 764 - 320) 2994 cells filled with previous offloads. The Unit 2 SFP capacity bounds the Unit 1 SFP. The previous batches are assumed to have been irradiated at the power optimization power level, 3548 MW_t, at a 97% capacity factor, for up to three 24-month fuel cycles. Decay heat is calculated using the ANS 5.1-1979 Standard with two sigma uncertainty. The decay heat calculations also include contributions from miscellaneous actinides and activation products consistent with the recommendations of GE SIL 636.

The SFP is assumed to be almost-filled with spent fuel assemblies (SFAs) from previous refuelings, such that there are only spaces available for one more batch offload, plus one full core offload. A batch (i.e., "normal") offload into the pool is assumed to proceed during a refueling outage lasting 20 days. This is Case 1. Case 1 analysis results provide the "maximum normal heat load," to use the SRP 9.1.3 terminology.

The plant then returns to power, and full-power operation is assumed for 36 days (this 36 day period corresponds to the time assumed in SRP 9.1.3, Section

III.1.h.iii). At that point, an "emergency" arises that requires the offload of the full core into the SFP (which contains the batch previously offloaded plus the previous inventory of SFAs). This is Case 2. Case 2 analysis results provide the "abnormal maximum heat load," again using the SRP 9.1.3 terminology. An additional Case 2a is also analyzed, assuming the plant runs at full power for a 24-month cycle, and then the full core is offloaded into the SFP.

For purposes of the bounding SFP analyses, a batch is assumed to consist of 320 SFAs, and the offload rate is assumed to be an average rate of 15 SFAs per hour. These values are chosen for conservatism, and are not design bases. A full core consists of 764 SFAs. This applies to both LaSalle Units.

The time before fuel offload begins is assumed to be 24 hours. This assumption is based on Technical Requirements Manual 3.9.a, which requires the reactor to be subcritical for at least 24 hours prior to movement of irradiated fuel in the reactor pressure vessel.

For one batch offloaded into the SFP ("maximum normal heat load"), in accordance with single failure considerations, only one pump (3000 gpm) through one heat exchanger (HX) is assumed to be operable for the FPCCS. An initial Service Water System temperature of 104°F is assumed, and the SFP is assumed to initially be at 100°F for these conditions. (The 104°F Service Water System value accounts for the maximum system operating temperature; the 100°F SFP temperature correlates with administrative controls on SFP temperature during normal operation). This results in zero heat removal at the onset of the analysis.

For the full core offloaded into the SFP ("abnormal maximum heat load"), the FPCCS capacity flowrate without a single failure is two pumps (5050 gpm total) through two heat exchangers. The 5050 gpm is based on the FPCCS capacity calculations with two pumps running. An initial Service Water System temperature of 104°F is assumed, with the SFP initially at 100°F.

The ability of the FPCCS to remove design heat loads with a maximum Service Water System temperature of 104°F is evaluated in Reference 39.

9.1.3.2.3.3 Analysis Results

The peak heat loads, peak SFP temperature, time of peak SFP temperature, time to boil assuming loss of all FPCCS cooling, and the boil off rates for the cases analyzed, are depicted in Table 9.1-6. The time to boil was calculated by assuming that FPCCS cooling is lost at the time of peak SFP temperature for each case.

An "in-reactor" hold time of 24 hours before a batch offload (initial case) gives a calculated peak SFP temperature of 157°F using the above assumptions, whereas delaying the batch offload for 165 hours (Case 1) gives a calculated peak SFP temperature of less than 140°F.

If the service water system temperature is 100°F instead of 104°F, the calculated peak SFP temperature will remain with the current Licensing limit of 140°F by delaying the batch off load for 112 hours.

The bounding analyses, which as previously noted contain assumptions and parameters which were deliberately chosen to provide ultra-conservative decay heat loads, show that with both trains of FPCCS operating, even for an "emergency" full core offload commencing 24 hours after shutdown, the SFP temperature peaks at 152°F at 78 hours after shutdown (Case 2).

The case with the highest decay heat load is Case 2a, whereby after a 24-month fuel cycle, a full core is offloaded into the SFP, which contains the previous inventories of uprated SFAs and the batch offloaded in the last refueling. The highest peak decay heat load for this Case 2a is 61 x 10^6 BTU/hr, assuming the core is offloaded 24 hours after shutdown. For this case, the SFP temperature peaks at 157°F at 78 hours after shutdown.

9.1.3.2.3.4 Operational Considerations

For each offload a refueling-specific analysis is performed considering current plant conditions, to ensure that the SFP water temperature is maintained below 140° F in accordance with the acceptance criteria as described in Section 9.1.3 of the SRP. As indicated by the analysis results depicted in Table 9.1-6, a normal refueling outage offload may commence within 24 to 165 hours after shutdown, depending on the heat load and the FPCCS heat removal capabilities.

Depending on the actual heat load for the specific offload, the actual configuration of SFP cooling required can be determined and measures taken to ensure the availability of the equipment. These measures ensure that adequate cooling capability is provided for planned refuelings, either a core shuffle or a full core offload, and for unplanned offloads.

9.1.3.2.3.5 Fuel Pool Cooling Used as Alternate Decay Heat Removal System

Systems that cool the fuel pool can also be used as an alternate method of decay heat removal from the reactor cavity during refueling outages. When the fuel pool gates are removed, a natural circulation develops between the reactor cavity and spent fuel pool due to the temperature and density differences between the two bodies of water. When the fuel pool gates are installed, parallel flowpaths exist to route water to both the fuel pool and the reactor cavity to provide cooling capability. To qualify this alternate method of decay heat removal, an analysis is performed prior to the refueling outage to evaluate the heat load in both the reactor vessel and spent fuel pool that will be unique to each refueling outage. The heat load is calculated using industry accepted conservative methodologies. From the heat load, the heat rejection capability of the spent fuel pool cooling system is determined. The fuel pool cooling system has the capability to route all flow to the fuel pool, all flow to the reactor cavity, or a portion of the flow to the fuel pool with a portion of the cooling flow directly to the refueling cavity. Conservative values for the service water temperature are determined based on the time of year during which the refueling outage occurs. This analysis demonstrates that the temperature of the water in the reactor cavity will not exceed 140°F, if specified flowrates are maintained. Requirements for spent fuel pool cooling as described in this UFSAR section must also be satisfied. Furthermore, analysis is performed to show that no local boiling will occur on the surface of the fuel rods. Administrative controls are procedurally implemented to ensure compliance with the analysis assumptions such as time after shutdown, flow capability, and temperature limits.

9.1.3.2.3.6 Fuel Pool Cooling Assist Mode, and Emergency Makeup Capabilities

The FPCCS is designed nonseismic. The cooling water for the secondary side of the spent fuel pool cooling system heat exchangers is provided by the nonseismic station Service Water system. The FPCCS conforms to the guidance in NRC SRP 9.1.3, including a seismic Category I makeup system and an appropriate backup method to add coolant to the SFP. The review procedures of SRP 9.1.3 section III.1.f state that the backup system need not be a permanently installed system, nor Category I, but must take water from a Category I source.

The Residual Heat Removal (RHR) System is designed for a Fuel Pool Cooling Assist Mode by spooling in suction and return lines to the RHR "B" loop pump and heat exchanger of that unit, to provide backup cooling capability to the SFP if required. Note that there is no requirement that the RHR system be aligned for SFP cooling during an offload.

In the event there is a loss of SFP cooling the "B" train of the RHR system may be employed to cool the SFP. Also, in the event of an excessive heat load, the "B" loop of the RHR system can be used to cool the spent fuel pool. The flow rate is approximately 7500 gpm through the RHR heat exchanger and back to the RHR return in the fuel pool. The RHR system, including all piping to and from the spent fuel pool, is independent of the FPCCS and is seismic Category I. Procedural controls are in place to institute the RHR Fuel Pool Cooling Assist Mode, if required, on loss of both Units' FPCCS.

In the event conditions occur which allow the SFP coolant to boil, normal makeup may be made from the cycled condensate storage system. This system, however, is not safety-related and may not be available, except during normal operating conditions. A seismic Category I fuel pool emergency makeup system, which is capable of a makeup rate of 300 gpm to the pool, is present should it be necessary to provide emergency makeup in the event that the cycled condensate storage system is not available. The fuel pool emergency makeup system, which is part of the CSCS-ECWS, is safety-related and meets the single-failure criterion.

9.1.3.3 Testing and Inspection

No special tests are required because at least one pump, heat exchanger, and filter-demineralizer is continuously in operation while fuel is stored in the pool. Duplicate components are 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 provided to verify system operability.

9.1.3.4 Radiological Considerations

The water level in the spent fuel storage pool is maintained at a height which is sufficient to provide shielding for required building occupancy. Radioactive particulates removed from the fuel pool are collected in filter-demineralizer units which are located in shielded cells. For these reasons, the exposure of station personnel to radiation from the spent fuel pool cooling and cleanup system is minimal. Further details of radiological considerations for this and other systems are described in Chapter 12.0.

9.1.4 Fuel Handling System

The fuel handling system, consisting of the spent fuel cask, reactor building crane, and associated fuel servicing equipment, provides both safety and efficiency for movement of the fuel.

9.1.4.1 Design Bases

9.1.4.1.1 Safety Design Bases

[Historical Information]

As presented in Reference 1 the spent fuel cask handling facilities are not designed to meet a single failure criterion, but rather the facility and equipment layout is designed to accept a cask drop accident without compromising safety. The design layout of the plant, the duration of postirradiation cooling and the postulated radiological consequences of a cask drop accident (as presented in Subsection 15.7.5) preclude any unacceptable hazards to the public health.

[End Historical Information]

The reactor building overhead crane and associated cask lifting devices used in the reactor building are designed to meet the single-failure proof requirements of NUREG-0612, which acceptably minimizes the probability of a spent fuel cask drop accident. Single-failure proof means that the crane system is designed so that a single credible failure will not result in the loss of capability of the system to safely retain the load.

The crane trolley, which handles the spent fuel cask, meets the single-failure proof requirements of ASME NOG-1-2004, NUREG-0554 and NUREG-0612, Appendix C. The crane bridge meets ASME NOG-1-2004 criteria to the extent that the analysis follows ASME NOG-1 methodology for modeling, load combinations, and stress allowables. It also meets the single-failure proof requirements of NUREG-0554 and NUREG-0612, Appendix C.

9.1.4.1.2 Power Generation Design Bases

The fuel handling system provides a safe and effective means for transporting and handling fuel from the time it reaches the plant until it leaves the plant after postirradiation cooling.

9.1.4.2 System Description

Table 9.1-4 is a listing of typical tools and servicing equipment supplied with the nuclear system. The following subsections describe the use of some of the major tools and servicing equipment and address safety aspects of the design, where applicable.

9.1.4.2.1 Description of Fuel Transfer

9.1.4.2.1.1 Arrival of Fuel on Site

The reception and handling of new fuel at the plant include the following activities:

a. The new fuel arrives at the site by a transport vehicle, either railcar or truck, and is brought into the reactor building through the equipment access doors. This procedure allows secondary containment maintenance at all times.

b. The shipping crates, which hold two fuel bundles, are inspected for shipping damage.

c. An appropriate lifting device is employed to handle shipping crates or new fuel containers.

d. The new fuel bundles are inspected on the refuel floor, and stored in the new fuel storage racks or are placed directly into the spent fuel pool storage racks.

e. New fuel may then be channeled and stored in the spent fuel pool prior to the beginning of refueling activities; if not, channeling is done during actual refueling.

9.1.4.2.1.2 Refueling Procedure

The refueling process includes the following activities which involve the handling of new and spent fuel after preliminary refueling activities are completed:

a. new fuel is transferred to the spent fuel pool for temporary storage in preparation for channeling if necessary;

b. irradiated fuel, after inspection, is transported by the refueling bridge to the spent fuel pool in preparation of dechanneling;

c. the channeling of new or reload fuel and the dechanneling of spent fuel is done using the fuel prep machines;

d. spent fuel is stored in the spent fuel storage racks and new or reload fuel is prepared for installation in the core; and

e. new or reload fuel is installed in the core.

Loads over the refueling floor, and over the Spent Fuel Storage Pool racks when fuel assemblies are in the racks, are to be restricted as follows:

- All movements of a spent fuel-shipping cask shall be controlled by the critical “L” path control system of the reactor building crane. Refer to Figure 9.1-6.
- Loads in excess of 1290 pounds shall not travel over the spent fuel storage pool racks.
- One fuel assembly may be moved over the spent fuel storage pool racks provided that it is not raised above 2-foot clearance over the racks.

The requirements are applicable at all times, and if the requirements are not satisfied, place the crane load in a safe condition.

The spent fuel shipping cask critical “L” path control system of the Reactor Building Crane should be demonstrated operable prior to and during spent fuel shipping cask movement.

9.1.4.2.1.3 Departure of Spent Fuel from Site

The departure from the site of spent fuel stored in the fuel pool includes the following activities which involve the handling of postirradiated fuel:

a. the reception of the spent fuel shipping cask by rail or truck,

b. inspection and decontamination of the cask,

c. the filling of the common cask well and transfer canal and the removal of the transfer canal's gate into the Unit 1 or Unit 2 fuel pool,

d. the lifting and placement of the empty fuel cask in the cask well with reactor building crane,

e. the loading of the cask with fuel,

f. the closure and decontamination of the cask in the decontamination pit,

g. inspection of the cask for leakage,

h. the lifting of the cask from the decontamination pit and lowering of the cask through the equipment hatch to the awaiting railcar or truck, and

i. connection of the cask to the transport vehicle's interface systems; e.g., cooling system, final inspection, and departure.

9.1.4.2.2 Spent Fuel Cask

The spent fuel cask is used to transfer spent reactor fuel assemblies from the reactor building spent fuel pool via the cask pool to an offsite fuel reprocessing facility.

Contingent upon the design of the spent fuel cask handling facilities, the largest spent fuel casks used will be of the 100-ton cask design. Although no spent fuel casks of this size are licensed at this time, NL Industries, Inc. has designed a 100-ton cask and the General Electric Company is planning to design a 100-ton cask, the IF-400, in the near future. Using information supplied by General Electric, the IF-400 cask will hold thirty-two fuel assemblies (approximately 4 percent of a core).

A Dry Storage Cask is used for movement and storage of spent nuclear fuel as part of the onsite Independent Spent Fuel Storage Installation (ISFSI) as discussed in Section 9.1.2.3.

9.1.4.2.3 Reactor Building Crane

The main purpose of the reactor building crane is to facilitate reactor disassembly and re-assembly and to handle the spent fuel cask between the cask transport vehicle, the cask pool, and the cask decontamination pit in the reactor building. Secondary purposes of the reactor building crane include handling loads related to maintenance and replacement of equipment from the reactor building which are received or shipped through the railcar access doors.

The reactor building crane is a single-trolley top-running electric overhead traveling bridge crane with a 125 ton capacity main hoist, a 10-ton capacity auxiliary hoist and a span of 124 feet 8 inches. The general arrangement of the crane in the reactor building is shown in Drawing Nos. M-5 and M-6.

The reactor building crane is classified as Safety Related and Seismic Category I. The crane does not perform any safety-related functions, but the structural failure of the crane could result in fuel damage or damage to safety-related equipment. The main hoist is classified as a Type 1 main hoist per ASME NOG-1-2004 and is single-failure proof for all critical loads as defined by ASME NOG-1-2004 and as submitted in LaSalle's Phase I response to NUREG-0612. The auxiliary hoist is single-failure proof up to 10 tons per NUREG-0554. The crane is seismically designed to maintain control of the critical loads during a design basis seismic event (SSE). The RB crane must retain the carried load but does not need to operate during or after a seismic event. The electrical components and controls are classified as non-safety related. A critical load is any lifted load whose uncontrolled movement or release could adversely affect any safety-related system when such a system is required for unit safety or could result in potential off-site exposure in excess of the limit.

The reactor building crane bridge is designed, fabricated, installed, tested, and maintained in accordance with Electric Overhead Crane Institute (EOCI) Specification No. 61-1961; ANSI/ASME B30.2 Overhead and Gantry Cranes; AISC, AISE, and other applicable manufacturer's association and engineering society codes. It has been seismically qualified to ASME NOG-1-2004.

The single-failure proof reactor building crane trolley and electrical controls modifications to the bridge are designed, fabricated, installed and tested in accordance with ASME NOG-1-2004. Parts of the following specifications are referenced in or were used to supplement ASME NOG-1-2004: CMAA-Specification 70, AWS D1.1/D1.1M Structural Welding Code – Steel, ASME B30.2, Overhead and Gantry Cranes, and National Electric Code (NEC) Article 610. The trolley is maintained per ANSI/ASME B30.2 Overhead and Gantry Cranes.

Operation of the crane is from the cab or floor by radio control for all motions. Control at any one time is from one point only.

The structure of the crane bridge consists of welded box-type girders with truck saddles and truck frames of welded-steel construction. The trolley side frames, sheave frames, and truck frames are of structural steel welded construction. High strength friction-type bolts are used for major field connections for bridge and trolley assembly. The rated full-load capacities, hook travel distances, a full range of operating speeds (fpm) for the bridge, trolley, and hoist, and a description of the controls and braking systems are as follows:

Rated Crane Capacity:

a. main hoist - 125 tons, and

b. auxiliary hoist - 10 tons.

Hook Travel Distances:

a. main hoist - 160 feet

b. auxiliary hoist - 160 feet

Operating Speeds, fpm:

	Normal Mode	Cask Mode	Micro Speed	No Load Speed
Bridge	75	18.5	N/A	75
Trolley	75	30	N/A	75
Main Hoist	5	5	1.25	7.5
Auxiliary Hoist	50	N/A	5[1]	75

The main hoist speeds above are within the recommended values given in Table 5331.1-1 of ASME NOG-1. The auxiliary hoist speeds above are within the recommended values given in FIG. 70-6 of CMAA-70-1975. The trolley speed is less than the values of Table 5332.1-1 of ASME NOG-1. The bridge speed is less than the values of Table 5333.1-1 of ASME NOG-1. The rated load speeds are within 10% of the design speed.

[1]Note 1: Aux hoist: Micro speed is used for NUREG-0612 heavy loads.

Controls:

a. Bridge and trolley – AC IMPULSE G+ Series 3 microprocessor based variable frequency drive type control, and

b. Hoists – AC IMPULSE VG+ Series 3 microprocessor based variable frequency drive type control with eddy current load brake.

Brakes:

a. Bridge and trolley – two brakes – a disc brake that is used for the parking and emergency brake and a regenerative brake through the drive, that acts as the control brake, and

b. Hoists – two (for each hook) shoe type mechanical holding brakes, each rated in excess of 150% of full load hoisting torque at the point of application. A Magnetorque eddy current brake is provided that activates on loss of power or when brakes are engaged to slow down the motor. A regenerative brake through the drive acts as the control brake.

During an emergency, the brake system is designed to allow manual operation of the mechanical hoist brakes through an emergency brake release lever. After the holding brakes are released, the hoisting system utilizes the eddy current brake to lower the load safely without power. A time delay is included in the brake control system to activate the first mechanical brake and then activate the second mechanical brake when power is interrupted.

In accordance with ASME NOG-1-2004, the structural portion of the crane is designed for (1) dead load plus rated lifted load plus vertical impact load of 15% of the maximum lifted load, with structural steel members' normal stress not to exceed 50% and shear stress not to exceed 40% of the material yield strength, (2) dead load plus rated lifted load plus a lateral load of 5% of the total dead load plus the maximum lifted load in the direction transverse to the crane bridge, or 10% of the trolley dead load plus the maximum lifted load in the direction longitudinal to the crane bridge, with structural steel members' normal stress not to exceed 50% and shear stress not to exceed 40% of the material yield strength, (3) dead load with and without the credible critical load concurrent with an operating basis earthquake (OBE), with structural steel members' normal stress not to exceed 90% and shear stress not to exceed 50% of the material yield strength, (4) dead load with and without the credible critical load concurrent with a safe shutdown earthquake (SSE), with structural steel members' normal stress not to exceed 90% and shear stress not to exceed 50% of the material yield strength, (5) dead load plus a design basis tornado with no lifted load, with structural steel members' normal stress not to exceed 90% and shear stress not to exceed 50% of the material yield strength. The trolley design includes a 15% degradation factor in accordance with NUREG-0554 (Section 2.2) to account for degradation and wear on only those components in the load path and only those components that see relative movement between interfacing surfaces. This includes the main sister hook, the interface between the rope assembly pin and the trunnion and the gears and pinions in the gearbox. The wire rope assembly has only a 5% design load degradation factor since the fleet angles are limited, the equipment is indoors, and the ropes are not being immersed.

The main hoist and auxiliary hoist cables are designed to a 10:1 safety factor to the breaking strength of the cable.

9.1.4.2.3.1 Overall Safety Features

A travel control system similar to the one originally described in Special Report Number 2 to the PSAR (Reference 1) is provided on the reactor building crane. The function of the travel control system is to restrict the path and the sequence of motions in order to confine the spent fuel shipping cask to a predefined and safety analyzed corridor. This path, designated the critical "L" path (Figure 9.1-6), has been designed to keep the spent fuel shipping cask from passing over the spent fuel pool and to allow cask travel only over heavy structural members.

The control system for crane operation in the critical L-shaped path is made up of a series control logic which regulate the speed of the bridge and the trolley. It also monitors the positions of the trolley, the bridge, and the height of the fuel cask above the refueling floor at all times when the crane is in the critical path mode of operation. Input signals to the control logic for monitoring trolley, bridge, and cask movements are provided by a primary system of photoelectric sensors and a secondary system of proximity switches.

The control system is actuated by a permissive control switch located in the crane control cab. The permissive control switch is a key-operated selector switch labelled crane control normal-cask. The permissive control switch, when in the cask position, activates relays to automatically limit the bridge speed to 18.5 fpm and trolley speed to 30 fpm (in the west direction). A mechanical stop on the Trolley Control Switch in the east direction limits Trolley speed to 30 fpm (in the east direction). The travel time required to transverse the L-shaped path consisting of a bridge travel of 35 feet 4-1/2 inches and a trolley travel of 31 feet is approximately 2 minutes in each direction. The bridge and trolley speeds were arbitrarily chosen. However, the acceleration and deceleration loads, corresponding with the reduced crane velocity of 18.5 fpm, result in decreased load swing. The photoelectric sensors and the proximity switches are also energized with the switch in the cask position. Additional logic built into the control system prohibits the cask from transversing the "L"-shaped path unless the cask has been raised to the maximum limit of 15 inches off the floor. During cask movement, it also prohibits the bridge and trolley from being operated simultaneously. The capability to operate the crane from either the crane control cab or the radio control is retained with the permissive switch in the cask position.

The traverse photoelectric system, which is used to monitor bridge and trolley movement, consists of two types of incandescent coaxial scanners for retroreflection and reflected light, with an accompanying lamp burnout relay control. The retroreflective target, a foil sealed crystal reflector, is located in the L-shaped path, on the unistrut and attached to the ceiling. Two photo retroreflective devices are used in conjunction with auxiliary control relays and lights. The lights indicate the movement, the position of the bridge or trolley, and the state of the sensing devices.

The proximity switches are mounted on the bridge and trolley. The bridge mounted devices determine the 35 foot 4-1/2 inch travel distance. The trolley devices determine the 31 foot trolley travel. The proximity switch control logic is in series with the photoelectric control system to complete the control system for the L-shaped path.

The control path width is 6 inches minus 3/4 inch or 5-1/4 inches for the trolley path and 6 inches minus 3/8 inch or 5 5/8 inches for the bridge path. The 5 1/4-inch path for the trolley includes 1 1/2-inches of the mechanical bridge float. The 5 5/8-inches includes a 3/4 inch trolley float. By including the acceleration and deceleration rates associated with a top trolley speed of 30.0 fpm and bridge speed of 18.5 fpm, the resultant path is modified by plus or minus 3 inches.

The height of the cask is controlled by a contact of the geared limit in conjunction with a photo retroreflective scanner. An incandescent coaxial reflected light scanner is mounted on the underside of the trolley and focused on a retroreflective target mounted on top of the bottom block sheave housing. The scanner and reflector arrangement give cask height indication as well as hook swing indication. The geared-limit switch and the photoelectric scanner are in series with the path control logic mentioned earlier to complete the control system.

A cessation of crane motion results anytime the cask moves outside of the limits established for the L-shaped path as defined earlier.

9.1.4.2.3.2 Mechanical Safety Features

All bridge, trolley, and hoist motions on the crane are controlled through their respective drive motors by means of static stepless crane controls. The static stepless control feature provides highly accurate and reliable speed regulation over the entire range of loads within the capacity and speed range of the crane.

The crane system is equipped with mechanical and electrical limiting devices to shut off power to the driving motor(s) when the crane hook approaches the end of travel, or when other parts of the crane system would be damaged if power were not shut off.

Mounted on the motor drives of the main and auxiliary hoists are two spring-set, electromagnetic brakes that are engaged to stop and hold the load under normal and emergency operating conditions. Each brake on the main and auxiliary hoist is capable of stopping and holding the load equal to 150% of the full load hoisting torque at the point of application. The crane bridge and trolley have a disc brake that is used for a parking and emergency brake. The brakes for the bridge and trolley are integrated into the motor by the vendor and sized accordingly.

The wire rope equalizer system uses an equalizer beam design. The dual rope reeving system uses four (4) individual attaching points as a means for balancing or distributing the load between the two operating rope reeving systems. Each independent reeving system is designed to hold the MCL and transfer the load with excessive shock in the unlikely occurrence of failure of one of the rope systems. The equalizer system guards against side loading or lifting loads that are not positioned directly beneath the main hook or when the load is off balance. The design of the wire rope attachment points prevents mis-alignment because the torque arm limits movement.

Hooks for both the main and auxiliary hoist are load tested at twice their rated capacity. In addition to the load test, each hook is subjected to a magnetic particle and an ultrasonic examination.

9.1.4.2.3.3 Electrical Safety Features

In addition to the photoelectric and proximity switches described in Subsection 9.1.4.2.3.1, the reactor building crane is provided with limit switches to stop the main and auxiliary hooks in their highest and lowest safe positions.

The variable frequency drive (VFD) allows infinite speed control while continuously monitoring the direction of the load. The VFD receives input from an encoder to ensure the VFD compensates or the brakes are engaged if the commanded direction of the load is different than the actual direction and speed detected by the encoder. The control system includes numerous safety devices to protect against malfunction, inadvertent operator action, or failure.

The first part of the control system is based on the hoisting system and direct inputs to a relay based control system. The system does not depend on scanning rates, or programming issues for the first layer of safety. All load cells, limit switches, and pressure switches are “hard-wired” to activate safety systems. Some of the special controls include:

Load Cells – Located in series with each wire rope, they are used in a number of safety functions including broken rope detection, over load, load hang-up and "two-blocking."

Up Limit Switches – Stops bottom blocks up travel to prevent "two-blocking."

Geared Limit Switch – Stops bottom block from traveling too far in the up or down direction.

Overspeed Switch – Ensures that the load is always in control or the brakes are applied.

Pressure Switches – Detects over load pressure on the hydraulic cylinders and monitors for overload, load hang up, and "two-blocking."

Limit Switches on Upper Block – Detects retraction (compression) of the hydraulic cylinders and monitors for overload, load hang up, and "two-blocking."

Emergency Stop buttons – Emergency stop buttons are included on each operator's control station and the radio transmitter.

The hoisting systems are designed to provide protection from two-blocking and load hang-up. The two-block protection system provides four (4) different levels of protection. "Two-blocking" is the act of continued hoisting in which the load-block and the head-block assemblies are brought into physical contact, thereby preventing further movement of the load block and creating shock loads to the rope reeving system.

Control Circuit Upper Limit Switch is a gear-operated rotary switch, which senses drum revolutions, stops the hoist motor at a pre-set upper and lower elevation. This switch also controls the height of the spent fuel cask to 15 inches above the refueling floor.

Weight operated Upper limit switch uses a hook block actuated weight operated limit switch that is calibrated to disable power to the hoist motor at a preset upper elevation that is higher than the control circuit limit switch elevation.

Overload (load cell) limit system uses four (4) individual load cells, one for each wire rope, to monitor lifting conditions and assure crane is operating within the limits of the MCL. The overload system detects an overload condition at between 105% and 120% of the MCL, depending on the actual set point. When an overload condition is detected, the load cell sends a signal to the hoist motor control circuit and disables hoisting.

Floating upper hook block protection system is designed to safely manage a two-block or load hang-up condition without damage to the crane or the load it is handling. When a two-block condition occurs, the equalizer system trips the respective limit switches. These limit switches send a signal to the MAGNAHOLD protection system, stopping the load.

Crane overload protection is provided by load cells located in series with each wire rope. When the load cells sense a load in excess of the hoist's rated capacity, the hoist drive motor is stopped. In the event that the drive motor over speeds during lowering, over speed protection is provided by the over speed switch that ensures the load is always in control or the brakes are applied. These features are applicable to both the main hoist and the auxiliary hoist.

The RB overhead crane is provided with an emergency stop button on each operator's control station – both in the cab and on the remote control – to allow the crane operator to immediately stop the load in the case of a malfunction.

9.1.4.2.4 Refueling, Pool Storage, and Servicing Equipment

The following equipment and servicing aids are listed in Table 9.1-4:

a. fuel servicing equipment,

b. servicing aids,

c. reactor vessel servicing equipment,

d. in-vessel servicing equipment,

e. refueling equipment,

f. storage equipment, and

g. under reactor vessel servicing equipment.

9.1.4.3 Safety Evaluation

9.1.4.3.1 Spent Fuel Cask

Dry Cask storage casks are handled using single-failure proof equipment inside the building, which acceptably minimizes the probability of a spent fuel cask drop accident.

The stability of the Dry Cask storage casks during handling activities has been evaluation utilizing tornado wind load and missile criteria described in Reference 42.

An analysis of spent fuel cask drops is presented in Subsection 15.7.5. [Historical]

9.1.4.3.2 Reactor Building Crane

The RB crane trolley meets the single-failure proof criteria of ASME NOG-1-2004, NUREG-0554 and NUREG-0612, Appendix C. This ensures that a single credible failure of the crane system will not result in the loss of capability of the system to safely retain a load. All dual elements in the hoisting system comply with ASME NOG-1 for allowable stresses. This includes the upper head block, the wire rope and the lower load block. The load block assembly utilizes (2) two load attached points and is comprised of a sister hook with a 2nd center pin hole load attachment point. The load blocks are conservatively designed to support a load greater than three times the maximum critical load (static and dynamic) being handled without permanent deformation of any part of the load-block assembly. The hooks on the main and auxiliary hoist are a single load attaching point configuration that has been designed to support a load of six times the critical load (static and dynamic) without permanent deformation of the hook. The hoist drum is not required to have the single-failure proof feature, but the trolley is provided with drum retainers to retain the drum in the event of a shaft or bearing failure.

Because the RB crane is single-failure proof, a load drop or cask drop is a highly unlikely event. The crane critical "L" path control system provides an additional measure of safety to provide a designated path for the cask to travel over structurally reinforced floor areas.

Only one hoist may be operated at a time. This selection is controlled by the Main / Aux Hoist selector switch located in both the cab and on the radio control. When in the cask mode, the bridge and the trolley can not be operated at the same time.

Following the issuance of NUREG-0612, "Control of Heavy Loads at Nuclear Plants," the NRC through generic letter dated December 22, 1980, requested CECo to review its provisions for handling and control of heavy loads at LaSalle. The responses were to be made in two stages. The first response (Phase I, Section 5.1.1 of NUREG-0612) was to identify the load handling equipment within the scope of NUREG-0612 and to describe the associated general load handling operations such as safe load paths, procedures, operator training, special and general purpose lifting devices, the maintenance, testing and repair of equipment and the handling equipment specifications. The second response (Phase II) is intended to show that either single-failure-proof handling equipment was not needed or that single-failure-proof equipment had been provided. Responses were provided by CECo per references 1 and 2.

NRC's review and evaluations and conclusions are presented in Section 9.1.2 and 9.1.3 of NUREG-0519, Supplement No. 5. Based on the review and evaluation, it was concluded that the guidelines in NUREG-0612, Section 5.1.1 have been satisfied and thus Phase I for LaSalle was acceptable.

For more information on the control of heavy loads, see Appendix O.

Suspension of crane operations is required when the Spent Fuel Storage Pool water level is not within the Technical Specification limit and irradiated fuel assemblies are in the Spent Fuel Storage Pool.

9.1.4.3.3 Refueling, Storage, and Servicing Equipment

The refueling, storage, and servicing equipment are not safety-related items; therefore they do not possess safety functions.

9.1.4.4 Inspection and Testing Requirements

All tests and inspections of equipment that is part of the fuel handling system are performed in accordance with normal EGC station practices.

After erection in the reactor building, the crane bridge (along with the original trolley) was tested to 125% of rated capacity, 156.25 tons. The ability of the crane to perform all its intended functions was demonstrated during this test.

The single-failure proof trolley was tested at the vendor's facility. Both the main hoist and auxiliary hoist were tested to 125% (+5%,-0%) of the manufacturer's rated load in accordance with ASME NOG-1 and ASME B30.2. A functional test was performed at the site after installation to verify it could perform its intended functions.

Periodic inspection testing of the crane is performed per ASME B30.2.

9.1.4.5 Instrumentation Requirements

The LCSC fuel handling system employs adequate redundant control and instrumentation to provide the safe operation of the reactor building crane, the fuel grapple, and the fuel platform auxillary hoist during normal new fuel and spent fuel handling procedures. Refer to Subsections 7.7.13, 9.1.4.2.3 and 9.1.2.1.3 for more detailed description.

9.1.5 References

1. E.D. Swartz (CE), Letter to D. G. Eisenhut (NRC). Subject: Response to NUREG 0612, June 22, 1981.

2. E.D. Swartz (CE), Letter to D. G. Eisenhut (NRC). Subject: Supplemental Response to NUREG-0612, October 19, 1982.

3. LSCS-PSAR Special Report No. 2, "Supplemental Crane Design Features and Fuel Cask Drop Analysis."

4. Letter, P.C. Shemanski (NRC) to T. J. Kovach, "LaSalle County Station Unit 2 Supplemental Submittal - High Density Spent Fuel Rack - TAC No. 62832," dated January 24, 1990 approves a ComEd request to change to a k-infinite limit. The basis for the NRC approval is NFS' "Supplemental Submittal for LaSalle County Unit 2 High Density Fuel Racks," dated November 17, 1989 NFS:BPS:89-141.

5. Holtec International Document, "Licensing Report for Capacity Expansion of the LaSalle County Station Unit 1," Holtec Report Number 92765, dated May 21, 1992.

6. EMF-96-117, "Criticality Safety Analysis for ATRIUM-9B Fuel: LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Rack)," NFS NDIT# 960087, April 1996.

7. EMF-95-088, "Criticality Safety Analysis for ATRIUM-9B Fuel: LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Rack)," NFS NDIT# 960088, February 13, 1996.

8. EMF-95-134, "Criticality Safety Analysis for ATRIUM-9B Fuel: LaSalle Units 1 & 2 New Fuel Storage Vault," NFS NDIT# 960089, December 7, 1995.

9. NEDE-24011-P-A, "GESTAR II - General Electric Standard Application for Reactor Fuel."

10. GE SIL No. 152, “Criticality Margins for Storage of New Fuel”, dated March 31, 1996.

11. “Criticality Safety Analysis: Spent Fuel Storage Racks: LaSalle County – Unit 2, Specification No. T-3758 dated April 1986.

12. Letter, “Criticality Safety Evaluation of Wet ATRIUM-9B Fuel Assemblies in the LaSalle Inspection Stand,” dated August 20, 1996, jhr 96:313.

13. 10CFR50.68(b) Criticality Accident Requirements (Federal Register Vol. 63, No. 218, November 12, 1998).

14. Letter from J. A. Benjamin, Commonwealth Edison (ComEd) Company, to U.S. NRC, "Response to Request for Additional Information License Amendment Request for Power Uprate Operation," dated 02/15/2000.

15. Letter from D. M. Skay, U. S. NRC, to O. D. Kingsley, Commonwealth Edison (ComEd) Company, "LaSalle – Issuance of Amendments Regarding Power Uprate (TAC NOS. MA6070 and MA6071)," dated May 9, 2000, including "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 145 to Facility Operating License No. NPF-11 and Amendment No. 120 to Facility Operating License No. NPF-18; Commonwealth Edison Company LaSalle County Station, Units 1 and 2; Docket Nos. 50-373 and 50-374" dated May 9, 2000.

16. Letter from JoAnn Shields (ComEd) to Dr. Thomas E. Murley (NRC), LaSalle County Station Unit 1, Application for Amendment to Facility Operating License NPF-11, Unit 1 Spent Fuel Pool Rerack, dated June 5, 1992.

17. Letter from Byron L. Siegel (NRC) to Thomas J. Kovach (ComEd),k Request for Additional Information (RAI), LaSalle Station, Unit 1 Spent Fuel Pool Rerack (TAC NO. M83797), dated Sept 30, 1992.

18. Letter from JoAnn Shields (ComEd) to Dr. Thomas E. Murley (NRC), LaSalle County Station Unit 1 Proposed Spent Fuel Pool Rerack Amendment, NRC Docket 50-373, dated Nov. 4, 1992.

19. Letter from Robert J. Stransky (NRC) to Thomas J. Kovach (ComEd), Issuance of Amendment (TAC NO. M83797), dated Feb. 24, 1993.

20. Letter from C. M. Allen (ComEd) to Harold R. Denton (NRC), LaSalle County Station Unit 2, Proposed Amendments to Technical Specification for Facility Operating License NPF-18, High Density Spent Fuel Racks, dated Sept. 19, 1986.

21. Letter from Elinor G. Adensam (NRC) to Dennis L. Farrar (ComEd), Additional Information on Re-racking of Spent Fuel Pool – LaSalle County Station, Unit 2, dated Nov. 28, 1986.

22. Letter from C. M. Allen (ComEd) to USNRC Document Control Desk, LaSalle County Station Unit 2, Proposed Amendment to Technical Specification for Facility Operating License NPF-18 to Install High Density Fuel Racks, dated May 17, 1988.

23. Letter from Paul C. Shemanski (NRC) to Henry E. Bliss (ComEd), Request for Additional Information – Proposed License Amendment for LaSalle Unit 2 High Density Spent Fuel Racks – TAC NO. 62832, dated April 18, 1989.

24. Letter from W. E. Morgan (ComEd) to USNRC, LaSalle County Station Units 1 and 2, Response to NRC Request for Additional Information, High Density Fuel Storage Racks, dated June 6, 1989.

25. Letter from Paul C. Shemanski (NRC) to Thomas J. Kovach (ComEd), Issuance of Amendment 48 to Facility Operating License NPF-18, LaSalle County Station Unit 2, dated June 15, 1989.

26. Letter from W. E. Morgan (ComEd) to Dr. Thomas E. Murley (NRC), LaSalle County Station Unit 2, Supplemental – High Density Spent Fuel Rack, dated Dec. 11, 1989.

27. Letter from Paul C. Shemanski (NRC) to Thomas J. Kovach (ComEd), LaSalle County Station Unit 2 Supplemental Submittal – High Density Fuel Storage Rack – TAC NO. 62832, dated Jan. 24, 1990.

28. Sargent & Lundy Calculation 029135 (EMD) dated March 19, 1981, "Seismic Qualification Fuel Storage Vault."

29. Sargent & Lundy Calculation 029136 (EMD) dated March 19, 1981, "Seismic Qualification Equipment Storage Rack."

30. EMF-2254(P), Revision 0, "Criticality Safety Analysis for ATRIUM-10 Fuel LaSalle Units 1 and 2 New Fuel Storage Vault", TODI NFM0100078, Sequence 0, July 18, 2001.

31. EMF-2556(P), Revision 0, "Criticality Safety Analysis for ATRIUM-10 Fuel LaSalle Unit 1 Spent Fuel Storage Pool (Boral Rack)", TODI NFM0100096, Sequence 0, September 17, 2001.

32. GE SIL No. 636, Rev. 1, "Additional Terms Included in Reactor Decay Heat Calculations", dated June 6, 2001.

33. AREVA Report ANP-2578(P), "Criticality Safety Analysis for ATRIUM-10 Fuel LaSalle Unit 2 Spent Fuel Storage Pool (50% Degraded Boraflex Rack)," dated November 2006.

34. DRF 0000-0012-8549-SFP, "GE14 – Spent Fuel Storage Rack Criticality Analysis for LaSalle Unit 1 Power Station BORAL RACK", Revision 1, August, 2003.

35. DRF 0000-0028-6844-SFP, "GE14 – Boraflex Spent Fuel Storage Rack Criticality Analysis for LaSalle Unit 2", Revision 0, September 2004.

36. Holtec Report HI-931060, "Criticality Safety Evaluation of the Spent Fuel Storage Racks with Postulated Degradation of Boraflex," dated February 1994.

37. ComEd letter J.B. Hosmer to the U.S. NRC, "Commonwealth Edison Company (ComEd) Response to NRC Generic Letter 96-04, 'Boraflex Degradation in Spent Fuel Racks,' dated June 26, 1996," dated November 6, 1996.

38. EC0000357077, "Nominal Boron-10 Areal Density in Boraflex Spent Fuel Pool Racks used in Spent Fuel Pool Criticality Analyses," dated September 30, 2005.

39. EC 334017, Rev. 0, "Increased Cooling Water Temperature Evaluation to a New Maximum Allowable of 104° F."

40. Deleted.

41. Deleted.

42. LaSalle County Station Units 1 and 2, 10 CFR 72.212 Evaluation Report.

43. Engineering Change (EC) 364491, "U2 Spent Fuel Pool – NETCO Snap-in Rack Insert Demonstration."

44. Engineering Change (EC) 372204, "U2 Spent Fuel Pool – Installation of NETCO Snap-in Fuel Rack Inserts."

45. RS-09-133, "License Amendment Regarding the Use of Neutron Absorbing Inserts in Unit 2 Spent Fuel Pool Storage Racks," Letter from Patrick R. Simpson (Exelon Generation Company, LLC) to U.S. NRC Document Control Desk, dated October 05, 2009.

46. Calculation L-003391, revision 02, "LaSalle Unit 2 Spent Fuel Pool Criticality Evaluation with NETCO Rack Inserts."

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TABLE 9.1-2b

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TABLE 9.1-3

FUEL POOL COOLING AND CLEANUP SYSTEM RELATED SPECIFICATIONS

Parameter	Value
Design SFP Heat Exchanger Heat Removal Capacity*	14.5 MBtu/hr @
Fuel Pool Pumps (2) Flowrate	3000 gpm (single pump)
Service water Flow Rate to FPCCS Heat Exchanger	4000 gpm
Fuel Pool Filter Demineralizers (2)	1500 gpm each
Fuel Pool Demineralizer Bypass Line (Normal)	1500 gpm
Fuel Pool Demineralizer Bypass Line (Maximum)	3000 gpm
RHR Loop B Pump	7500 gpm
RHR Heat Exchanger Capacity (Fuel Pool at 140° F)	42 MBtu/hr
RHR Heat Exchanger Capacity (Fuel Pool at 212° F)	168 MBtu/hr
CSCS Cooling Water to RHR Heat Exchanger	7400 gpm

*Per the original Design Data Sheet (parallel flow; 1 Heat Exchanger, 120 °F Pool temperature, and 95°F Service Water temperature). The heat exchanger heat removal capacity will vary depending on the inlet flow stream temperatures. As discussed in section 9.1.3, the heat removal capacity has been re-evaluated for the conditions given in that section.

TABLE 9.1-4

TOOLS AND SERVICING EQUIPMENT

FUEL SERVICING EQUIPMENT

Fuel Preparation Machines
New Fuel Inspection Stand
Channel Bolt Wrenches
Channel Handling Tool
Fuel Pool Sipper
Channel Gauging Fixture
General Purpose Grapples
Fuel Inspection Fixture
Channel Transfer Grapple
Channel Storage Adapter

SERVICING AIDS

Pool Tool Accessories
Actuating Poles
General Area Underwater Lights
Local Area Underwater Lights
Drop Lights
Underwater TV Monitoring
Underwater Vacuum Cleaner
Viewing Aids
Light Support Brackets
Incore Detector Cutter
Incore Manipulator
Underwater Viewing Tube

REACTOR VESSEL SERVICING EQUIPMENT

Reactor Vessel Servicing Tools
Steamline Plugs
Shroud Head Bolt Wrenches
Head Holding Pedestals

Head Stud Rack
Dryer-Separator Carousel
Steamline Plug Installation Tool
Vessel Nut Handling Tool

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
Incore Guide Tube Seals
Blade Guides
Fuel Bundle Sampler
Peripheral Orifice Grapple
Jet Pump Service Tools
Peripheral Fuel Support Plug
Fuel Bail Cleaner
Peripheral Orifice Holder

REFUELING EQUIPMENT

Refueling Equipment Servicing Tools
Refueling Platform Equipment

STORAGE EQUIPMENT

Spent Fuel Storage Racks
Channel Storage Racks
Storage Racks (Control Rod/ Defective Fuel)

In-Vessel Racks
New Fuel Storage Rack
Defective Fuel Storage Containers

UNDER REACTOR VESSEL SERVICING EQUIPMENT

Control Rod Drive Servicing Tools
Control Rod Drive Handling Equipment
Equipment Handling Platform
Thermal Sleeve Installation Tool
Incore Flange Seal Test Plug
Key Bender

TABLE 9.1-5

Fuel Grapple and Auxiliary Hoist Load Limits

	Overload Cutoff (lbs)	Loaded Interlock (lbs)	Stall Torque of Hoist System (lbs)
Triangular Mast * Fuel Grapple (762E974 Mast)	1200 ± 50	485 ± 50	3000
Tubular Mast* Fuel Grapple (NF500 Mast)	1600 + 100/-0	700 + 50/-0	3000
Auxiliary Hoist	1000 ± 50	400 ± 50	3000

* The tubular (NF-500) mast is the principal mast used. The triangular (762E974 or NF-400) mast is available as a spare.

TABLE 9.1-6

SPENT FUEL POOL DECAY HEAT LOAD ANALYSIS RESULTS

SFP Case (Power Uprate)	Peak Heat Load (which then decreases with time)	Time to Boil (from peak Temp.)	Boiloff Rate (at 212°F)	Peak SFP Temp. (with FPCCS), at time after shutdown	Remarks
Case 1: Batch offload of 320 SFAs 165 hours after shutdown (S/D). 15 SFAs per hour.	Total 23 X 106 BTU/hr	8.4 hrs	47 gpm	140°F at 198 hrs after S/D	Pool almost full (2994 cells filled) w/ uprate SFAs. After offload, the SFP contains 3314 SFAs. 1 FPCCS pump and HX operating.
Case 2: Full core offload of 764 SFAs 24 hours after S/D. 15 SFAs per hour.	Total 55 X 106 BTU/hr	2.6 hrs	116 gpm	152°F at 78 hrs after S/D	36-day operation after Case 1 batch offload and 20-day refuel. After offload, the SFP contains 4078 SFAs. 2 FPCCS pumps and HXs operating.
Case 2a: Full core offload of 764 SFAs 24 hours after S/D. 15 SFAs per hour.	Total 61 X 106 BTU/hr	2.2 hrs	128 gpm	157°F at 78 hrs after S/D	24-month operation after Case 1 batch offload and 20-day refuel. After offload, the SFP contains 4078 SFAs. 2 FPCCS pumps and HXs operating.

9.2 WATER SYSTEMS

The auxiliary water systems for the LaSalle County Station are as follows:

a. CSCS equipment cooling water system,

b. station service water system,

c. reactor building closed cooling water system,

d. demineralized water makeup system,

e. potable and sanitary water system,

f. ultimate heat sink,

g. cycled condensate system and refueling water storage facilities,

h. turbine building closed cooling water system (TBCCWS),

i. primary containment chilled water system,

j. station heat recovery system,

k. suppression pool cleanup system, and

l. chemical feed system.

9.2.1 CSCS Equipment Cooling Water System

The function of the core standby cooling system-equipment cooling water system (CSCS-ECWS) is to circulate lake water from the ultimate heat sink for cooling of the residual heat removal (RHR) heat exchangers, diesel-generator coolers, CSCS cubicle area cooling coils, RHR pump seal coolers, and low-pressure core spray (LPCS) pump motor cooling coils. This system also provides a source of emergency makeup water for fuel pool cooling and also provides containment flooding water for post-accident recovery. This CSCS-ECWS system is equivalent in purpose to the essential service water cooling systems at other stations.

9.2.1.1 Design Bases

9.2.1.1.1 Safety Design Bases

a. The system is sized based on the following minimum equipment cooling water flow requirements:

1. RHR heat exchanger - 7400 gpm

2. diesel-generator cooler (division 1 and 2 only) - 800 gpm

3. diesel-generator cooler (division 3) - 650 gpm

4. RHR pump seal cooler ('A' and 'B' RHR pumps only) - 5 gpm

5. LPCS pump motor cooling coil - 3 gpm

6. northwest cubicle area cooling coil - 75 gpm

7. southwest cubicle area cooling coil - 108 gpm

8. northeast cubicle area cooling coil - 66.5 gpm

9. southeast cubicle area cooling coil - 72.5 gpm

10. emergency makeup to fuel pool - 300 gpm, nominal

11. containment flood (Division 2 fuel pool emergency makeup pump only) - 300 gpm, nominal.

b. System classifications are as shown in Section 3.2. All portions of this system are protected from the effects of tornados, missiles, pipe whip, and flooding.

c. To meet single failure criteria, the CSCS-ECWS for each unit is designed as three independent subsystems, one of which is shared between units (Drawing Nos. M-87 and M-134).

d. Straining are provided to prevent plugging of cooled component heat transfer passages. All strainers include provisions for backwashing without significantly affecting system operation.

Organic fouling of heat transfer surfaces will be minimized by the Chemical Feed system which will treat the service water tunnel inlet flow with oxidizing biocides. However, the Chemical Feed system should not be considered auxiliary equipment required for the CSCS-ECW systems to perform their function. Therefore, the operability of the CSCS-ECW systems is not tied to the operability of the Chemical Feed system.

e. To detect leakage of radioactivity to the environment, radiation monitors are installed in the CSCS-ECWS immediately downstream of cooled components that contain radioactive fluids. The CSCS-ECWS discharge lines from these components are capable of remote manual isolation from the main control room.

f. Design of system piping and components is based on a 40-year life. Exterior surfaces of all buried system piping is protected by bituminous coatings and wrappings and provisions for cathodic protection are installed where such protection is found to be required based on electrical potential measurements. The design of all system piping includes a corrosion allowance of at least 0.08 inches.

g. The RHR service water portion of the system is required to operate during all unit shutdowns to remove core residual heat and following a LOCA to provide containment cooling. The diesel-generator cooling water portions of the system are required at any time the diesel generators are operated (i.e., loss of offsite power) or when the LPCS pumps are operated. The CSCS cubicle area coolers require cooling water only when the CSCS pumps are operating and the normal reactor building ventilation systems are not functioning (i.e., loss of offsite power).

h. To prevent inadvertent injection of lake water into the reactor or spent fuel pool, spool pieces are installed in the outlet of the fuel pool emergency makeup pump to isolate these pumps. The "swing-type" fuel pool emergency makeup spool piece is normally connected to the pump test line, but may be disconnected, rotated, and reconnected to the emergency makeup line when necessary. The containment flooding spool piece is normally disconnected and stored. These spool pieces are located in the basement of the diesel-generator building so as to be readily accessible during a LOCA.

i. Seal cooling is required for the RHR pumps when process fluid temperatures may exceed 212°F. There are no operational conditions where the 'C' RHR pumps would experience these elevated temperatures.

9.2.1.1.2 Power Generation Design Bases

Since containment cooling and core residual heat removal are not normally required, the CSCS-ECWS has no power generation design bases except to be available for operational testing.

9.2.1.2 System Description

The CSCS-ECWS for each unit consists of three independent piping subsystems corresponding to the three essential electrical power supply divisions for each unit. All pumps and strainers are located in the basements of the buildings within watertight cubicles to provide separation between divisions and flood protection. The outdoor CSCS-ECWS piping is buried to provide tornado and missile protection. The system is shown schematically on Drawing Nos. M-87 and M-134.

The CSCS-ECW subsystems take a suction from the service water tunnel located in the basement of the Lake Screen House. The service water tunnel is kept full by six inlet lines which connect to the Circulating Water pump forebays. Prior to entering the service water tunnel inlet pipes, the water is strained by the Lake Screen House travelling screens to prevent large pieces of debris from entering the system and blocking flow or damaging equipment. The travelling screens are not seismically designed nor are they supplied with electrical power from the plant essential power buses. A 54-inch normally closed bypass line is installed to assure access to a continuous supply of CSCS water to the system in the unlikely event that all the travelling screens become blocked.

To minimize biological fouling, microbiologically influenced corrosion (MIC), scaling and silting of the service water tunnel and CSCS-ECW systems, a biocide, scale inhibitor/silt dispersant and corrosion inhibitor are injected into each of the six service water tunnel inlet pipes.

By treating the service water tunnel, the normal service water and fire protection systems are also treated with the biocide scale inhibitor/silt dispersant and corrosion inhibitor. The feed rates are adjusted based on changes in the total service water tunnel inlet flowrate and/or desired treatment levels of total available oxidant in the cooling system effluents.

The chemicals may be injected either continuously or intermittently. Continuous injection assures that treated water will be drawn into the normally stagnant CSCS-ECW systems when they are operated.

Division 1 of each unit includes two RHR service water pumps which supply cooling water to the Division 1 RHR heat exchanger and RHR pump seal cooler. The fuel pool emergency makeup pump in Division 1 of each unit supplies a source of emergency makeup water to the spent fuel pool. Also included in Division 1 of Unit 1 is a diesel-generator cooling water pump which supplies cooling water to the Division 1 diesel generator, Unit 1 and 2 LPCS pump motor coolers, and Units 1 and 2 Division 1 CSCS area coolers (northeast and northwest reactor building corner cubicles.) Electrical power for operation of these pumps is supplied from essential power supply Division 1 as described in Section 8.3.

Two RHR service water pumps are also provided in Division 2 of each unit to supply cooling water to the Division 2 RHR heat exchanger and the two Division 2 RHR pump seal coolers. The diesel-generator cooling water pump in Division 2 of each unit supplies cooling water to the Division 2 diesel generator and to the Division 2 CSCS area cooler (southeast reactor building corner cubicle.) The Division 2 fuel pool emergency makeup pump provides a redundant source of emergency makeup water to the spent fuel pool and also provides a source of containment flooding water to the RHR system for post-accident recovery. Electrical power for these pumps is supplied from the essential power supply Division 2 as described in Section 8.3.

Both the HPCS diesel generator and the Division 3 CSCS area cooler (southwest reactor building corner cubicle) are supplied with cooling water by the Division 3 HPCS diesel-generator cooling water pump. Electrical power for this pump is fed from the essential power supply Division 3 as described in Section 8.3.

All pumps in the system are constructed to ASME Boiler and Pressure Vessel Code Section III requirements. Mechanical seals are used to minimize shaft seal leakage. All pumps are driven by 460-V, 3 phase, 60 Hz electric motors.

An automatic backwashing strainer is installed in the discharge line of each diesel-generator cooling water pump and each pair of RHR service water pumps. These strainers are constructed to Section III of the ASME Boiler & Pressure Vessel Requirements, replacements are procured in accordance with NRC Generic Letter 89-09. The strainers have stainless steel edge type strainer baskets with a 1/16-inch particle retention capability. For loss of offsite power, the automatic backwashing characteristic is lost; however, the strainers can be backwashed manually. Sufficient backwash is assured by established procedures and applicable design documents. Debris and backwash water are flushed to the system discharge piping where they are returned to the ultimate heat sink.

Balancing of flow rates through the various cooled components is accomplished by use of installed flow measuring nozzles and outlet valves of cooled components with exception that the RHR pump seal coolers do not have flow measuring nozzles. For the RHR heat exchangers, an orifice plate is installed at the heat exchanger outlet to permit adjustment of flow, and a flow measuring element is installed at the heat exchanger inlet. Flow through the RHR pump seal coolers is assured by proper sizing of the RHR heat exchanger outlet orifice and regulation of the associated outlet valve to maintain flowrates within design values. For the LPCS pump motor coolers, a flow measuring orifice is installed in the inlet piping.

Discharge pipes are combined into a common discharge for identical divisions of both Units 1 and 2. The discharge pipe outlets at the CSCS cooling pond are located above the normal cooling lake level and are protected against missiles by a reinforced concrete structure. A weir is located in the discharge chute to prevent debris from being washed into the discharge pipes by wave action when the system is not in use.

9.2.1.3 Safety Evaluation

Redundancy is provided by designing the system as five independent subsystems. Separation between subsystems assures that no single failure can affect more than one subsystem. Therefore, assuming a single failure in any subsystem including the subsystem shared between units, two subsystems in each unit will remain unaffected. These two subsystems can supply the minimum required cooling water for safe shutdown of a unit or mitigate the consequences of an accident.

Complete blockage of all lake screen house traveling screens is unlikely even if the screens are not operating for a period of time. However, if this should occur, the normally closed valve in the 54-inch bypass pipe may be opened to assure a continuous supply of water to the system pumps. This bypass pipe is located 10 feet below the minimum pond surface elevation to prevent ingestion of floating debris or blockage by ice, and 1 foot 6 inches above the intake structure floor to prevent ingestion of sand and other heavier-than-water debris. Debris transported into the 54" bypass line would, depending upon its size and density:

- settle out in the service water tunnel, or
- be removed by strainers, or
- be carried through the system and returned to the lake.

The probable amount of loss of the ultimate heat sink (UHS) pond capacity due to sediment deposition during the plant life of 40 years is 5.3 acre-feet (Subsection 2.4.11.6). The UHS has a surface area of 83 acres at the design level of 690 feet MSL, hence the total sediment deposition during the plant life will be less than 0.1 foot. Furthermore, the maximum velocity in the intake flume of the CSCS cooling pond under the maximum drawdown conditions is less than 0.1 fps, much less than the nonerodible velocity. Because of the low velocities, erosion of the intake flume bottom material does not take place, hence no sediment blockage of the intake can occur. Therefore, it is not likely that the CSCS-ECWS intake pipe and intake bypass pipe will be blocked or clogged with sand and/or other heavier-than-water debris over the lifetime of the plant. Refer to section 2.5.5.2.5, CSCS Pond Flume Failure Analysis.

9.2.1.4 Inspection and Tests

All components and piping (except buried portions) are located so as to be readily accessible for the required periodic inspections.

The system pumps will be operated periodically to verify operability. Sufficient flow and pressure instrumentation is provided to verify that each pump is operating within its design limits. Test taps at the inlet and outlet of each cooled component permit verification that the component's cooling water passages remain unrestricted.

9.2.1.5 Instrumentation and Control

All system pumps have manual control switches located in the main control room. The normally closed motor-operated valves at the RHR heat exchanger outlets are remotely operated from the main control room, but may also be operated locally using the valve handwheel. In addition, the Division 2 RHR service water pumps and RHR heat exchanger outlet motor-operated valve have manual controls located on the remote shutdown panel in the auxiliary equipment room. The diesel-generator cooling water pumps are started automatically during the corresponding diesel generator start sequence.

Local temperature indication is provided for each divisional intake pipe and at the outlet of each cooled component, with exception of the LPCS pump motor cooler. RHR heat exchanger outlet temperatures are also recorded and annunciated (high temperature alarm only) in the main control room.

Differential pressure across each cooling water strainer is indicated locally and also annunciated in the main control room. An automatic backwashing control switch is set to initiate automatic backwashing at 4 psid across the strainer element.

Excluding the RHR pump seal coolers flow elements are installed in the supply or discharge lines of the cooled components. Control room indication is provided for the RHR heat exchanger flow only. A flow element is also installed in the test line from each fuel pool emergency makeup pump.

Local discharge pressure indication is provided for each of the system pumps.

9.2.2 Station Service Water System

The purposes of the station service water system are:

a. to provide cooling water for various station auxiliary systems and components,

b. to provide water for filling the fire protection system and to serve as a backup supply,

c. to provide water for the traveling screen wash, and

d. to provide water to the radwaste system.

9.2.2.1 Design Bases

9.2.2.1.1 Safety Design Bases

The service water system is not an engineered safety feature and therefore does not have any safety design bases.

9.2.2.1.2 Power Generation Design Bases

The service water system removes heat from various equipment in the turbine building, reactor building, auxiliary building, service building, and radwaste facility during normal plant conditions, shutdown, and abnormal plant conditions when offsite power is available. The service water system removes the heat rejected by the reactor building closed cooling water and turbine building closed cooling water systems. It is also designed to supply strained cooling lake water to the radwaste facilities and the fire protection system.

9.2.2.2 System Description

The service water system has five motor-driven single stage horizontal centrifugal pumps and two motor-driven single stage centrifugal jockey pumps. The capacities of the service water pump and service water jockey pumps are 16,000 gpm and 5000 gpm, respectively. Two of the service water pumps serve each unit, with the fifth pump and the jockey pump serving either unit. A maximum service water supply temperature of 104° F is evaluated in Reference 39 of Section 9.1.5.

Four of the five Main Service Water pumps are utilized for normal operation, with the installed spare Main Service Water pump in standby status. When pressure in either loop drops due to pump failure, a low-pressure alarm sounds in the control room and the standby pump is started.

During shutdown or startup of one of the units, the service water pump combination can be adjusted such that the required number of Main Service Water or Jockey pumps is operating to meet that systems' cooling requirements.

Five service water pumps and two jockey pumps take suction from the lake screen house intake and discharge into a common header. The discharge header is supplied with stop valves to segregate, when appropriate, the service water system of Unit 1 from Unit 2.

Three automatic backwash service water strainers (one per unit with an installed spare capable of supplying either unit) are provided to remove suspended matter(the strainer basket perforations are 1/8" slotted type) that may have passed through the circulating water pump screens. The service water pumps are controlled so that if the operating pumps cannot maintain the required discharge pressure, an alarm sounds in the control room signaling the operator to start another pump. In order to prevent biological fouling of the service water system, a biocide is injected by the chemical feed system into the service water tunnel inlet lines. Corrosion inhibitor, scale inhibitor and silt dispersant are also injected.

The service water system is designed to supply water during normal plant operation, normal shutdown, and during abnormal plant conditions. When offsite power is available service water is supplied to the following systems, equipment, and facilities located in the Reactor Building (RB), Turbine Building (TB), Service Building (SB), Auxiliary Building (AB), Radwaste Building (RW), and Lake Screen House (LH):

a. turbine building closed cooling water heat exchangers (TB),

b. reactor building closed cooling water heat exchangers (RB),

c. turbine-generator oil cooler heat exchangers (TB),

d. turbine-generator alternator exciter cooler heat exchangers (TB),

e. turbine-generator stator water cooling heat exchangers (TB),

f. fuel pool heat exchangers (AB),

g. auxiliary building air conditioning equipment condensers (AB),

h. service building air conditioning equipment condensers (SB),

i. radwaste control room air conditioning equipment condensers (RW),

j. primary containment centrifugal water chiller condensers (RB),

k. backup and system fill for the water spray type fire protection system (LH),

l. circulating water system traveling screen wash water (LH),

m. gland water system to the Unit 1 only circulating water pumps (LH),

n. chemical evaporator condensers (RW), (abandoned-in-place)

o. floor drain evaporator condensers (RW), (abandoned-in-place)

p. laundry reverse osmosis heat exchanger (TB), (no longer used)

q. laundry reverse osmosis chiller (TB), (no longer used)

r. turbine generator hydrogen coolers (TB) and

The service water return lines from the fuel pool heat exchangers are connected to the process sample system in order to periodically test for possible contamination via a grab sample. In addition, the service water combined effluent flow is continuously monitored for contamination.

9.2.2.3 Safety Evaluation

The service water system is not a safety-related system. It is not necessary for a safe plant shutdown, or required during or after the design-basis loss-of-coolant accident (LOCA). However, a brief evaluation is presented here for a more complete understanding of the plant auxiliary systems and their independence from safety-related equipment.

The service water system provides a reliable source of cooling water for station auxiliaries that are nonessential to the safe shutdown of the station during or following a design-basis LOCA. The loops can be operated separately to provide maximum reliability.

During normal plant operation the service water system utilizes two pumps in each unit with the jockey pumps secured and the installed spare pump in standby status. When pressure in either loop drops due to an increased demand or pump failure, a low-pressure alarm sounds in the control room and the standby pump is started. During shutdown (or startup) of one of the units, the service water pump combination can be adjusted such that the required number of service water or jockey pumps is operating to meet that systems' cooling requirements.

The service water jockey pumps are used to provide minimum flow requirements during a loss of offsite power. These jockey pumps can be connected to the emergency diesel generator.

The service water system is not designed to remain in service during the design-basis loss-of-coolant accident (LOCA); however, it is likely that a LOCA will not cause a malfunction in the service water system. The service water system is not required to operate normally during a design basis earthquake, tornado, or flood. The service water pumps are designed to function normally during in-plant fires.

During maintenance to the traveling screens in the lake screen house, a normally closed valve in a bypass line may be opened to assure a continuous supply of water to the system pumps. This bypass line is located 10 feet below the minimum pond surface elevation and 1.5 feet above the intake structure floor. This positioning prevents ingestion of floating debris, blockage by ice, or ingestion of sand and other heavier-than-water debris.

9.2.2.4 Tests and Inspections

The service water system is not safety related and does not require inspections. Because this system is normally in operation, the only tests required are functional tests during initial system startup or after maintenance.

9.2.2.5 Instrumentation Application

Principal measurements, such as service water header pressure, are indicated in the main control room. Local pressure and temperature gauges are provided for manual valve adjustment for flow balancing and equipment cooling. For that equipment which requires a controlled temperature, local automatic temperature controllers are provided to control service water flow through the equipment.

Abnormal conditions, such as low service water pressure, are detected with instrumentation and annunciated in the main control room. This provides the operator with information to assess the abnormal condition and initiate corrective measures.

Instrumentation is provided for automatic operation of the service water strainers. An abnormally high differential pressure across each strainer is annunciated, upon occurrence, in the main control room.

9.2.3 Reactor Building Closed Cooling Water System

The purpose of the reactor building closed cooling water (RBCCW) system is to provide cooling water to various reactor, and off-gas building auxiliary components.

9.2.3.1 Design Bases

9.2.3.1.1 Safety Design Bases

The RBCCW system is not an engineered safety feature and therefore does not have a safety design bases.

9.2.3.1.2 Power Generation Design Bases

The reactor building closed cooling water system is designed to provide recycled cooling water to remove the maximum expected heat load of equipment in the reactor, and off-gas buildings durning normal modes of reactor operation and during abnormal operating conditions when offsite power is available.

9.2.3.2 System Description

The RBCCW system contains five motor-driven horizontal centrifugal pumps to provide the required flow and five horizontal straight tube type heat exchangers cooled by service water. The pumps and heat exchangers are each sized at 100% of the capacity required for each unit; the capacities of each pump and heat exchanger are 4000 gpm and 40,000,000 Btu/hr, respectively. Unit 1 contains three of the RBCCW pumps and three of the RBCCW heat exchangers with a capacity to interconnect the third (spare) heat exchanger and the pump to Unit 2 (Drawing Nos. M-90 and M-136).

The RBCCW system contains clean demineralized water with an added as a corrosion inhibiting agents. Leakage from any of the reactor auxiliary systems equipment will be to the RBCCW system where it will be confined and isolated. The RBCCW system water pressure is lower than that of the service water system; consequently, the pressure differential will prevent the passage of contamination into the service water system. The RBCCW loops are periodically monitored for radioactive contamination via a grab sample with the process sampling system.

The reactor building closed cooling water system provides cooling for the following equipment:

a. reactor building equipment drain tank heat exchangers,

b. off-gas refrigeration machines,

c. off-gas building air conditioning units,

d. reactor recirculation system pump motor coolers, pump seals, and pump bearings,

e. reactor building process sampling system coolers panel,

f. drywell penetration cooling coils,

g. control rod drive feed pumps,

h. reactor water cleanup nonregenerative heat exchangers,

i. reactor water cleanup pump heat exchanger,

j. instrument storage room air conditioning unit,

k. drywell pneumatic system compressors and aftercoolers,

l. drywell equipment drain sump heat exchanger, and

m. drywell sump sample pump.

The reactor building closed cooling water system supplying the above equipment is designed for a 110° F maximum supply temperature. Through heat rejection to loop heat exchangers which are cooled by the plant service water system, temperatures remain at or below this maximum.

9.2.3.3 Safety Evaluation

The RBCCW system is not a safety-related system. It is not necessary for a safe plant shutdown, or required during or after the design-basis loss-of-coolant accident.

9.2.3.4 Tests and Inspections

The RBCCW system is not safety related and does not require safety inspections. Because this system is normally in operation, the only tests required are functional tests during initial system startup or after maintenance.

9.2.3.5 Instrumentation Application

RBCCW temperature is automatically controlled by local temperature controllers which regulate service water flow through the RBCCW heat exchangers. RBCCW pump discharge header temperature and pressure are indicated in the main control room, along with annunciation of abnormal pressure. Local pressure and temperature gauges are provided for manual valve adjustment for flow balancing and equipment cooling.

Instrumentation is provided in the main control room for the operator's information in assessing annunciated abnormal conditions and for initiating corrective measures.

Low RBCCW system pressure is detected by pressure switches which monitor the discharge header pressure of the RBCCW pumps. The pressure is indicated and annunciated in the main control room.

Cooling water flow through the reactor recirculation pump seals and motor cooling coils is locally monitored; low flow is annunciated in the main control room. Cooling water outlet temperatures from recirculation pump motor cooling coils, pump seals, and bearings are recorded and annunciated upon high abnormal temperature.

Water level in each RBCCW expansion tank is indicated locally. Water level can be controlled either manually or automatically by tank mounted local level switches. Abnormal high-and low-water level conditions are annunciated in the control room. Leakage into and out of the RBCCW system is detected by these abnormal high-and low-level conditions, respectively.

9.2.4 Demineralized Water Makeup System

The demineralized water makeup system is abandoned-in-place and has been replaced with a vendor trailer. The makeup water treatment system supplies water suitable for makeup to power cycle and various plant closed systems. This system treats raw well water and supplies makeup to the following equipment and systems:

a. cycled condensate makeup,

b. turbine building closed cooling water systems,

c. reactor building closed cooling water system,

d. reactor water cleanup system,

e. decontamination stations,

f. reactor standby liquid control system,

g. radwaste facilities,

h. Off Gas Glycol Tanks,

i. chemistry laboratory,

j. condensate storage and transfer system, and

k. gland water.

9.2.4.1 Design Bases

The makeup system is a vendor trailer, consisting of demineralizers and filters. It is designed to produce demineralized water at a rate corresponding to the continuous requirements of the plant. Note that the regeneration capability of the makeup demineralizers has been removed.

9.2.4.1.1 Safety Design Bases

The demineralized water makeup system is not a safety-related system. It is not necessary for a safe plant shutdown, or required during or after the design-basis loss-of-coolant accident.

9.2.4.1.2 Power Generation Bases

The makeup demineralizing system consists of a vendor trailer capable of producing deionized water at an output flow rate of 50 gpm. However, the vendor trailer may be modified to produce more output flow rate to meet additional plant requirements. The vendor trailer produces deionized water at an average daily gross capacity of 72,000 gallons. Portable vendor demineralizers are being used for additional makeup to the clean condensate tank. The regeneration capability of the makeup deminerilizers has been removed.

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9.2.4.2 System Description

Raw water is pumped from onsite wells, and treated via a vendor trailer system. The trailer system consists of parallel sand filters for removing iron, manganese, and suspended matter. The filtered water is then stored in the well water storage tank. Water from the well water storage tank is pumped to the makeup demineralizer trailer system and potable and sanitary water systems as required.

The sand filters in the vendor trailer are backwashed with previously filtered water.

The stream taken from the well water storage tank for sanitary and potable water is processed through an additional treatment system. A part of the water is chlorinated, as needed, and sent to the potable water system; the remaining water will be used in the sanitary water system. The potable and sanitary water system is discussed in Subsection 9.2.5.

9.2.4.3 Safety Evaluation

The demineralized water makeup system is not a safety system. It is not required for a safe shutdown, nor for operation during or following a design-basis accident.

9.2.4.4 Testing and Inspection

The makeup demineralizer system and makeup condensate system have provisions for testing and inspection during installation as well as plant operation. Stainless steel or plastic sampling lines are included for sampling the influent and effluent of treated water. Isolating valves are provided to isolate some parts of the system for maintenance and testing.

9.2.4.5 Instrument Application

Local and remote indicators and alarms are provided as required for monitoring of the system. Conductivity in the effluent from each dimineralizer train is monitored to maintain effluent quality.

9.2.5 Potable and Sanitary Water System

The purpose of the potable and sanitary water system is to provide potable water and water for the sewage treatment plant. Some components of the water sewage treatment plant are abandoned-in-place.

9.2.5.1 Design Bases

9.2.5.1.1 Safety Design Bases

The potable and sanitary water system is not required for safe shutdown of the plant. Therefore, it has no safety design bases.

9.2.5.1.2 Power Generation Design Bases

The potable and sanitary water system is not required for power generation; however the following bases were utilized in the system design:

a. The potable water system is designed to produce and maintain the quality of water required to meet drinking water standards.

b. The sanitary waste water treatment system is designed to meet the effluent quality limits set by the Illinois Environmental Protection Agency.

c. The potable and sanitary water system is designed so that there is no connection to systems having the potential for containing radioactive materials.

9.2.5.2 System Description

The potable and sanitary water system is supplied from two deep wells located on the station property. The potable and sanitary water system does not connect to any system that might discharge radioactive materials. Sewage treatment is provided by primary and secondary aerated lagoon cells. The effluent of the lagoon is normally treated by sand filtration, for Total Suspended Solids (TSS) reduction. Sewage treatment effluent is disinfected and then discharged into the receiving body of water. Some components of the water sewage treatment system are abandoned-in-place.

9.2.5.3 Testing and Inspection

The potable and sanitary water systems are proved operable and tested by their use during normal operations. The portions of each system normally closed to flow are tested by opening these closed portions to flow. Then by operating the system through the normally closed portions the integrity and operability are checked.

9.2.6 Ultimate Heat Sink

The ultimate heat sink (UHS) provides sufficient cooling water to permit the safe shutdown and cooldown of the station for 30 days with no makeup for both normal and accident conditions.

9.2.6.1 Design Bases

9.2.6.1.1 Safety Design Bases

The ultimate heat sink has the following design bases:

a. to provide sufficient water volume permitting a safe shutdown and cooldown of the station for 30 days with no water makeup for both normal operating and accident conditions - the initial maximum water temperature supplied to the plant is taken as 101.25° F. The UHS post-accident temperature analysis indicates a peak water supply temperature of 104°F.

b. to withstand the most severe postulated natural phenomenon as discussed in Chapter 2.0;

c. to withstand the postulated site-related incidents as discussed in Subsection 2.5.5; and

d. to provide water for fire protection equipment.

The gizzard shad net installed across the inlet channel is designed as non-safety component. See justification under section 2.5.5.2.5, CSCS Pond Flume Failure Analysis.

A more detailed physical description of the ultimate heat sink is provided in Sections 2.4 and 2.5.

9.2.6.1.2 Power Generation Design Bases

The ultimate heat sink, as a safety system, is not used during normal plant operations. Therefore, the ultimate heat sink has no power generation bases.

9.2.6.2 System Description

In the unlikely event that the main dike is breached, there is a submerged pond within the cooling lake for the LaSalle County Station that is designed to hold 460 acre-feet of water with a surface area of 83 acres. This remaining water constitutes the ultimate heat sink for the station, and has a depth of approximately 5 feet and a top water elevation established at 690 feet. Figures 2.4-4 and 9.2-1 illustrate the physical layout and capacity of the ultimate heat sink.

9.2.6.3 Safety Evaluation

Following a postulated main dike failure, the top water elevation of the UHS is established at 690 feet. Both units are shutdown with a postulated loss of off-site power (LOOP). Administrative controls are in place which require the circulating water pumps and the non-safety related service water pumps to be tripped off, when the lake level drops to elevation 690 feet, to preserve the UHS pond. Thus, there are no non-safety service water flows included in the UHS analysis.

The Core Standby Cooling System (CSCS) equipment cooling water system flow requirements of 38,600 gm are based on all RHR service water pumps operating (eight RHR-SW pumps, 4,000 gpm each) and all diesel generator cooling water pumps operating (three DG pumps, two at 1300 gpm and one at 2,000 gpm; and two HPCS DG pumps at 1000 gpm each). Fire protection system flow requirements are not included in the UHS analysis, since the flow requirements are negligible (see Note a.).

Station Cooling Water Requirements				
	Fire Protection (a)	Service Water	RHR Service Water Pumps	Diesel Cooling Water Pumps
Total plant flow for 30-day UHS analysis (b)	0 gpm	0 gpm	32,000 gpm	6,600 gpm

NOTES:

a. Fire Protection requirements are based on the largest fire demand of 3670 gpm for the low-pressure heater bay and it is determined that the fire protection water requirements would be at least 440,400 gallons; this is slightly under 3/10 of 1 percent of the UHS consisting of 1.5 E8 gallons (assuming the water level of the ultimate heat sink to be at the 690-foot elevation).

b. Assumes operation of the ultimate heat sink only with no water input from the external lake.

The ability of the ultimate heat sink to provide adequate cooling has been analyzed for the following two types of weather situations:

a. the weather situation which produces maximum temperatures, and

b. the weather situation in which evaporation losses are maximum.

The analysis consisted of two parts. Maximum temperature and maximum evaporation weather situations were determined from historical weather data. The worst case historical weather was determined using a program that assesses the temperature response of the LaSalle lake for 1 day and 30 day intervals covering the historical weather data. Similarly, the worst UHS evaporation over a 30 day period was assessed. The 1 day and 30 day periods for which the lake temperature and evaporative loss are maximum then become the worst case historical weather periods. This worst case historical weather was then used to perform a detailed analysis of the ultimate heat sink. This established the capability of the UHS to safely shut down and cool the station.

9.2.6.3.1 Worst Case Weather Situations

At the time of the original (circa 1970's), the historical weather data included that data that was available at the time of the analysis. Since then, more severe summer weather has occurred. The historical weather data set spanned the years 1948 through 1974. An updated weather data set which spans the years from 1948 through 1996 was used for the analysis for power uprate.

The worst period of recorded conditions for maximum temperature and evaporation was determined by performing a computer analysis of the weather data furnished by the U.S. Weather Bureau for Peoria, Illinois, July 1948 to June 1996. Because Peoria weather data was not available from January 1952 through

December 1956, Springfield, Illinois data was substituted for that period. The data consists of 3-hour interval readings for the wind speed, dry bulb, and dewpoint temperatures, and cloud cover information.

For the purpose of evaluating the performance of the UHS for all types of weather conditions, the long base period of the above data is preferable to any other available data (e.g. onsite measurements). Statistically, the weather at Peoria or Springfield, Illinois is not different from that at LaSalle as discussed in Section 2.3.

These data were used to evaluate water surface temperatures and evaporation rates for prescribed rates of heat rejection from the surface of the ultimate heat sink. The values used for the heat rejection rates are representative of the loss-of-coolant and offsite electrical power design-basis accident. Worst evaporation weather situations were obtained by selecting the weather conditions of the 30 consecutive days for which the evaporation loss was maximum.

Limiting weather conditions for peak UHS temperature analysis were obtained by extracting the conditions for the worst 24-hour period and the worst 30 consecutive day period of highest average temperature. This methodology is consistent with Regulatory Guide 1.27, Rev. 1. Using this data, a synthetic worst temperature period was constructed.

These periods for maximum evaporation and peak temperature were determined to have the following dates:

<u>Maximum Evaporation Period</u>

Worst 30 Days: June 18, 1954 to July 18, 1954
Average Evaporation: 1.85 cfs

<u>Maximum Temperature Period</u>

	Worst 24 Hours	Worst 30 Days
Dates:	July 15, 1995 (midday) to July 16, 1995 (midday)	July 10, 1983 to August 9, 1983
Average Bulk Water Temperature of UHS:	94.8°F	89.2°F

In this analysis the weather conditions given for the worst 24-hour period of maximum temperature are conducive to poor heat rejection because of a combination of conditions involving low wind speed, high air temperature, humidity, and intensity of solar radiation. Although higher dry bulb and dew-point temperatures are recorded for other dates, the wind speed on those dates is large enough to offset the effect of the higher temperatures and to increase the heat rejection capability of the heat sink.

9.2.6.3.2 Ultimate Heat Sink Temperatures and Evaporation Losses During Shutdown Conditions

Heat sink temperatures and evaporation losses for the above listed weather periods were evaluated with a computer model. In the model, the heat sink is represented by a number of small segments upon which mass and heat balance calculations are performed. The model predicts the transient response of the heat sink to all of the external conditions affecting it, (e.g., variable plant heat rejection, wind speed, dry bulb and dew-point air temperature, and solar radiation).

Key inputs for computer model are shown in Figure 9.2-1, the volume capacity curves for the UHS, and Figure 9.2-6, the emergency heat load. The results obtained by the computer model for UHS inlet and outlet temperatures and UHS drawdown are shown in Figures 9.2-2 and 9.2-3 for the worst temperature conditions.

The maximum temperature for cooling water supplied to the plant from the UHS during accident conditions is 104°F. Because the UHS follows a diurnal cycle (warms up during the day, cools off at night), its thermal response following an accident is dependent upon the temperature of the lake and the time of day when the postulated failure of the dike occurs. The results of the analysis for the worst-case historical weather effect on the temperature of cooling water supplied to the plant from lake/UHS indicate the peak temperature of cooling water from the lake will be 97.5°F and it occurs late in the afternoon (approximately 6 pm). After it occurs, the lake follows the diurnal cycle and cools off until the next morning where it begins to heat up again. A parametric study evaluating key parameters that affect UHS performance was completed. The key parameters are the UHS sediment level, the time of day when the postulated failure of dike occurs, and the initial UHS temperature (i.e., temperature of the lake when the postulated failure of dike occurs). The results show that the most severe time for the dike to fail is early in the morning (approximately 9 am). This is the start time which results in the highest peak UHS temperature. The referenced analysis shows that the temperature of cooling water supplied to the plant from the UHS during accident conditions will not exceed 104°F, if the initial temperature of the UHS is ≤ 102.3°F. (These temperatures are considered analytical limits and do not include margin due to instrument uncertainty or other assumed margin.)

The maximum drawdown under maximum evaporation conditions is less than 1.5 feet. This value includes seepage based on a seepage study that indicated that over a 30 day period the UHS could drop about 0.1-ft. The worst-case evaporative drawdown and seepage losses would reduce UHS volume to 220 acre-ft, a consumption of approximately 35% of the minimum lake inventory. Therefore, this analysis shows that the ultimate heat sink has the capability to shut down the plant in the event of a postulated LOCA in one unit and a simultaneous shutdown of the other unit, assuming extreme evaporative conditions.

With an average silt deposition of the Technical Specification maximum of 1.5 ft, the UHS volume is 341 acre-ft. From as-built conditions, this corresponds to a deposited volume of silt of 124 acre-ft. This represents more than 20 times the expected deposit volume of 5.3 acre-ft over a 40-year period (Section 2.4.11.6).

Therefore, it is concluded that significant margin exists in the UHS pond size, and the parameters subject to surveillance in the Technical Specification reflect this margin.

9.2.6.3.3 Plant Shutdown

In accordance with the agreement reached with the NRC Regulatory Staff, EGC commits to the following action in the event of low cooling lake water level. In the event that the cooling lake water level drops to an elevation (MSL) of 690 feet or below, the nuclear reactors are shut down until the cause of the abnormally low water level is corrected and normal cooling lake water level is again obtained. For further information consult LSCS-PSAR, Amendment 10, Section 10.12.

9.2.6.3.4 Gizzard Shad Net

Since the shad net is designated as non-safety related, emergency operating procedures are in place to inspect the net following a seismic event and repair it as necessary. This measure is taken to prevent a shad run from occurring at the Lake Screen House (see further discussion in Section 2.5.5.2.5, CSCS Pond Flume Failure Analysis).

9.2.7 Cycled Condensate System

The purpose of the cycled condensate system is to provide the necessary source of makeup water to various systems in the plant and also to provide additional water for on line and refueling activities. For additional information concerning refueling water refer to Subsection 9.2.11.

9.2.7.1 Design Bases

9.2.7.1.1 Safety Design Bases

The cycled condensate and refueling water storage facilities are not required to function in any but normal station operating conditions and therefore have no safety design bases.

9.2.7.1.2 Power Generation Design Bases

The cycled condensate and refueling water storage facilities are designed to provide a continuous source of water for all operating systems in the plant and a source of water for maintenance activities which require makeup water of cycled condensate water quality. The design objective water quality for the cycled condensate system is as follows:

Conductivity	≤ 1.0 μmho/cm at 25° C
Chlorides (as Cl)	≤ 0.05 ppm
Boron (as BO_3)	≤ 0.1 ppm
pH	6-8 at 25° C
Radioactivity Concentration	≤ 3 x 10^{-3} μCi/cc

Chemistry excursions in the tanks can alternatively be controlled via an external, auxiliary demineralization system, wheeled into the plant on a truck skid. Isolable pipe taps have been provided for external hose hook-ups on the main 16-inch supply headers and on the 6-inch make-up demin return headers.

The cycled condensate storage tanks are classified as Quality Group D equipment and are designed and fabricated in accordance with ANSI B96.1-1967. The tanks are designed for snow loads of 30 lbs/ft^2.

9.2.7.2 System Description

The cycled condensate system for each unit consists of a nominal 350,000 gallon storage tank.

The contents of the cycled condensate storage tank are protected from freezing by the use of immersion type electric heaters and heat tracing of pipelines.

Cycled condensate is distributed from the tank to various systems throughout the plant. Pressurized distribution is accomplished by the condensate makeup pumps, the condensate transfer pumps, and the condensate jockey pump. Unpressurized distribution (i.e., direct suction from the storage tank) is also supplied to various systems. The cycled condensate system for each Unit (Drawing Nos. M-74 and M-127) serves the following systems:

	System	Purpose
a.	RHR	flushing
b.	control rod drive	CRD pump supply
c.	fuel pool filter	resin mixing and

	demineralizer precoat tank	sluicing
d.	fuel pool	makeup
e.	HPCS flushing	
f.	gland steam evaporators	makeup
g.	RWCU filter demineralizers	resin mixing and sluicing
h.	LPCS flushing	
i.	Refueling volume	makeup and partial filling
j.	Condensate system	makeup
k.	Radwaste building services	makeup and supply (makeup and supply to the evaporators are abandoned-in-place)
l.	turbine building services	makeup and supply
m.	RCIC flushing	
n.	condensate polisher system	resin sluicing and pre-filter backwash

The cycled condensate storage tank supplies water and accepts recycled condensate water from the liquid radwaste system. In addition, it also supplies and accepts water during load changes due to thermal expansion and contraction of reactor water and steam during startup and shutdown. Level control in the condenser hotwell regulates the amount of water added to the condensate system and the amount of water rejected to the cycled condensate storage tank from the condensate system. Rejected water passes through the condensate polisher before entering the condensate storage tank.

Makeup to the cycle condensate storage system is achieved by the manual valving of the makeup demineralizer discharge to either of the two cycled condensate storage tanks (one for each unit) or by the use of portable vendor demineralizers when necessary.

9.2.7.3 Safety Evaluation

Each unit's cycled condensate system is a non-Seismic Category I, Quality Group D system as defined in Table 3.2-1 except for the 8-inch diameter supply line to the RCIC system. This supply line from the cycled condensate storage tank supply stop valve is a Seismic Category I, Quality Group B design and is routed underground from the storage tank to its point of entry in the reactor building.

The Unit 1 RCIC supply line is 761-feet long and contains 2153 gallons of water. With a pump capacity of 650 gpm, approximately 3 minutes are available for the remote manual rearrangement of valves from the control room in order to take suction from the suppression pool.

The Unit 2 RCIC line is approximately 980-feet long, contains about 2800 gallons, and provides approximately 4 minutes and 15 seconds for the remote manual switchover.

However, switchover to the suppression pool is accomplished automatically upon a low water level signal from the CST.

9.2.7.4 Testing and Inspection

The condensate storage tanks are filled and hydrostatically tested. The 8-inch line to the RCIC is tested for proper valve transfer.

9.2.8 Turbine Building Closed Cooling Water System

The purpose of the turbine building closed cooling water (TBCCW) system is to provide cooling water to various turbine building auxiliary components.

9.2.8.1 Design Bases

9.2.8.1.1 Safety Design Bases

The TBCCW system is not an engineered safety feature; therefore it has no safety design bases.

9.2.8.1.2 Power Generation Design Bases

The turbine building closed cooling water system is designed to provide recycled cooling water to remove the maximum expected heat load of equipment in the turbine building during normal plant operation or during abnormal operating conditions when offsite power is available.

9.2.8.2 System Description

Each unit has its own independent TBCCW system. Each system contains two motor driven, horizontal pumps and two horizontal straight tube type heat exchangers. Each TBCCW heat exchanger is sized at 100% capacity per unit under normal conditions for approximately 20,000,000 Btu/hr at 2500 gpm. The installed

TBCCW pumps deliver approximately 2000 gpm each. Therefore, each TBCCW heat exchanger has a capacity of approximately 16,000,000 Btu/hr at 2000 gpm. Drawing Nos. M-67 and M-124 illustrate the TBCCW system. The pump and heat exchanger not in service are used as standby equipment in case of failure or maintenance.

The TBCCW supply and return lines for the station air compressors have a cross-connecting capability. This capability provides cooling water to all compressors during a period of reactor shutdown with either units' TBCCW system out of service. Since the air demand will be at its highest peak during shutdown due to increased maintenance, this service is required.

The TBCCW system contains clean demineralized water with added corrosion inhibiting agents. Leakage from any of the turbine building equipment will go either to the TBCCW loop where it will be isolated or to the Equipment or Floor Drain System. The TBCCW system water pressure is lower than that of the service water system; consequently, the pressure differential will prevent the passage of contamination into the service water system. The TBCCW loops are periodically monitored for radioactive contamination via a grab sample from the process sampling system.

The TBCCW system provides cooling water to the following equipment:

a. turbine electrohydraulic control package,

b. condenser vacuum pump cooler,

c. heater drain pumps and motors,

d. motor-driven reactor feed pump mechanical seal heat exchangers, mechanical seal jacket cooler cavities and oil coolers,

e. condensate pumps and condensate booster pumps,

f. station air compressors,

g. generator bus duct coolers,

h. process sampling stations/ coolers/refrigeration units,

i. electrode boiler recirculation pump gland coolers (electrode boiler is abandoned-in-place), and

j. the electrode boiler sample cooler (electrode boiler is abandoned-in-place).

k. penetration sleeve cooling coils

l. turbine building offices A/C unit (unit 2 only).

m. electrode boiler feed pumps (electrode boiler is abandoned-in-place).

The TBCCW system supplying the above equipment is designed for a 110° F maximum supply temperature by heat rejection to loop heat exchangers which are cooled by the plant service water system, temperatures remain at or below this maximum.

9.2.8.3 Safety Evaluation

The TBCCW system is not a safety-related system. It is not necessary for a safe plant shutdown, or required during or after the design-basis loss-of-coolant accident.

9.2.8.4 Tests and Inspections

The TBCCW is not safety related and does not require safety inspections. Because this system is normally in operation, the only tests required are functional tests during initial system startup or after maintenance.

9.2.8.5 Instrumentation Application

TBCCW temperature is automatically controlled by local temperature controllers which regulate service water flow through the TBCCW heat exchangers. TBCCW pumps discharge header temperature and pressure are indicated in the main control room, along with annunciation of abnormally low pump discharge header pressure and high pump suction/heat exchanger discharge header temperature conditions. Local pressure and temperature gauges are provided for manual valve adjustment for flow balancing and equipment cooling.

Water level in each TBCCW expansion tank is indicated locally. The level can be controlled automatically by tank mounted local level switches or manually. Abnormal high-and low-water level conditions are annunciated in the control room. Leakage into and from the TBCCW system can be detected by these abnormal high- and low-level conditions respectively.

9.2.9 Primary Containment Chilled Water System

This system provides chilled water to the primary containment cooling units to meet the cooling load requirements in each drywell. A separate system is used for each unit drywell. Although the primary containment chilled water system is not safety related, it can be operated upon loss of offsite electric power.

9.2.9.1 Design Bases

9.2.9.1.1 Safety Design Bases

The primary containment chilled water system is not safety related; therefore, it has no safety design bases.

9.2.9.1.2 Power Generation Design Bases

a. At penetrations through the primary containment (drywell), the chilled water supply and return piping for each Unit 1 and Unit 2 are equipped with two motor-operated isolation valves to ensure primary containment isolation. The isolation valves are powered from essential buses. This part of the system is designed to meet Seismic Category I requirements.

b. The chilled water piping components within each drywell are supported in accordance with Seismic Category I criteria to preclude damage to safety-related components during a safe shutdown earthquake.

c. The system cooling capacity is based on heat losses from piping and valves, equipment, reactor pressure vessel, and unidentified steam leakages. The chilled water leaving and entering the system is approximately 46° F and 66° F, respectively.

d. Capability for two full-capacity redundant chilled water circuits are provided to meet the power generation objectives.

e. The power supply to the 550 ton refrigeration units, and chilled water pumps are designed to allow a manual connection to the standby diesel generators, if the normal electric power is not available.

f. The chilled water system holdup tank is designed with sufficient chilled water storage capacity to provide cooling for approximately 10 minutes until the refrigeration units are manually transferred to emergency buses.

g. Service water and ethylene glycol solution are used as a coolant in the centrifugal chiller units equipped with double-bundle condensers. Service water only is utilized in chillers with single-bundle condensers.

9.2.9.2 System Description

Both primary containments for Units 1 and 2 are provided with separate chilled water systems. The PCCW system contains clean demineralized water with added corrosion inhibiting agents.

The design of the primary containment chilled water system is shown in Drawing Nos. M-86 and M-133. Nominal sizes and types of principal system components are listed in Table 9.2-1. The system is designed to provide an adequate quantity of chilled water to the drywell fan-coil units and area coolers at a maximum of 46°F leaving water temperature from the chillers, and a maximum of 20°F delta-T across the chillers. Two of the three chillers for each unit are provided with double-bundle condensers, while the third chiller has a single-bundle condenser. The double-bundle condensers are designed for service water at a maximum inlet temperature of 100°F in one bundle, and a 40% solution of ethylene glycol in water at a temperature of approximately 70°F in the other bundle. Both bundles are sized for 100% condensing capacity for each chiller. The temperature rise across the service water and glycol bundles is approximately 11°F and 16°F, respectively. The chillers with single-bundle condensers are designed for service water at a maximum inlet temperature of 100°F and a rise of 10°F.

The ability of the drywell chillers to maintain drywell temperature with service water at a maximum inlet temperature of 104° F is evaluated in Reference 39 of Section 9.1.5.

The primary containment chilled water system for each Unit 1 and 2 consists of two chilled water circuits each comprised of one chilled water pump, one double-bundle centrifugal chiller, and one drywell fan-coil unit. To achieve rated cooling capacity, a single-bundle chiller must be operated in parallel with the in-service double-bundle unit. Flow paths including valves are provided to cross-connect the double-bundle chillers to be in-line with either of the chilled water pumps. Valves are also provided so that the single-bundle chillers can be paralleled with any of the double-bundle chillers in either Units 1 or 2. Also, an arrangement of check valves is provided such that the operating chilled water loop will supply the six area coolers in the drywell in addition to its associated fan-coil unit.

The drywell chillers are located on elevation 786 feet 6 inches of the auxiliary building for both Units 1 and 2.

Two isolation valves are provided in each supply and return line from individual fan-coil units and area coolers at the point of primary containment penetrations. These valves are powered from the essential buses and can be manually operated from switches provided on the main control board.

9.2.9.3 Safety Evaluation

The primary containment chilled water system is not a safety-related system.

9.2.9.4 Testing and Inspection

The chiller refrigerant suction and condensing pressures, compressor lubricant pressure, and water pressure differential across the condensers and evaporators of each chiller is periodically monitored to ensure that all normally operating equipment is functioning properly.

9.2.9.5 Instrumentation and Controls

The drywell chilled water system works in conjunction with the primary containment ventilation system to meet the cooling requirements inside the drywell. Each piece of equipment is manually started, but each A and B chilled water pump is interlocked with its respective chiller. The chiller is interlocked with a flow switch provided in the water line entering the chiller. Freeze protection and other necessary safety protections, such as high refrigerant head pressure, low suction pressure, and lubricant oil failure, are provided with the refrigeration unit. Low temperature of the water leaving the chiller, and loss of water flow through the chiller are annunciated on the main control board. Each chiller is provided with the necessary controls to maintain the design outlet water temperature. During station shutdown, the chiller outlet water temperature controller will be manually reset to a higher temperature to maintain drywell temperatures at human comfort levels under low cooling load conditions.

Thermocouples are provided in different areas in the drywell to monitor temperature. These temperatures are indicated on the main control board.

9.2.10 Station Heating and Heat Recovery System

The station heat recovery system employs waste heat to preheat the outside air of once through ventilation systems within the turbine building (TB), reactor building (RB), and radwaste building (RWB) during winter. The Turbine and Reactor Building Ventilation Systems heating coils also condition the outside air by circulating the same station heat glycol through the chillers during the summer. (Note: The SWGR heat recovery fans have been abandoned-in-place).

9.2.10.1 Design Bases

9.2.10.1.1 Safety Design Bases

The station heat recovery system is not required to function in any but normal station operating conditions, and therefore, has no safety bases.

9.2.10.1.2 Power Generation Design Bases

The station heat recovery system is designed to provide heating of the outside ventilation air of Units 1 and 2 for the reactor building, turbine building, and radwaste building. The system reclaims exhaust heat from once through systems in the turbine building, reactor building, and radwaste building; from the return air of the switchgear system, and; from the primary containment double-bundle chiller condensers of both Units 1 and 2. The station heat recovery heating coils of the TB and RB Ventilation System are used for cooling the outside air by circulating the glycol solution from the chillers.

9.2.10.2 System Description

The schematic design of the station heat recovery system is shown in Drawing No. M-102. Equipment parameters of principal system components are listed in Table 9.2-2.

The heating portion of the station heat recovery system consists of primary containment (VP) chiller condenser coils, heating coils and heat extraction coils of various systems, glycol electric heaters and recirculating pumps. The cooling portion of the station heat recovery system consists of chillers which circulate glycol solution to the Turbine and Reactor Building Ventilation heating coils.

The station heat recovery system recirculates a minimum 40% by weight of ethylene glycol and water solution to protect against freezing.

In the heating mode, the circulating glycol solution picks up heat from VP double-bundle chiller condenser coils of Units 1 and 2, and then passes through heating coils of the turbine building, reactor building, and radwaste building for preheating of the atmospheric intake air. The glycol solution then picks up heat in heat extraction coils of turbine building, reactor building, radwaste building, and switchgear systems. Supplementary heat is added to the glycol solution in glycol electric heaters when necessary, to bring its temperature to approximately 60° F. The glycol solution is then pumped through chiller condensers and thus completes the cycle.

In the cooling mode, the glycol solution is chilled by the SH chiller units and is circulated to the heating coils of the Turbine Building and Reactor Building Ventilation Systems to condition the outside air.

A primary makeup pump, a backup makeup pump and a makeup tank are also part of the system. The primary makeup tank pump provides the suction head for the recirculating pumps by pumping the glycol solution from the makeup tank. Should the suction head for the recirculating pump drop below the required suction head, the backup makeup tank pump automatically starts.

A manual bypass is provided across heating coils and heat extraction coils for heating the radwaste building system.

The heating mode of the station heat recovery system, used to preheat the ventilation air for major plant ventilation systems, such as the turbine building, reactor building and radwaste building ventilation systems, while recovering the heat from exhaust air from the turbine building, reactor building, switchgear and radwaste building ventilation systems; and it is supplemented with rejected heat from primary containment double-bundle chiller condensers and glycol heaters provided in the glycol loop. This is a self-sustaining system when the plant is normally operating.

To avoid freezeup or low temperatures in the plant areas during startup and normal plant shutdown, when equipment heat is not available to the heat recovery system, electric heating coils are provided to preheat ventilation air for the reactor building, turbine building and radwaste building ventilation systems.

To offset the transmission heat losses through walls, electric unit heaters are provided in all plant areas to limit the minimum area temperature to 65° F. Electric heating coils of sufficient capacity are provided in the air stream of various HVAC systems to limit the area temperature to 65° F minimum. The heat recovery system and the electric heating provisions made in various HVAC systems are not safety related and are not powered from emergency buses.

Temperature control is provided on all the safety-related HVAC systems, such as the control room, auxiliary electric equipment room, switchgear heat removal, and diesel generator ventilation systems, to maintain inside temperature of 65° F utilizing heat dissipated from equipment. (Note: The SWGR heat recovery fans have been abandoned-in-place).

9.2.10.3 Safety Evaluation

The operation of the station heat recovery system is not safety related.

9.2.10.4 Testing and Inspection

The system is balanced for the design solution flows and system operating pressures. Temperatures, solution flows, and pressure differentials across coils are monitored. Maintenance is performed on a scheduled basis in accordance with the equipment manufacturer's requirements.

9.2.11 Suppression Pool Cleanup System

The purpose of the suppression pool cleanup system is to provide a means of improving the quality of the water contained in the suppression pool and to transfer suppression pool water to the reactor well and dryer-separator well for refueling. In addition, the system can be used as a means of transferring water from the suppression pool to the condenser for inspection of the suppression pool or for hydrotesting the condenser.

9.2.11.1 Design Bases

9.2.11.1.1 Safety Design Bases

The suppression pool cleanup system is not required to function except when the unit is shutdown for refueling or maintenance, and therefore has no safety design bases.

9.2.11.1.2 Power Generation Design Bases

The suppression pool cleanup system for each unit is designed to provide a means of cleaning the water in the suppression pool, if necessary, after a unit is shut down for refueling or maintenance. Design bases for the system is as follows:

a. cleanup flow rate 7000 gpm from the suppression pool,

b. flow rate to refueling facilities 2500 gpm, and

c. water quality objective:

suspended solids	5 ppb
total dissolved solids	25 ppb
silica (as SiO_2)	5
sodium (as Na)	5
chloride (as Cl)	2
conductivity @ 25° C (µmho/cm)	0.1
pH at 25° C	6.5-7.5

9.2.11.2 System Description

The suppression pool cleanup system (Drawing Nos. M-96 (sheet 5) and M-142 (sheet 5) takes suction from the suppression pool by means of connecting a spool piece between the suppression pool cleanup pump and the suction line of the C Loop RHR pump. Additional spools are connected to the condensate system upstream and downstream of the condensate polisher system. After installation of the required spool pieces, the suppression pool cleanup pump is manually started and the water in the suppression pool is pumped through condensate prefilters, and polishers and back to the suppression pool. Water quality is monitored at the condensate polisher control panel. The discharge of the suppression pool cleanup pump may be connected to the fuel pool cooling system by a separate spool piece into the diffuser line for the reactor well. After the connection is made to the diffuser piping, the pump is used to transfer clean water from the suppression pool to the diffusers located in the reactor well for refueling. This flow is used to fill the reactor well and the dryer-separator storage pit. Of the approximately 1,000,000 gallons in the suppresion pool, about 500,000 gallons are used for refueling activities. After the reactor well and dryer-separator storage pit have been filled, normal makeup to the refueling volumes will be provided through the cycled condensate system of the unit that is undergoing refueling (Subsection 9.2.7).

When refueling activities have been completed, the refueling volumes; i.e., reactor well and dryer-separator storage pits, are drained by use of the Loop A RHR pump test return line which discharges back to the suppression pool. A spooled connection is used between the RHR system and the fuel pool cooling system to accomplish this task. The level in the reactor well is monitored during the drainage procedure to prevent damage to the fuel pool cooling pump.

An additional function of the suppresion pool cleanup system is to provide a means of transferring water from the suppression pool during times when inspection of the suppression pool and associated piping within the pool is required. This is accomplished by means of a spooled cross connection to the feedwater system at a point prior to the entry of the feedwater system flushing line into the condenser. The flow path will also allow a means of assisting in the hydrotesting of the condenser with existing water volumes present; thus minimizing the need of large volumes of water for testing the condenser, then discharging them from the plant site.

9.2.11.3 Safety Evaluation

The suppression pool cleanup system does not possess any safety design bases.

9.2.11.4 Inspection and Testing

No special tests are required for the system other than routine visual inspection.

9.2.11.5 Radiological Considerations

The suppression pool cleanup system is designed to reduce radioactivity in the suppression pool water before usage for refueling, thus reducing exposure to operating personnel to that experienced with the normal fuel pool quality water.

9.2.12 Chemical Feed System

The purpose of the Chemical Feed (CF) system is to minimize macroscopic biological fouling (e.g. asiatic clams) and microbiologically influenced corrosion (MIC) in the Service Water (WS), Core Standby Cooling Systems - Equipment Cooling Water (CSCS-ECW), Fire Protection (FP), and Circulating Water (CW) systems. The CF system will minimize silting, scaling and corrosion problems in the WS, CSCS-ECW, and FP systems by chemical injection. Additionally, scale inhibitor is injected into the CW system. The CSCS-ECW and FP systems are normally stagnant. Chemical treatment of these systems only occurs when these systems are in operation.

TABLE 9.2-1

PRIMARY CONTAINMENT CHILLED WATER SYSTEM

EQUIPMENT DATA

EQUIPMENT	NUMBER, TYPE, QUANTIY AND NOMINAL CAPACITY	
A. Water Chillers Equipment Numbers	1VP01CA 1VP01CB	2VP01CA 2VP01CB
Type	Motor-driven,	Centrifugal
Quantity	2	2
Capacity (tons of refrigeration)	550	
B. Chilled Water Pumps		
Equipment Numbers	IVP01PA 1VP01PB	2VP01PA 2VP01PB
Type	Centrifugal,	Horizontal
Quantity	2	2
Capacity (gpm)	1,300	1,300
Head (ft H_2O)	154	154
C. Secondary Condenser	1VP04AA 1VP04AB	2VP04AA 2VP04AB
Type	Min. 40% by wt. Glycol Solution	
Quantity	2	2
Flow Rate (gpm)	950	950
Pressure Drop (ft, water)	27	27
Total Heat Removal (Btu/hr)	$8.4x10^6$	$8.4x10^6$
D. Water Chillers		
Equipment Numbers	1VP14S	2VP14S
Type	Motor-driven,	Centrifugal
Quantity	1	1
Capacity (tons of refrigeration)	400	400

TABLE 9.2-2
(SHEET 1 OF 3)

STATION HEAT RECOVERY SYSTEM EQUIPMENT DATA

NAME OF EQUIPMENT	NUMBER, TYPE, QUANTITY AND NOMINAL CAPACITY	
1. Heat Recovery Pumps	OSHO1PA OSHO1PB	
Type	Centrifugal	
Quantity	2	
Capacity (gpm)	2,800	
Pump Head (ft water)	240	
Motor (hp)	300	
2. Primary Containment Chiller Secondary Condenser	1VPO4AA 1VPO4AB	2VPO4AA 2VPO4AB
See Table 9.2-1 Secondary Condenser		
3. Turbine Building Ventilation Supply System Heating Coils	1VTO2AA 1VTO2AB	2VTO2AA 2VTO2AB
See Table 9.4-13 Supply Air Heat Recovery Coils		
4. Reactor Building Ventilation Supply System Heating Coils	1VRO2A	2VRO2A
See Table 9.4-5 Supply Air Heat Recovery Coils		
5. Radwaste Building Ventilation Supply System Heating Coils	OVWO3A	
See Table 9.4-11 Supply Air Heat Recovery Coil		
6. Radwaste Building Ventilation Exhaust System Heat Extraction System Coil	OVWO4A	
See Table 9.4-11 Exhaust Air Heat Recovery Coil		
7. Turbine Building Ventilation Exhaust System Heat Extraction Coils	1VTO4A	2VTO4A
See Table 9.4-13 Exhaust Air Heat Recovery Coils		

TABLE 9.2-2
(SHEET 2 OF 3)

NAME OF EQUIPMENT	NUMBER, TYPE, QUANTITY AND NOMINAL CAPACITY	
8. Switchgear Ventilation Exhaust System Heat Extraction Coils	1VXO1A	2VXO1A
See Table 9.4-17 Heat Recovery Coil		
9. Reactor Building Ventilation Exhaust System Heat Extraction Coils	1VRO4A	2VRO4A
See Table 9.4-5 Exhaust Air Heat Recovery Coil		
10. Glycol Electric Boilers	OSHO1BA OSHO1BB	
Type	Min. 40% by wt. Glycol Solution	
Quantity	2	
Heating Capacity (kW)	1,000	
Flow Rate (gpm)	1,300	
11. Makeup Tank Pump	OSHO2P	
Type	Centrifugal	
Quantity	1	
Capacity (gpm)	100	
Pump Head (ft, water)	35	
Motor (hp)	3	
12. Fill Pump	OSHO3P	
Type	Centrifugal	
Quantity	1	
Capacity (gpm)	100	
Pump Head (ft, water)	175	
Motor (hp)	15	

TABLE 9.2-2
(SHEET 3 OF 3)

13. Cooling Water Chillers	0SH01CA to CG
Type	Air Cooled Water Chiller
Capacity (tons)	380
14. Primary Cooling Water Pump	0SH19PA to PG
Type	Centrifugal
Quantity	1 per chiller
Capacity (gpm)	690
Pump Head (ft, water)	50
Motor (hp)	15
15. Secondary Cooling Water Pump	0SH20PA to PC
Type	Centrifugal
Capacity (gpm)	1300
Pump Head (ft, water)	220
Motor (hp)	150
16. Makeup Tank Pump	0SH18P
Type	Centrifugal
Quantity	1
Capacity (gpm)	50
Pump Head (ft, water)	53
Motor (hp)	2

9.3 PROCESS AUXILIARIES

9.3.1 Compressed Gas Systems

There are two compressed gas systems utilized by the LSCS:

a. station air, consisting of service air and instrument air, and

b. the drywell pneumatic system.

The purpose of the service air systems is to provide air for general station use. The instrument air system supplies high quality dry air for automatic controls and instruments outside the reactor containment. The drywell pneumatic system provides high quality dry air for the operation of automatic controls within the drywell.

9.3.1.1 Design Bases

9.3.1.1.1 Safety Design Bases

No gas compressors or their associated equipment are required to safely shut down the unit following a postulated LOCA and/or loss of offsite electrical power. Valves requiring pneumatic supply for safe reactor shutdown are provided with individual pneumatic accumulators of sufficient capacity to safely shut down the unit.

9.3.1.1.2 Power Generation Design Bases

LaSalle County Station utilizes two compressed gas systems. The station air system, which receives air from the station air compressors, provides all station air requirements outside the containment during normal operation. This includes the supplying of high quality dry air for automatic controls and instruments outside the reactor containment. A separate drywell pneumatic system provides the required pneumatic supply to charge pneumatic accumulators and to operate valves inside the primary containment.

The station air system provides:

a. oil-free compressed air for service and maintenance use throughout the plant at required pressures; and

b. oil-free, filtered to remove 98% of all particles larger than 0.07 microns, and dried (to a dew point of -40° F) air for instruments and controls outside the primary containment at a nominal pressure of 100 psig. Pressure reducing devices are provided where needed;

The drywell pneumatic system provides oil-free, filtered and dried (to a dew point of -40° F) pneumatic supply for valves inside the primary containment at nominal pressures of 100 psig and 175 psig as required.

9.3.1.2 System Description

9.3.1.2.1 Station Air System

Compressed air is supplied to the station by three oil-free centrifugal air compressors discharging to a common header. Each compressor is designed for an operating capacity of 1960 scfm at 115 psig discharge pressure and is equipped with an air intake filter silencer and an after-cooler. Normal air requirements are met by the operation of two of these compressors.

Compressed air is discharged from the common air compressor header to three approximately 200-ft^3 air receivers. Isolation valves are installed to facilitate hose use for cross-trying Unit 1 and Unit 2 Station air systems when normal cross-tie capability is not available. Each of these air receivers has a dual filter and air dryer train with a capacity of 1200 scfm at a dew point of -40° F. Air from the filter-dryer train is discharged to separate instrument-air and service-air headers. These receivers are interconnected through piping and valving, so that source flow is sent into either system from the compressors, i.e., not from service air to instrument air receiver or vice versa. The service air system includes an approximate 150-ft^3 receiver for each unit and the instrument air system includes an approximate 200-ft^3 receiver for each unit. These receivers are located at the extreme ends of their respective air loops in order to have the largest damping effect on sudden changes in air demand (Drawings No. M-81 and M-82).

9.3.1.2.2 Drywell Pneumatic System

The function of the drywell pneumatic system is to supply compressed gas to operate valves in the drywell. The drywell pneumatic system draws suction from the drywell. The gas is passed through one of two oil-free compressors at a discharge pressure of 175 psig. Each compressor is rated for 100% of the required capacity for recharge of all safety/relief valve (SRV) accumulators in 4 minutes and for direct operation of miscellaneous valves. Compressed gas is cooled, filtered, and dried (to a dew point of -40° F) and routed to a receiver of 52 ft^3 capacity (Drawing No. M-66). Compressed gas from the air receiver is filtered and passed into the drywell where it serves the following:

a. main steam isolation valves,

b. main steam safety/relief valves,

c. automatic depressurization system (ADS) valve accumulators (relief function),

d. reactor recirculation sample valve, and

e. reactor recirculation pump seal water valves.

This system also provides pneumatic supply for testing or manual operation of the following:

a. reactor core isolation cooling system testable check valve,

Upon discharge from the air receiver and after filtration, the air is divided into two supply headers. One header reduces the nominal 175 psig air to approximately 100 psig and supplies all pneumatic requirements within the drywell. The other header supplies all the ADS accumulators with 175-psig air.

Each ADS SRV has an ADS accumulator installed to provide a source of stored compressed gas for SRV operation. These accumulators are supplied by the Drywell Pneumatic System consisting of a safety-related portion and a non safety-related portion. The non safety-related portion is the normal pneumatic supply to the ADS accumulators. The safety-related portion, referred to as the ADS accumulator backup compressed gas system, maintains the ADS accumulators pressurized following a loss of the normal non safety-related pneumatic supply.

The ADS accumulator backup compressed gas system consists of two bottle banks that serve as the safety-related pneumatic supply for the seven ADS SRVs. One bottle bank supplies four of the seven ADS SRVs while the other serves the remaining three ADS SRVs. Each bottle bank consists of four bottles of compressed nitrogen and one reserve bottle at each bottle bank that can be utilized during bottle replacement. The reserve nitrogen bottle is valved in during the replacement of the four bottles installed at each bottle bank to allow for bottle change.

An issue was identified in 2006 concerning the ADS accumulator backup compressed gas system that is utilized to support both the Low-Low Setpoint (LLS) function of the SRVs and the ADS function of the SRVs. The sharing of the safety-related pneumatic supply to support both the LLS and ADS functions could create a condition that results in LLS SRV actuations depleting the available supply of compressed gas, resulting in insufficient compressed gas being available for the ADS SRVs to perform their design function. A minimum bottle pressure of 500 psig for each bottle bank or a minimum bottle pressure of 1100 psig for the reserve bottle ensures that sufficient usable nitrogen exists to support both the LLS and the ADS function of the SRVs plus the assumed design leakage. To ensure the safety function of the ADS SRVs is maintained during any postulated condition, the ADS accumulator backup compressed gas system is required to be operable whenever the ADS function is required operable. With the backup compressed gas system bottle bank pressure $\geq$ 500 psig or the reserve bottle pressure $\geq$ 1100 psig, there is sufficient nitrogen available for any postulated event involving LLS actuation and a subsequent need for ADS.

In addition, to ensure the common pneumatic interface does not affect the ADS design function, both the low and medium LLS SRVs (Section 7.3.1.2.2.10) are required to remain functional to ensure sufficient nitrogen remains available to support LLS and ADS actuations during any postulated event. This requirement has been added to Section 3.5 of the LaSalle Technical Requirements Manual. (Reference 2)

The ability to provide long term pneumatic supply to the ADS SRVs to support reactor decay heat removal, as discussed in Sections 5.4.7.3.1 and 15.2.9, is evaluated in Reference 3. In addition, there is an emergency pressurization station in an accessible area of the auxiliary building at which each ADS gas line can be recharged indefinitely via nitrogen bottles brought to that point, in the event the reactor building becomes inaccessible (Drawing No. M-66).

9.3.1.3 Safety Evaluation

The station air system (including compressors, filters, dryers, air receivers, etc.) are not nuclear safety related. Portions of the drywell pneumatic system are nuclear safety related.

The Station Air System and Drywell Pneumatic System lines that penetrate primary containment are provided with containment isolation valves which meet the requirements as applicable of General Design Criteria 56 or 57 of Appendix A to 10CFR50 as described in Section 6.2. Containment isolation is discussed in detail in Section 6.2.

All systems penetrating the primary containment, with the exception of the bottled nitrogen to the ADS valves, are isolated upon a containment isolation signal. The Service Air System lines which penetrate primary containment have two locked-close manual isolation valves with a blanked flange connection during non-shutdown conditions. If necessary, the bottled nitrogen system can be isolated by means of remote manually controlled valves. The bottled nitrogen allows operation of the ADS valves following an accident via continuous supply to the two groups of ADS accumulators. The ADS valves then operate in a normal manner.

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All main steam isolation valves, main steam relief valves, and ADS valves are equipped with individual accumulators of sufficient capacity to operate these valves in the event of loss of the air supply to the accumulators on a containment isolation signal.

A complete loss of pneumatic supply could occur only upon rupture of a supply line, upon loss of station auxiliary power, or upon loss of instrument air to the drywell pneumatic compressors. Complete loss of pneumatic supply at power causes a normal plant shutdown. All controls and pneumatic-operated valves are designed to fail in the safe position upon loss of pneumatic supply

Verification of design response to a loss-of-pneumatic-supply accident is an essential part of the preoperational test on the drywell pneumatic system (Regulatory Guide 1.80, reissued as Regulatory Guide 1.68.3). Upon loss of pneumatic supply caused by a line rupture, the immediate action by the operator is to isolate the rupture. The location of rupture causing the loss of pneumatic supply can be isolated by valving. The service and instrument air system demonstration verifies that the valves fail as designed upon a loss of air. Those systems and pneumatic operators that are essential for safe plant shutdown are provided with independent accumulators to supply the required quantity of gas. The instrument air receivers are sized to provide sufficient air to the instruments and controls for 2 to 3 minutes after loss of compressors. Receivers are allowed to blow down to 80 psig to meet this objective.

9.3.1.4 Testing and Inspection

Inspection of equipment is made and system performance verified periodically and after maintenance in accordance with the station air quality monitoring program.

9.3.1.5 Instrumentation Applications

The compressed gas systems are instrumented to automatically maintain the proper system pressure and to present annunciation in the main control room whenever system pressures drop below setpoint limits. The station air system pressure is indicated in the control room and high system temperature is alarmed there also. Drywell pneumatic system low header pressure and high ADS header pressure are alarmed in the control room. Also, ADS bottles low pressure is alarmed in the control room.

Control switches are provided on the main control board which allow the operator to control the station air compressors. The drywell pneumatic compressors are controlled locally. Control switches are also provided to position the isolation valves for the drywell pneumatic system. The redundant isolation valves on the drywell containment atmosphere to compressors suction lines are controlled by control switches on the main control board panel and are automatically closed by the containment isolation signal.

9.3.2 Process Sampling System

The process sampling system is a monitoring system which is not required for safety, but it monitors the process related variables in fluids that pass through safety systems.

9.3.2.1 Design Bases

9.3.2.1.1 Safety Design Bases

The process sampling system is not required for safety and therefore possesses no safety design bases.

9.3.2.1.2 Power Generation Design Bases

The process sampling system:

a. monitors the performance of the plant,

b. monitors the operation of the equipment, and

c. provides information for making operating decisions.

9.3.2.2 System Description

The process sampling system (Drawing Nos. M-115 and M-159) continuously and/or periodically takes liquid, steam, and gas samples to evaluate plant operating conditions.

Sample sources, sample pressure and temperature, line size and length, analysis to be performed, background radiation, and identification of panel are as indicated on Table 9.3-1.

Aqueous streams are sampled to monitor plant water quality and to determine corrosion product and activity levels. Filter and demineralizer efficiencies, as well as heat exchanger tube leaks, are also determined by sampling.

Sample tubing size and sample flow rates are established to ensure fresh, prompt samples to the analyzers in accordance with analysis requirements. Sample lines are of corrosion resistant materials and sized to deliver water at a rate sufficient to maintain turbulent flow, and are routed as short and direct as possible to minimize contamination decay and constituent change. The samples are routed to stations located in the reactor building, turbine building, and radwaste building. Grab samples at each station are provided with a hood, adequate ventilation, sink, and demineralized water supply.

Samples are provided with temperature and pressure control at each sample station.

Two panels, a Material Monitoring system (MMS) and a Data Acquisition System (DAS), monitor the durability and effectiveness of noble metal compounds deposited on reactor vessel and piping surfaces. These panels are used to determine when noble metal compounds should next be re-injected into the reactor vessel. For details on the injection of noble metal compounds into the reactor vessel, see Section 5.2.3.2.1. The MMS panel contains flow, pressure and temperature instruments, along with two electrochemical corrosion potential (ECP) probes. The DAS panel receives and records outputs from the MMS instruments. In addition, the DAS panel receives a reactor vessel hydrogen concentration signal from the reactor building sample panel 1PL14J.

Reactor coolant is supplied to the MMS panel from the common discharge header of the RWCU pumps and is returned to the common suction header of the RWCU pumps. The MMS panel contains metal coupons which were treated with noble metal compounds, along with the reactor vessel and piping. The coupons are exposed to similar water velocities and temperatures as the materials in the reactor vessel, to ensure representative samples. Periodically during the operating cycle, a coupon is removed from the MMS and analyzed for noble metals. The amount of metal remaining is used in determining the most effective re-application schedule. See Table 9.3-1 (Sheet 1 of 6) for more sample details.

9.3.2.3 Safety Evaluation

The process sampling system is classified as Quality Group D, as defined in Table 3.2-1, from the sample sink up to the root valve located near the main process line. The root valve and piping upstream up to the connection on the main process line have the same classification as the process line except that process sample lines 3/4 inch NPS and less are not classified greater than Class B. The only sample line connected to the primary coolant pressure boundary is the reactor recirculation water sample line (Table 6.2-8). The ability to obtain reactor coolant samples at other locations is addressed in plant procedure as plant conditions warrant. The piping associated with sampling during these conditions is considered process sample lines although representative samples may be obtained. Other sample lines handling radioactive fluids are connected to nonreactor coolant pressure boundary systems and are provided with manual and/or solenoid operated valves. Air operated valves will fail closed on loss of offsite power. Grab sample lines for systems having a nominal pressure rating of 600 pounds or higher are provided with two valves in series to reduce the potential for leakage.

Radioactive lines are routed to minimize radiation exposure to plant personnel. Where practical, lines are routed near ceilings and away from accessible areas. Where not practical, lines are shielded to reduce radiation exposure to acceptable limits consistent with the plant access requirements including plant operation, shutdown, and maintenance.

9.3.2.4 Testing and Inspection

The process sampling system is used during various plant operating modes. No special test and inspections are required. Malfunctions on principal sample lines are alarmed locally and by a trouble alarm in the control room. Grab samples are taken periodically to check proper instrument calibration.

9.3.2.5 Instrumentation Application

All continuous sample analyzers have outputs for a recorder, and all are capable of having alarms on the local panel. Loss of sample due to low flow, indicating a line break, line plugged, or valve closed, causes an alarm locally for feedwater and reactor recirculation sample flow. In addition, any alarm on the local panel can be connected to initiate a trouble alarm in the main control room.

9.3.3 Equipment and Floor Drainage System

The equipment and floor drainage system provides a method by which liquid wastes may be channeled to a process area.

9.3.3.1 Design Bases

9.3.3.1.1 Safety Design Bases

Although the equipment and floor drainage system is not safety related, some safety considerations are considered to alleviate possible accident conditions. The safety objective of this system is to mitigate internal flood propagation. Equipment and floor drain penetrations through primary and secondary containment barriers are designed to maintain containment integrity during normal operations and design-basis accidents. Drain system piping is routed to maintain the integrity of all watertight barriers located around safety-related equipment and to mitigate the effects of flooding due to tank ruptures, breaks in the circulating water system piping, and, where applicable, actuation of the fire suppression system in an area combined with use of fire hoses.

9.3.3.1.2 Power Generation Design Bases

The performance objective of the plant equipment and floor drainage systems is to collect and remove all waste liquids from their points of origin to a suitable processing area in a controlled and safe manner. Water from radioactive drains is collected for processing through the liquid radwaste system. Drain line penetration through containment barriers is designed to maintain containment integrity during normal operations and design-basis accidents.

9.3.3.2 System Description

Equipment and floor drains are segregated with respect to the following criteria:

Radioactive Drains	Nonradioactive Drains
a. anticipated levels of dissolved and suspended solids,	a. chemical concentrations,
b. chemical concentrations,	b. oil contamination,
c. detergent concentrations, and	c. ethylene glycol solutions, and
d. oil contamination	d. sodium pentaborate solutions

Radioactive drains are segregated into the preceding classifications or combinations thereof. The wastes are collected and routed back to various holding tanks in the liquid radwaste system from which they can be most efficiently and effectively processed. Nonradioactive drains are segregated from potentially radioactive drains, where possible, to minimize the buildup of plant radioactive water inventories and to reduce the amounts of drain water that must be processed by the liquid radwaste systems. Nonradioactive drains will be appropriately neutralized or routed through outside oil separators, as required, prior to discharge to the river or cooling lake via the cooling lake blowdown line or the storm sewer system. Ethylene glycol and sodium pentaborate solutions will be collected and removed from the plant for adequate disposal. The system classifications for the equipment and floor drainage systems are described in Chapter 3.0.

The equipment drain systems for the reactor and turbine buildings are shown in Drawing Nos. M-80, M-128, M-91, and M-137, respectively. The floor drain systems for each building are shown in Drawing Nos. M-104, M-149, M-105, M-150, M-106, M-151, M-107, and M-109.

Primary containment integrity will normally be maintained in transferring equipment and floor drains from the drywell sumps to the liquid radwaste system by two primary containment isolation valves. These valves in series outside of the primary containment wall close upon a high drywell pressure signal or low reactor water level signal.

9.3.3.2.1 Radioactive Equipment Drainage System

Drains, from equipment carrying radioactive or potentially radioactive liquids, are segregated and routed into either the equipment or floor drain systems. Radioactive drainage, which is low in dissolved and suspended solids and has no chemical detergent or oil contamination, is collected in either equipment drain sumps or equipment drain tanks located in each building. The sump pumps and equipment drain tank transfer pumps start automatically on high level and discharge directly to the waste collector tank. Drain system designations in this category are reactor building equipment drains and turbine building equipment drains.

Potentially radioactive or radioactive equipment drainage, which is high in dissolved or suspended solids or has possible oil contamination, is routed into the floor drain system or directly to a floor drain sump in such a manner that the possibility of airborne contamination will be minimized. Drain system designations in this category are reactor building floor drains, turbine building floor drains, auxiliary building floor drains, and off-gas and solid radwaste floor drains.

Potentially radioactive or radioactive equipment drainage, which contains chemicals or detergents, is collected and routed back to the chemical waste collector and laundry drain collector tanks, respectively. Corrosion-resistant materials are used in the chemical waste collection system. Drain system designations in these categories are reactor building floor drains and turbine building floor drains for chemicals and nonfoaming detergents, and laundry equipment and floor drains for foaming detergents.

The tanks, sumps, and pumps of the equipment drain system are sized to handle all anticipated normal and maximum leakage from the equipment served. A 6-inch curb is provided around each equipment drain sump to prevent floor drain quality water from entering the equipment drain system.

9.3.3.2.2 Radioactive Floor Drainage System

Radioactive floor drains from each isolated area or building of the plant are segregated with respect to the degree of radioactivity and chemical detergent or oil contamination. The wastes are collected and routed to the appropriate floor drain sumps or holding tanks in the liquid radwaste system. Floor drain lines are routed where possible in a manner that will minimize the possibility of contaminating low radiation areas.

Oil separators are provided for all sumps which collect from potentially oil contaminated floor drains. The oil is separated before the drainage is transferred to the liquid radwaste system. As with the radioactive equipment drainage system, the sumps, tanks, and pumps are sized to handle all anticipated normal and maximum floor drainage.

9.3.3.2.3 Provision of Spare Pumps

In most cases, collector tanks are provided with two full capacity pumps, each capable of handling the maximum anticipated requirement.

9.3.3.2.4 Miscellaneous Drainage System

Building roof drainage is collected in branch lines, emptied into headers, and discharged to the storm drain system. Nonradioactive chemical liquid wastes are collected and neutralized prior to discharge to the river. Corrosion-resistant materials are used in the chemical waste collection system. Nonradioactive floor drains are routed through an oil separator prior to release.

9.3.3.3 Safety Evaluation

The equipment and floor drainage system is not a safety-related system and therefore requires no safety evaluation.

9.3.3.4 Testing and Inspection

The station equipment and floor drainage systems are proved operable for use during normal station operation.

9.3.3.5 Instrumentation Application

High and low level switches are provided in each sump to start and stop the sump pump automatically. For sumps having two pumps, a separate high level switch set at a higher level will start the second pump and actuate annunciation in the appropriate control room.

Leak detection instrumentation is provided for sump pumps located in the reactor building. High leakage rate is annunciated in the main control room. The leak detection instrumentation for these sumps is discussed in Subsection 7.7.15.

9.3.4 Chemical and Volume Control System (PWR's)

The LaSalle County Station (LSCS) does not have a pressurized water reactor; therefore this subsection is not applicable.

9.3.5 Standby Liquid Control System (BWR's)

9.3.5.1 Design Bases

9.3.5.1.1 Safety Design Bases

The standby liquid control system shall meet the following safety design bases:

a. Backup capability for reactivity control shall be provided, independent of normal reactivity control provisions in the nuclear reactor, to be able to shut down the reactor if the normal control ever becomes inoperative.

b. The backup system shall have the capacity for controlling the reactivity difference between the steady-state rated operating condition of the reactor with voids and the cold shutdown condition, including shutdown margin, to assure complete shutdown from the most reactive condition at any time in core life.

c. The time required for actuation and effectiveness of the backup control is consistent with the nuclear reactivity rate of change predicted between rated operating and cold shutdown conditions. A fast scram of the reactor or operational control of fast reactivity transients is not specified to be accomplished by this system.

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 shall be dispersed within the reactor core in sufficient quantity to provide a reasonable margin for leakage or imperfect mixing.

f. The system shall be reliable to a degree consistent with its role as a special safety system; the possibility of unintentional or accidental shutdown of the reactor by this system shall be minimized.

g. All portions of the system which are required for sodium pentaborate injection are seismically qualified as Seismic Category I.

h. In the event of a Loss-of-Coolant-Accident the Standby Liquid Control solution injected into the reactor core and leakage through the break will control the pH in the suppression pool to prevent elemental iodine re-evolution.

9.3.5.1.2 Power Generation Design Bases

The standby liquid control system is not required during normal station operation, as it provides no power generation function. Therefore, the standby liquid control system has no power generation bases.

9.3.5.2 System Description

The standby liquid control (SLC) system (Drawing Nos. M-99 and M-145) is manually initiated from the main control room to pump a boron neutron absorber solution into the reactor if the operator believes the reactor cannot be shutdown or kept shut down with the control rods. Once the operator's decision for initiation of the SLC system is made, the design intent is to simplify the manual process by providing a keylocked switch for each pump. This prevents inadvertent injection of neutron absorber by the SLC system. However, insertion of the control rods is expected to assure prompt shutdown of the reactor should it be required. The SLC system is also used to mitigate the consequences of an ATWS event, refer to UFSAR 15.8 for details.

The keylocked control room switches are provided to assure positive action from the main control room should the need arise. Standard power plant procedural controls are applied to the operation of either of the keylocked control room switches.

The SLC system is required only to shut down the reactor and keep the reactor from going critical again as it cools.

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.

The boron solution tank, the test water tank, the two positive displacement pumps, the two explosive valves, the two motor-operated pump suction valves, and associated local valves and controls are located in the secondary containment. The liquid is piped into the reactor vessel and discharged near the bottom of the core shroud, so it mixes with the cooling water rising through the core (Section 5.3 and Subsection 3.9.5).

The specific neutron absorber solution is sodium pentaborate ($Na_2 B_{10} O_{16}$ * 10 H_20). Due to the ATWS rule, LaSalle switched from sodium pentaborate using naturally found boron to sodium pentaborate with boron enriched with boron-10, a better neutron absorber. The safety analysis was originally performed using natural boron and since the enriched boron-10 solution absorbs more neutrons (more conservative), the analysis was not reevaluated.

Measures were taken to prevent stratification of the solution and plugging of the system piping. A sparger, utilizing air for mixing purposes, is provided in the tank. To prevent plugging, the tank outlet is raised above the bottom of the tank.

At all times when it is possible to make the reactor critical, the SLC system shall be able to deliver enough sodium pentaborate solution into the reactor (Figure 9.3-1) to ensure reactor shutdown. This is accomplished by placing sodium pentaborate in the SLC tank and filling it with demineralized water to at least the low level alarm point. The solution can be diluted with water up to the overflow level volume to allow for evaporation losses or to lower the saturation temperature.

The saturation temperature of the recommended solution is 59° F at the low level alarm volume and approximately 49° F at the tank overflow volume (Figure 9.3-2). The equipment containing the solution is installed on the 820' elevation of the Reactor Building. The Reactor Building Ventilation System maintains the air temperature within the range of 65°F to 104°F. In addition, a heater system maintains the solution temperature at 75° F to 85° F to prevent precipitation of the sodium pentaborate from the solution during storage. High or low temperature, or high or low liquid level, causes an alarm in the control room.

Each positive displacement pump is sized to inject the solution into the reactor in 50 to 125 minutes, regardless of the amount of solution in the tank. The pump and system design pressure between the explosive valves and the pump discharge is

1400 psig. The two relief valves are set to ≤ 1400 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 either of two keylocked switches (system A or B) on the control room console. This assures that switching from the "STOP" position is a deliberate act. Switching from "STOP" actuates the appropriate system, starts the appropriate injection pump, actuates both of the explosive valves, opens both pump suction motor-operated valves, and closes the reactor cleanup system outboard isolation valve to prevent loss or dilution of the boron.

If the pump lights, or explosive valve light indicates that the liquid may not be flowing, the operator can immediately utilize the alternate pump by turning its respective keylocked switch. Cross piping and check valves assure a flow path through either pump and either explosive valve. The local switch does not have a "STOP" position. This prevents the isolation of the pump from the control room. Pump discharge pressure is 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, solution level, and heater system status is provided locally at the storage tank. Table 9.3-2 contains the process data for the various modes of operation of the SLC.

9.3.5.3 Safety Evaluation

The standby liquid control system is a special safety system and is maintained in a standby status whenever the reactor is critical. The system is expected never to be needed for safety reasons because of the large number of independent control rods available to shutdown the reactor.

The SLC system is also credited with buffering the pH of the Suppression Pool following a LOCA involving fuel damage.

However, to assure the availability of the SLC system, two sets of the components required to actuate the system pumps and explosive valves are provided in parallel redundancy.

The system is designed to bring the reactor from rated power to a cold shutdown condition at any time in core life. The negative reactivity reduces reactor power from rated to zero level and allows cooling the nuclear system to room temperature, with the control rods remaining withdrawn in the rated power pattern. It includes the reactivity gains that result from complete decay of the rated power xenon inventory. It also includes the positive reactivity effects from eliminating steam voids, changing water density from hot to cold, reduced Doppler effect in uranium, reducing neutron leakage from boiling to cold, and decreasing control rod worth as the moderator cools.

The minimum average concentration of 45% enriched boron in the reactor to provide adequate shutdown margin, after operation of the SLC System, is 660ppm. This shutdown margin calculation is performed on a cycle specific basis.

Sodium pentaborate is injected into the reactor based on the required boron concentration of 660 ppm in the reactor coolant including recirculation loops, at 68°F and reactor normal water level. The concentration injected is increased by 25% to allow for imperfect mixing and leakage. An additional 250 ppm is provided to accommodate dilution by the RHR system in the shutdown cooling mode. This concentration is achieved when the solution is prepared as defined in Subsection 9.3.5.2 and maintained above saturation temperature.

Cooldown of the nuclear system requires a minimum of several hours to remove the thermal energy stored in the reactor, cooling water, and associated equipment. The controlled limit for the reactor vessel cooldown is 100° F per hour, and normal operating temperature is approximately 550° F. Use of the main condenser and various shutdown cooling systems requires l0 to 24 hours to lower the reactor vessel to room temperature (70° F); this is the condition of maximum reactivity and, therefore, the condition that requires the maximum concentration of boron.

The specified boron injection rate is limited to the range of 6 to 25 ppm per minute. The lower rate assures that the boron is injected into the reactor in approximately 2 hours. This resulting reactivity insertion is considerably quicker than that covered by the cooldown. The upper limit injection rate assures that there is sufficient mixing so that boron does not recirculate through the core in uneven concentrations that could possibly cause reactor power to rise and fall cyclically.

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 (Chapter 3.0). The system piping and equipment are designed, installed, and tested in accordance with requirements stated in Chapter 3.0.

The SLC system is required to be operable in the event of a station power failure, therefore the pumps, heaters, valves, and controls are powered from the standby ac power supply or dc power in the absence of normal power. The pumps and valves are powered and controlled from separate buses and circuits so that a single failure does not prevent system operation.

The SLC system and pumps have sufficient pressure margin, up to the system relief valve setting, to assure solution injection into the reactor above the normal pressure in the bottom of the reactor. The nuclear system relief and safety valves begin to relieve pressure above approximately 1100 psig. Therefore, the SLC system positive displacement pumps cannot overpressurize the nuclear system.

Only one of the two standby liquid control pumps is needed for system operation. If one pump is found to be inoperable, there is no immediate threat to shutdown capability, and reactor operation can continue during repairs. The time during which one redundant component upstream of the explosive valves may be out of operation is consistent with the following: the probability of failure of both the control rod shutdown capability and the alternate component in the SLC system; and the fact that nuclear system cooldown takes several hours while liquid control solution injection takes approximately 2 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 of system function is obtained by demonstrating operation of the pump.

9.3.5.4 <u>Testing and Inspection Requirements</u>

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 and from the storage tank closed and the three valves to and from the test tank opened, demineralized water in the test tank can be recirculated by locally starting either pump.

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. Both injection valves open upon actuation. System operation is indicated in the control room.

After functional tests, the injection valve shear plugs and explosive charges are replaced and all the valves returned to normal positions.

After closing a local locked-open valve to the reactor, leakage through the injection valves can be detected by opening valves at a test connection in the line between the containment isolation check valves. Position indicator lights in the control room indicate that the local valve is closed for tests or open and ready for operation. Leakage from the reactor through the first check valve can be detected by opening the same test connection when the reactor is pressurized.

The test tank contains demineralized water for approximately 3 minutes of pump operation. Demineralized water from the makeup system or the condensate storage system is available for refilling or flushing the system.

The concentration of the sodium pentaborate in the solution tank is determined periodically by chemical analysis. A Boron-10 enrichment surveillance will be performed at least once per cycle (nominal 24 months) to ensure that sufficient enrichment exists to meet the equivalent control capacity. (Reference 1)

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 Chapter 7.0.

9.3.6 References

1. Letter from W.E. Morgan, Commonwealth Edison, to USNRC "LaSalle County Station Units 1 and 2, Implementation of 10CFR50.62 ATWS Rule," dated October 25, 1990.

2. Amendment 196 for LaSalle Unit 1 (Facility Operating License NPF-11) and Amendment 183 for LaSalle Unit 2 (Facility Operating License NPF-18), dated 03/19/2010.

3. Design Analysis L-003263, Volume Requirements for ADS Back-up Compressed Gas System (Bottle Bank), Rev. 02.

TABLE 9.3-1 (SHEET 1 OF 6)
PROCESS SAMPLING SYSTEM
(Reactor Building Samples)

UNIT # 1 SAMPLE NO.	UNIT # 2 SAMPLE NO.	SAMPLE IDENTIFICATION	MAXIMUM OPER PRESS PSIA	MAXIMUM COND TEMP. F	NO SAMPLE POINTS	P&ID UNIT 1 / UNIT 2	NO OF SAMPLE PUMPS REQ'D	SAMPLE LINE SIZE IN.	UNIT 1 SAMPLE LINE LENGTH FT.	UNIT 2 SAMPLE LINE LENGTH FT.	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY Ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX (NOTE 3)	REMARKS
1A1	2A1	REACTOR WATER	1260	550	1	M-93-2 / M-139-2	*	1/2 SS TUBE 959LS	130	*	RANGE 0-10 1CE-PS020	*	*	DO Range 0.1-400 1AE- PS058A DH Range 0-2 ppm 1AE-PS058B	*	*	*	*	*	H	Sample line size applies only to tubing downstream of outboard isolation valves
1A2	2A2	REACTOR WATER CLEAN UP SYSTEM INLET HEADER	1180	120	1	M-97-1 / M-143-1	*	1/2 SS TUBE 959LS	140	*	RANGE 0-10 1CE-PS021	*	*	DO Range 0.1-400 1AE-PS057A DH Range 0-2 ppm 1AE-PS057B	*	*	*	*	*	H	Sample line size applies only to tubing downstream of outboard isolation valves
*		REACTOR WATER CLEAN UP PUMP COMMON DISCHARGE HEADER	1205	550	1	M-97-1 M-143-1	*	¾ SCH. 160 PIPE	35	*	*	*	*	*	*	*	**	*	*	H	Periodic metal coupon sample for noble metal compound content
1A3-1 1A3-2 1A3-3	2A3-1 2A3-2 2A3-3	REACTOR WATER CLEAN UP DEMINERLIZERS 1A, 1B & 1C DISCHARGE	1145	120	3	M-97-1 / M-143-1	*	1/2 SS TUBE 959LS□	144 164 180	*	RANGE 0-1.0 1CE-PS022,23,24	*	*	*		*	*	*	*	H	Sample line size applies only to tubing downstream of outboard isolation valves
1A4	2A4	SERVICE WATER, FUEL POOL HEAT EXCHANGER OUTLET	120	130	1	M-69-1	*	3/8	109	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
1A5	2A5	SEVICE WATER, FUEL POOL HEAT EXCHANGER OUTLET	120	130	1	M-69-1	*	3/8	208	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
1A6	2A6	REACTOR BUILDING CLOSED COOLING WATER	100	140	1	M-90-1	*	3/8	29	*	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1A7-1 1A7-2	2A7-1 2A7-2	RHR HEAT EXCHANGERS 1A & 1B OUTLETS	500	253	2	M-96-4	*	3/8	294 188	*	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1A8	2A8	REACTOR BUILDING EQUIPMENT DRAIN TANK HEAT EXCHANGE (REACTOR BLDG. CCW) 1RE01A	100	140	1	M-90-1	*	3/8	388	*	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY
1A9-1 1A9-2	2A9-1 2A9-2	CLEANUP NON-REGENERATIVE HEAT EXCHANGER 1A, INLET 1ST STAGE & OUTLET 2ND STAGE (REACTOR BLDG. CCW)	100	140	2	M-90-1	*	3/8	65 65	*	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1A10-1 1A10-2	2A10-1 2A10-2	CLEANUP NON-REGENERATIVE HEAT EXCHANGER 18, INLET 1ST STAGE & OUTLET 2ND STAGE (REACTOR BLDG. CCW.)	100	140	2	M-90-3	*	3/8	144 144	*	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1A11	2A11	DRYWELL EQUIPMENT DRAIN SUMP HEAT EXCHANGER OUTLET 1RE02A	100	140	1	M-90-1	*	3/8	154	*	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY

NOTE 1: ALL CONTINUOUS LIQUID AND GAS SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE.
NOTE 2: ALL SAMPLES ON THIS SHEET ARE ON PANEL 1(2)PL145 - REACTOR BUILDING PROCESS SAMPLING PANEL, EXCEPT UNIT 1 AND UNIT 2 METAL COUPON SAMPLES, THAT ARE FROM THE MATERIAL MONITORING SYSTEM (MMS) PANEL.
NOTE 3: THE POTENTIAL ACTIVITY LEVELS ARE AS FOLLOWS:
H: ACTIVITY >0.1□ci/M1
M: 0.01 □ci.M1< ACTIVITY <0.1□ci/M1
L: ACTIVITY <0.1□ci/M1
B: BACKGROUND

*NOT APPLICABLE

TABLE 9.3-1 (SHEET 2 OF 6)
(Turbine Building Samples)

UNIT # 1 SAMPLE NO.	UNIT # 2 SAMPLE NO.	SAMPLE IDENTIFICATION	MAXIMUM OPERATING CONDITION PSIG	MAXIMUM OPERATING CONDITION F	NO. SAMPLE POINTS	P&ID UNIT 1 / UNIT 2	NO OF SAMPLE PUMPS REQ'D	SAMPLE LINE SIZE IN.	UNIT 1 SAMPLE LINE LENGTH FT.	UNIT 2 SAMPLE LINE LENGTH FT.	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX (NOTE 3)	REMARKS
1B1	2B1	PRIMARY STEAM	1025	550	1	M-55-2	*	3/8 "959 LS"	386	*	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY ON 1PL131, STEAM CALORIMETER (TAX-PS050) TO BE FURNISHED FOR LOCAL MOUNTING BY PURCHASER.
1B1-1 THRU 1B2-8	2B2-1 THRU 2B2-8	CONDENSER TRAYS	1.72 Psia	121	8	M-80-5	8 WATER JET EDUCTORS	½ SCH. 80 PIPE	1-4,5-8 133 78 139 71 133 71 139 78	*	*	RANGE 0-1 1CE-PS042A THRU H	*	*	*	*	*	*	*	H	WATER JET EDUCTOR PUMPS & CONDUCTIVITY CELL WITH VALVING ONLY WILL BE LOCATED ON PANEL 1PL37J.
1B3	2B3	CONDENSER PUMP DISCHARGE HEADER	205	135	1	M-58	*	3/8	70	*	RANGE 0-1 1CE-PS031	*	*	RANGE 0-100 1AX-PS026	RANGE 100 1AX-PS036	*	*	*	*	M	
1B4	2B4	CONDENSER POLISHER INLET HEADER	205	140	1	M-58	*	3/8	134	*	RANGE 0-1 1CE-PS030	*	*	*	*	*	*	*	*	L	
1B5-1 THRU 1B5-7	2B5-1 THRU 2B5-7	INDIVIDUAL CONDENSATE POLISHER OUTLETS	205	140	7	M-60-1,2	*	3/8	1-4, 5-7 191 151 182 162 142 149 128	*	*	*	*	*	*	*	*	*	*	H	
1B6	2B6	CONDENSATE POLISHER OUTLET HEADER	205	140	1	M-58	*	3/8	161	*		*	*	RANGE 0-100 1AE-PS027	RANGE 0-100 1AX-PS037	*	*	*	*	H	
1B7	2B7	FEEDWATER	2150	425	1	M-57	*	½ SCH. 160 PIPE	44	*	RANGE 0-1 1CE-PS033	*	*	DO Range 0.1-200 1AE-PS028A DH Range 0-2 ppm 1AE-PS028B	*	DUAL RANGE HIGH 0-1000 LOW 1AX-PS044	*	*	*	L	ALL SENSORS & ANALYZERS ARE ON PANEL 1PL40J WITH INDICATORS & TRANSMITTERS, *(NOTE 3) RECORDERS ONLY ON PANEL 1PL13J. ADDITIONAL SIGNAL SHALL ALSO BE FURNISHED - SEE BOTTOM OF TURBIDITY COLUMN - THIS SHEET. DO/DH RECORDER 1AR-PS028 IS ON PANEL 1PL40J
1B8-1 1B8-2	2B8-1 2B8-2	H.P. HEATERS 16A & 16B DRAIN OUTLETS 1FW01AA & 1FW01AB	345	375	2	M-61-1	*	3/8	294 170	*	*	*	*	*	*	DUAL RANGE HIGH 0-1000 LOW SURVEY (SHARE WITH B14)	*	*	*	H	
1B9-1 1B9-3	2B9-1 THRU 2B9-3	L. P. HEATERS 15A, 15B & 15C DRAIN OUTLETS 1CB05AA, B, & C	160	330	3	M-61-1	*	3/8	78 103 120	*	*	*	*	*	*	SURVEY (SHARE WITH B14)	*	*	*	H	
1B10-1 THRU 1B10-3	2B10-1 THRU 2B10-3	L. P. HEATERS 14A, 14B & 14C DRAIN OUTLETS 1CB04AA, B & C	85	300	3	M-61-1	*	3/8	78 78 103	*	*	*	*	*	*	SURVEY (SHARE WITH B14)	*	*	*	H	
1B11-1 THRU 1B11-3	2B11-1 THRU 2B11-3	L. P. HEATERS 13A, 13B & C DRAIN OUTLETS 1CB03AA, B & C	55	290	3	M-61-2	*	*	78 37 145	*	*	*	*	RANGE 0-300 SURVEY WITH 1B14	*	SURVEY (SHARE WITH B14)	*	*	*	H	
1B12-1 THRU 1B12-3	2B12-1 THRU 2B12-3	L. P. HEATERS 12A, 12B & 12C DRAIN OUTLETS 1CB02AA, B & C	10	175	3	M-61-3,4	3	3/8	131 112 149	*	*	*	*	*	*	SURVEY (SHARE WITH B14)	*	*	*	H	
1B13-1 THRU 1B13-3	2B13-1 THRU 2B13-3	L. P. HEATERS 11A, 11B & 11C DRAIN OUTLETS 1CB01AA, B & C	0	130	3	M-61-3	3	3/8	105 106 132	*	*	*	*	*	*	SURVEY (SHARE WITH B14)	*	*	*	H	
1B14	2B14	HEATER DRAIN TANK H. D. PUMP DISCHARGE HEADER 1HD01PA, B, C & D	745	290	1	M-61-2	*	3/8	54	*	*	*	*	RANGE 0-300 1AE-PS029	*	DUAL RANGE HIGH 0-1000 LOW 1AX-PS045	*	*	*	M	
1B15	2B15	CYCLED CONDENSATE STORAGE TANK 1CY01T	75	100	1	M-74	*	3/8	108	*	RANGE 0-10 1CE-PS034	*	*	*	*	*	*	*	*	L	
1B16	2B16	CONDENSATE STORAGE TANK 0MC01T	175	100	1	M-75-1	1	3/8	336	*	RANGE 0-10 1CE-PS035	*	*	*	*	*	*	*	*	B	
1B17	2B17	TURBINE BUILDING CLOSED COOLING WATER	75	130	1	M-67-1	*	3/8	259	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
1B18	2B18	CIRCULATING WATER 1CD01A	25	130	1	M-63	*	3/8	162	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
1B19-1 THRU 1B19-7	2B19-1 THRU 2B19-7	INDIVIDUAL CONDENSATE PREFILTER OUTLETS	205	140	7	M-60-7 / M-121-6	*	1/4	1-4 5-7 190 200 180 190 170 180 210	1-4 5-7 190 200 180 190 170 180 210	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE W/CAPABILITY TO 1(2) PLH4J CORROSION PRODUCT MONITOR

NOTE 1: ALL CONTINUOUS LIQUID & GAS SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE.

NOTE 2: A PORTION OF THE SAMPLE APPROXIMATELY 1000ML/MIN. MEASURED AT 100 % F SHALL BE ROUTED TO A CORROSION PRODUCT MONITOR STATION ON PANEL 1PL40J WHICH SHALL BE CAPABLE OF PROPORTIONALLY COLLECTING AND CONCENTRATING (ON MEMBRANE FILTERS AND ION EXCHANGE PAPERS OR COLUMNS) AT LEAST 24 HR. SAMPLE FOR LABORATORY ANALYSIS OF METALLIC IMPURITIES.

NOTE 3: ALL SAMPLES ON THIS SHEET ARE ON IPL13J TURBINE BUILDING PROCESS SAMPLING PANEL OR AS INDICATED IN REMARKS COLUMN.

NOTE 4: THE POTENTIAL ACTIVITY LEVELS ARE AS FOLLOWS: H: ACTIVITY > 0.1 µCi/ml M: 0.01 µCi/ml < ACTIVITY < 0.1 µCi/ml L: ACTIVITY < 0.01 µCi/ml B: BACKGROUND

*Not Applicable

TABLE 9.3-1 (SHEET 3 OF 6)
(Radwaste Building Samples)

UNIT SAMPLE #. PANEL # OPL -	UNIT SAMPLE #. PANEL # OPL -	SAMPLE IDENTIFICATION	MAXIMUM OPERATING COND. PSIG	 °F	NO. SAMPLE POINTS PER UNIT	P&ID TAP LOCATION UNIT 1 UNIT 2	NO OF SAMPLE PUMPS REQ'D	SAMPLE LINE SIZE (NOTE 3)	UNIT 1 SAMPLE LINE LENGTH FT.	UNIT 2 SAMPLE LINE LENGTH FT.	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX (NOTE 3)	REMARKS
1C1 31J	2C1 31J	WASTE COLLECTOR TANK (1WE01T OR 2WE01T)	170	100	1	M-103-2 M-103-3	*	3/8	97	84	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1C2 32J	2C2 32J	WASTE SURGE TANK (1WE02T OR 2WE02T)	170	100	1	M-103-2 M-103-2	*	3/8	69	58	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
IC3 31J	2C3 31J	WASTE MIXED BED DEMINERALIZER (1WE01D & 2WE01D)	170	100	1	M-103-2 M-103-3	*	3/8	254	207	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1C4 32J	2C4 32J	WASTE SAMPLE FILTER EFFLUENT (1WE01F & 2WE01F)	170	100	1	M-103-2 M-103-3	*	3/8	286	274	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY
1C5 31J	2C5 31J	WASTE SAMPLE TANKS (1WE03T & 2WE03T)	170	100	1	M-103-4 M-103-4	*	3/8	196	164	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C6 31J		WASTE SAMPLE TANK (0WE01T)	120	150	1	M-103-4	*	3/8	203	*	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
IC7 31J	2C7 32J	WASTE FLOC. TANKS (1WE04T & 2WE04T)	170	100	1	M-103-5 M-103-5	*	3/8	136	112	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
1C8 31J	2C8 31J	FLOOR DRAIN COLLECTOR TANK (1WF01T OR 2WF01T)	100	100	1	M-103-6 M-103-6	*	3/8	65	70	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY
1C9 31J	2C9 31J	FLOOR DRAIN CONC. FEED TANKS (1WF03TA OR 2WF03TA)	50	100	1	M-103-7 M-103-8	*	3/8	180	174	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY
1C10 31J	2C10 32J	FLOOR DRAIN SAMPLE TANKS (IWF03TB OR 2WF03TB)	100	100	1	M-103-7 M-103-8	*	3/8	166	190	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1C11 31J	2C11 31J	FLOOR DRAIN SAMPLE TANKS (TWF04T & 2WF04T)	120	150	1	M-103-9 M-103-9	*	3/8	88	67	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1C12 32J	2C12 32J	RADWASTE DISCHARGE TANKS (1WF05T & 2WF05T)	120	150	1	M-103-10 M-103-10	*	3/8	101	88	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1C13 32J	2C13 32J	FLOOR DRAIN MIXED BED DEMINERALIZERS (1WF01D & 2WF01D)	100	140	1	M-103-11 M-103-11	*	3/8	242	190	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C14-1 0C14-2 80J		LAUNDRY DRAIN COLLECTOR TANKS (0WY01TA & 0WY01TB)	120	150	2	M-103-17 M-103-17	*	3/8	198	205	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
0C15 80J		INLET REVERSE OSMOSIS UNIT (0WY02F)	150	120	1	M-103-17	*	3/8	217	*	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C16 80J		OUTLET REVERSE OSMOSIS UNIT (0WY02F)	150	120	1	M-103-17	*	3/8	217	*	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C17 32J		LAUNDRY DRAIN SAMPLE TANK (0WY02T)	150	150	1	M-103-17	*	3/8	200	*	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C18-1 0C18-2 80J		DECONTAMINATER COLLECTION TANKS (0WZ02TA & 0WZ02TB)	150	150	*	M-103-18 M-103-18	*	3/8	77	89	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
0C19 32J		DECONTAMINATER SAMPLE TANK (0WZ04T)	150	150	1	M-103-18	*	3/8	215	*	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE ONLY
1C20 31J	2C20 32J	CHEMICAL WASTE COLLECTOR TANKS (1WZ01T & 2WZ01T)	50	100	1	M-103-19 M-103-19	*	3/8	97	92	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1C21 31J	2C21 32J	CHEMICAL WASTE PROCESS TANKS	50	100	1	M-103-20 M-103-20	*	3/8	157	124	*	*	UNIT 1 0AE-PS003 UNIT 2 0AE-PS012	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
0C22 31J		CHEMICAL WASTE SAMPLE TANK (0WZ01T)	100	140	1	M-103-21	*	3/8	53	*	RANGE 0-100 0CE-PS002	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY
0C23 31J		FUEL POOL FILTER DEMINERALIZER INLET (1FC01DA-B & 2FC01DA-B)	120	140	1	M-98-2	*	3/8	*	338	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE ONLY
1C24-1 1C24-2 31J	2C24-1 2C24-2 32J	FUEL POOL FILTER DEMINERLIZER OUTLETS (1FC01DA-B & 2FC01DA-B)	120	140	1	M-98-2	*	3/8	347 319	330 302	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE ONLY

NOTE 1: ALL CONTINUOUS LIQUID & GAS SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE.
NOTE 2: ALL SAMPLES ON THIS SHEET ARE ON THE RADWASTE PANELS AS NOTED.
NOTE 3: 3/8"SAMPLE TUBING FOR FIELD ROUTED LINES ARE ST STL WITH .083 WALL.
NOTE: THE POTENTIAL ACTIVITY LEVELS ARE AS FOLLOWS: H: ACTIVITY >0.1□Ci.Ml M: 0.01 □Ci/Ml< ACTIVITY < 0.1 □Ci.Ml L: ACTIVITY < 0.01□Ci.Ml B: BACKGROUND
*Not Applicable

TABLE 9.3-1 (SHEET 4 OF 6)
(River, Lake, and Blowdown Samples)

UNIT # 1 SAMPLE NO.	UNIT # 2 SAMPLE NO.	SAMPLE IDENTIFICATION	MAXIMUM OPERATING CONDITIONS		NO SAMPLE POINTS	P&ID UNIT 1 UNIT 2	NO OF SAMPLE PUMPS REQ'D	SAMPLE LINE SIZE	UNIT 1 SAMPLE LINE LENGTH FT.	UNIT 2 SAMPLE LINE LENGTH FT.	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX	REMARKS
			PSIA	°F																	
D-1		LAKE BLOWDOWN VALVE PIT HOUSE AFTER RADWASTE ENTRY (BY PURCHASER)	*	*	1	M64-1 D-6	*	3/4"	132'	*	*	*	*	*	*	*	*	*	SEE GE 22A3012	BACKGROUND	TO DETECT DISCHARGE ACTIVITY AND ISOLATE BLOWDOWN ON HI ACTIVITY (BY PURCHASER)
D-2		LAKE MAKE-UP PUMP DISCHARGE	*	*	1	*	*	*	*	*	*	*	*	*	*	*	225-1000 0AE-PS005A	*	*	BACKGROUND	COMPOSITE COLLECTION FOR ANALYSIS (BY PURCHASER)
D-3		LAKE BLOWDOWN AT RIVER DISCHARGE	*	*	1	*	*	*	*	*	*	*	RANGE 5-10 0AE-PS007	RANGE 1-6 0AE-PS011	*	*	225-1000 0AE-PS005B	*	*	BACKGROUND	COMPOSITE COLLECTION FOR ANALYSIS (BY PURCHASED)
		LAKE BLOWDOWN AT RIVER DISCHARGE (IN FLUME)	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (NOTE 4)	*	BACKGROUND	RTD'S LOCATED IN DISCHARGE FLUME (ALL BY PURCHASER)
		RIVER DOWN STREAM	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (NOTE 5)	*	BACKGROUND	RTD'S LOCATED IN RIVER NEAR BOTTOM ON TRIPOD. (0PS02S)
		CIRCULATING WATER DISCHARGE TO LAKE (BY PURCHASER)	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (BY PURCHASER)	*	BACKGROUND	(ALL BY PURCHASER)
		CIRCULATING WATER INLET FROM LAKE (BY PURCHASER)	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (BY PURCHASER)	*	BACKGROUND	(ALL BY PURCHASER)
		RIVER UP STREAM	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (NOTE 2)	*	BACKGROUND	RTD'S LOCATED IN RIVER NEAR BOTTOM ON TRIPOD.
		LAKE BLOWDOWN AT RIVER DISCHARGE (IN PIPE)	*	*	4 TEMP. ELEMENTS RTD	*	*	*	*	*	*	*	*	*	*	*	*	4 RTD'S 30-100°F (NOTE 6)	*	BACKGROUND	IN REDUCER LOCATED IN RIVER DISCHARGE VALVE HOUSE. (BY PURCHASER)
		RIVER UP STREAM	*	*	4	*	*	*	*	*	*	*	*	RANGE 1-12 NOTE 3	*	*	*	*	*	BACKGROUND	DO2 ANALYZERS LOCATED IN RIVER NEAR BOTTOM ON TRIPOD (0PS01S)

NOTE 1:	ALL CONTINUOUS LIQUID & SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE				
NOTE 2:	ELEMENTS :	0TE-PS008A	0TE-PS008B	0TE-PS008C	0TE-PS008D
NOTE 3:	ELEMENTS	0AE-PS006A	0AE-PS006B	0AE-PS006C	0AE-PS006D
NOTE 4:	ELEMENTS:	0TE-WL038A	0TE-WL038B	0TE-WL038C	0TE-WL038D
NOTE 5:	ELEMENTS	0TE-PS010A	0TE-PS010B	0TE-PS010C	0TE-PS010D
NOTE 6:	ELEMENTS:	0TE-WL012A	0TE-WL012B	0TE-WL012C	0TE-WL012D

*Not Applicable

TABLE 9.3-1 (SHEET 5 OF 6)
(Miscellaneous Liquid Samples)

		SAMPLE IDENTIFICATION	INITIAL PRESS PSIA	COND. TEMP. F	NO SAMPLE POINTS	P&ID TAP LOCATION	PIPING DRAWING TAP LOCATION	SAMPLE LINE SIZE	SAMPLE LINE LENGTH	NO. OF SAMPLE PUMPS REQ'D	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX (NOTE 2)	REMARKS
	E1	REACTOR BUILDING CLOSED COOLING WATER HEAT EXCHANGE 1WR01AA OUTLET	100	140	*	M-90-1 B-5	*	*	*	*	*	*	*	*	*	*	*	*	*	B B	GRAB SAMPLE ONLY
	E2	REACTOR BUILDING CLOSED COOLING WATER HEAT EXCHANGE 1WR01AB OUTLET	100	140	*	M-90-1 B-4	*	*	*	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
	E3	REACTOR BUILDING CLOSED COOLING WATER HEAT EXCHANGE 0WR01A OUTLET	100	140	*	M-90-1 B-3	*	*	*	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY
	E4	STANDBY LIQUID TANK 1C41-A001	*	*	*	M-99 B-2	*	*	*	*	*	*	*	*	*	*	*	*	*	B	GRAB SAMPLE ONLY

NOTE 1: ALL CONTINUOUS LIQUID AND GAS SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE.

NOTE 2: THE POTENTIAL ACTIVITY LEVELS ARE AS FOLLOWS: H: ACTIVITY > 0.1 □Ci/Ml
M: 0.01 □ Ci/ Ml < ACTIVITY < 0.1 µCi/Ml
L: ACTIVITY < 0.01 □Ci/Ml
B: BACKGROUND

*Not Applicable

ABLE 9.3-1 (SHEET 6 OF 6)
(Gaseous Samples)

	SAMPLE NO.	SAMPLE IDENTIFICATION	INITIAL PRESS PSIA	COND. TEMP. F	NO SAMPLE POINTS	P&ID TAP LOCATION	PIPING DRAWING TAP LOCATION	SAMPLE LINE SIZE	SAMPLE LINE LENGTH	NO. OF SAMPLE PUMPS REQ'D	CONDUCTIVITY µmho/cm @ 25°C	CATION CONDUCTIVITY µmho/cm @ 25°C	PH @ 25°C	DISSOLVED OXYGEN ppb	SILICA ppb	TURBIDITY ppb	DISSOLVED SOLIDS	TEMPERATURE TYPE RTD/TC RANGE	RADIATION MONITOR	POTENTIAL RADIATION ACTIVITY MAX (NOTE 2)	REMARKS
	OF1	VENT (STACK) GAS	ATMOS	*	1	M-88-1 F-7	*	3/8	*	2	*	*	*	*	*	*	*	*	*	L	PANEL D18-P001
	IF2-1 IF2-2	OFF GAS UP STREAM OF SECOND STAGE EJECTORS	*	*	2	M-88-1 B-1 & D-1	*	3/8	*	1	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE VIAL SAMPLER (SAME PANEL AS 1F4)
	IF3-1 IF3-2	OFF GAS DOWN STREAM OF SECOND STAGE EJECTORS	*	*	2	M-88-2 E-B & D-B	*	3/8	*	SHARED WITH 1F2	*	*	*	*	*	*	*	*	*	H	GRAB SAMPLE VIAL SAMPLER (SAME PANEL AS 1F4)
	1F4	OFF GAS LINE UP STREAM OF 30 MINUTE HOLDUP	*	*	2	M-88-2 B-3	*	3/8	*	SHARED WITH 1F2	*	*	*	*	*	*	*	*	SEE PROC. RAD. MONIT. GE 22A3011	M	GRAB SAMPLE VIAL SAMPLER D18-J004
	IF5	OFF GAS LINE UP STREAM OF CHARCOAL ADSORBERS	*	*	1	M-88-4 C-8	*	3/8	*	1	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE VIAL SAMPLER (SAME PANEL AS 1F9)
	1F6	OFF GAS LINE CHARCOAL TRAIN “A” AFTER 1N62-D008	*	*	1	M-88-4 C-7	*	3/8	*	SHARED WITH 1FS	*	*	*	*	*	*	*	*	*	M	GRAB SAMPLE VIAL SAMPLER (SAME PANEL AS 1F9)
	1F7	OFF GAS LINE CHARCOAL TRAIN “B” AFTER 1N62-D014	*	*	1	M-88-4 A-6	*	3/8	*	SHARED WITH 1FS	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE VIAL SAMPLER (SAME PANEL AS 1F9)
	IF8	OFF GAS LINE DISCHARGE TO PLANT VENT	*	*	1	M-88-4 C-1	*	3/8	*	1	*	*	*	*	*	*	*	*	SEE PROC. RAD. MONIT. GE 22A3011	L	PANEL D18-J013
	1F9	OFF GAS LINE DISCHARGE TO PLANT VENT	*	*	1	M-88-4 C-1	*	3/8	*	SHARED WITH 1FS	*	*	*	*	*	*	*	*	*	L	GRAB SAMPLE VIAL SAMPLER D18-J014

NOTE 1: ALL CONTINUOUS LIQUID AND GAS SAMPLES WILL HAVE PROVISIONS AT THE PANEL FOR A MANUAL GRAB SAMPLE.

NOTE 2: THE POTENTIAL ACTIVITY LEVELS ARE AS FOLLOWS: H: ACTIVITY > 0.1 □Ci/Ml
M: 0.01 □ Ci/ Ml < ACTIVITY < 0.1 □Ci/Ml
L: ACTIVITY < 0.01 □Ci/Ml
B: BACKGROUND

*Not Applicable

TABLE 9.3-2

STANBY LIQUID CONTROL SYSTEM OPERATING PRESSURE TEMPERATURE CONDITIONS

	STANDBY MODE (a)		TEST MODES (a) CIRCULATION TEST		TEST MODES (a) INJECTION TEST(b)		OPERATING MODE (a)	
PIPING	PRESSURE (psig)(c)	TEMPERATURE (°F)	PRESSURE (psig)(c)	TEMPERATURE (°F)	PRESSURE (psig) (c)	TEMPERATURE (°F)	PRESSURE (psig) (c)	TEMPERATURE (°F)
Pump Suction	Makeup Water Pressure	70/100 (d)	Test Tank Static Head (e)	70/100 (d)	Test Tank Static Head (e)	70/100 (d)	Storage Tank Head	70/100 (d)
Pump Discharge to Explosive Valve Inlet	Makeup Water Pressure	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 1150 (f)	70/560 (g)	Reactor Static Head	70/560 (g)	Reactor Static Head (b)	125 (b)	Reactor Static Head to 1150 (f)	70/560 (g)

a The pump flow rate will be zero (pump not operating during the standby mode and at rated during the test and operating modes).

b Reactor be at 0 psig and 125° F before changing from the standby mode to the injection test mode.

c 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	Outlet	Pump Discharge Flange
Explosive Valve Outlet To But Not Including First		
Isolation Check Valve		Explosive Valve Outlet
First Isolation Check Valve To The Reactor		Reactor Sparger Outlet

d. During chemical mixing, the liquid in the storage tank will be at a temperature of 150° F maximum.

e 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.

f Maximum reactor operating pressure is 1150 psig at reactor standby liquid control sparger outlet.

g. 360□ F represents maximum sustained operating temperature.

9.4 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS

The outside atmosphere is used as the source air supply for all HVAC subsystems in a normal situation. Whenever ammonia is detected at the intakes for the control room and the auxiliary electric equipment room, an alarm is actuated in the main control room.

All air from potentially radioactively contaminated areas is exhausted through the station vent stack; examples include the HVAC systems for the reactor, turbine, and radwaste buildings and the local exhaust hoods for the radioactive laboratories, the machine shop, and the laundry.

Exhaust air from air conditioning that serves the following areas is not routed to the station vent stack:

a. service building office and storage areas,

b. auxiliary building office area,

c. lake and river screen houses,

d. diesel-generator rooms, and

e. HVAC equipment rooms.

9.4.1 Control Room Area Ventilation Systems

Control room area ventilation systems are comprised of the control room HVAC system, and the auxiliary electric equipment room HVAC system.

9.4.1.1 Control Room HVAC System

The control room HVAC system is common to both Units 1 and 2, and serves the control room (Units 1 and 2), main security control center, control room east area and control room toilet.

9.4.1.1.1 Design Bases

The control room HVAC system, an engineered safety feature, is designed to provide habitability in the control room for both Units 1 and 2 under normal and abnormal station conditions.

9.4.1.1.1.1 Safety Design Bases

a. The control room HVAC system is designed with sufficient redundancy in order to meet the single failure criteria.

b. The system monitors radioactive contamination which could pass into both outside air intakes and limits the introduction of potential contaminants into the system by filtering the contaminated air.

c. The system monitors ammonia concentrations from the outside air intakes and alarms in the main control room. Manual isolation of outside air intakes can be accomplished on detection of ammonia, thereby operating in the recirculation mode. In the recirculation mode, all the recirculated air is passed through the normally bypassed charcoal absorber.

d. The system monitors smoke in the control room environment. In the event of smoke or products of combustion in the control panels, the ionization detection system alerts the operators and automatically positions dampers to pass all the supply air delivered to the conditioned spaces through normally bypassed adsorbers for smoke and odor removal. Smoke detection in the outside air duct automatically starts the Emergency Makeup Filter Unit (EMU), and air is filtered through charcoal adsorbers. Provision is made in the system to clean up the inside environment by purging with 100% outside air. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

e. The system is designed to Seismic Category I requirements with the exception of heating equipment which is not Seismic Category I, but is seismically supported. The heating equipment is not essential to the safety of operating personnel or the function of safety-related equipment.

f. The equipment is powered from redundant essential buses; the instrumentation and power supply to the system is designed to meet IEEE 279 and IEEE 308.

g. The control room HVAC system is provided with approximately 1500 cfm of filtered outdoor air at all times, except during the recirculation mode. This quantity of outside air is sufficient to maintain positive pressure, compared to surrounding areas, inside the areas served by the control room HVAC system. The positive pressure inside the control room precludes infiltration of potentially contaminated air into the conditioned space.

h. The equipment, ducts, and accessories for the control room HVAC system are housed inside a missile protected structure. The outside air intake openings are also missile protected, and the radiation monitors are located such that monitoring capability would not be lost to a missile approaching from any direction.

i. The recirculation filter is a part of the Emergency Filtration System, and is credited for inlet air humidity levels below 70%. At higher humidity levels, the charcoal efficiency at removing radionuclides decreases, resulting in higher dose to control room personnel post-LOCA. Relative Humidity greater than 70% entering the Recirculation charcoal filter could temporarily degrade the efficiency of the Recirculation charcoal filter. Operation in the normal or pressurization mode with the Recirculation charcoal filter online for 10 hours will restore the efficiency of the Recirculation charcoal filter.

j. Each control room HVAC subsystem has a supply air filter unit that contains a charcoal filter unit, called the recirculation filter. Each filter unit consists of a pre-filter and a normally bypassed charcoal filter. Upon detection of smoke in the return ductwork, the charcoal filter is automatically placed in service. Within 2 minutes of detection of high ammonia concentration in the air intake, the Operator will align the CRE HVAC systems in recirculation mode and will don a self-contained breathing apparatus. Upon detection of high radiation, the Operator must manually place the charcoal filter on-line within 4 hours of detection to maintain control room doses to within 10 CFR 50.67.

9.4.1.1.1.2 <u>Power Generation Design Bases</u>

The control room HVAC system provides habitability of the control room for both normal and abnormal conditions; thereby assuring continued availability of a suitable room for supervision and control of the power generation station. The control room HVAC system is designed to maintain a controlled temperature between 65° F and 85° F inside the control room, main security control center and control room east area and control room toilet for personnel comfort and to ensure integrity of the equipment and components.

9.4.1.1.2 System Description

a. The control room HVAC system is comprised of two full capacity, redundant HVAC systems. Each system has a 100% capacity air handling equipment train consisting of a supply air filter, which contains a charcoal absorber for smoke and odor removal (normally bypassed), supply air fan, and blow-through type coil cabinet containing direct expansion cooling coils. All the air handling equipment is located in the auxiliary building at elevation 786 feet 6 inches. Each individual zone has an electric heating coil, and an isolation damper. Individual zone ducts from each train are cross-connected to common ducts and supply air through silencers to the corresponding zone. Return air ducts from each zone are connected together, and then through duct silencers to two 100% capacity redundant return air fans, discharging into the respective mixing box upstream of the supply air filters on each air handling equipment train. Provision is made to exhaust all the system air through the return air fan into the Auxiliary Building general area of 815 feet 0 inches, then relieved to the atmosphere via the Auxiliary Building roof louvers upon remote manual initiation. The control room HVAC system provides independent environmental control to the following five zones:

1. control room - Unit 1 area;

2. control room - Unit 2 area;

3. control room - Units 1 and 2 East area;

4. main security control center; and

5. control room toilet room.

b. The outside air for the control room supply is brought in through independent and separate missile-protected roof openings to each air handling equipment train mixing box. Each outside air intake opening is sized to introduce 100% outside air into the system. The minimum quantity of outside air (approximately

1500 cfm) required to maintain positive pressure in the control room with respect to surrounding potentially contaminated areas, is introduced under all plant operating conditions. There are two emergency makeup air filter units, each capable of processing the minimum air requirements for the control room HVAC system and auxiliary electric equipment room HVAC system (total 4000 cfm) as described in Subsection 9.4.1.2. The emergency filter trains are capable of removing 99.95% including filter bank bypass, of all particulate matter 0.3 micron and larger, and at least 95% of all radioactive and nonradioactive forms of iodine. Each emergency makeup air filter unit is comprised of a demister, electric heating coil, a high-efficiency prefilter, a HEPA filter, a charcoal adsorber, a HEPA filter and supply air fan, all installed in series. The prefilter limits large particulate loading of HEPA filter and the heating coil assures no higher than 70% relative humidity air entering the charcoal adsorber. A supply air filter is capable of removing 70% of all radioactive and non-radioactive forms of iodine.

c. The cooling for the two redundant air handling systems of the control room HVAC system is provided through corresponding direct expansion refrigeration systems. Each refrigeration system is comprised of D-X coils mounted in the air handling unit, an air cooled condenser, a refrigerant receiver, and all interconnected piping and specialties. The air cooled condenser is comprised of a vaneaxial fan and a condensing coil cabinet with an air filter. The air cooled condenser fan induces outdoor air through the condensing coil, exhausting into the station vent stack through a duct system. Air cooled condenser fans are provided with recirculation ductwork to assure the stable fan operation in the event snow is inducted into the condensing unit. A balancing damper in the recirculation flowpath is adjusted open during winter conditions to provide the required flow. The recirculation balancing damper is closed during non-winter system operation. The compressor units and air cooled condensers are located in the auxiliary building at an elevation of 802 feet. The refrigeration compressor capacity is based upon normal and accident room heat loss loads, including pressurization mode with either normal or Emergency Makeup Unit (EMU) outside airflow. Dependent upon the outside air temperature and humidity levels when the systems are in the purge mode (100% outside air) the total outside air-cooling load can exceed the refrigeration unit's capacity potentially tripping the refrigeration unit.

d. Deleted.

e. The system monitors smoke in the control room environment. In the event of smoke or products of combustion in the control panels, the ionization detection system alerts the operators and automatically positions dampers to pass all the supply air delivered to the conditioned spaces through normally bypassed adsorbers for smoke and odor removal. Smoke detection in the outside air duct automatically starts the Emergency Makeup Filter Unit (EMU), and air is filtered through charcoal adsorbers. Provision is made in the system to clean up the inside environment by purging with 100% outside air. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

f. Electric and electronic controls and instrumentation are used for the control room HVAC system. Each system has a local control panel and important operating functions are monitored in the main control room. Abnormal conditions, i.e., ammonia and high radiation detection at outside air intakes and ionization detection in return air ducts and minimum outside air intake are annunciated on the main control panel. Refer to Subsection 7.3.4.3 for a more detailed description of the control and instrumentation of the control room HVAC system.

g. Both manual charcoal valves and solenoid valves in series connected to the water fire suppression system are provided for the charcoal adsorber bed in the emergency makeup air filter trains, and for normally bypassed supply air filter unit charcoal adsorbers in the main handling trains.

9.4.1.1.3 Safety Evaluation

a. The control room HVAC system is designed to maintain a habitable environment and to ensure the operability of all the components in the control room under all the station normal and abnormal operating conditions. The system is provided with redundant equipment. The redundant equipment is supplied from separate essential power sources and is operable during loss of offsite power. The power supply and control and instrumentation meet IEEE 279 and IEEE 308 criteria. All of the HVAC equipment and surrounding structures are designed for the Seismic Category I requirements, except heating equipment which is only seismically supported. All the equipment for the control room HVAC system is rated to operate in the ambient conditions specified in Section 3.11. A failure analysis is presented in Table 9.4-2.

b. A local equipment fire in the control room does not cause the abandonment of the control room and does not prevent a safe shutdown of the reactors, because early detection, filtration, and purging capabilities are provided in addition to available fire fighting apparatus.

c. The air distribution in the control room is designed to supply air into the occupied area and exhaust the main control boards. In the event of smoke or products of combustion in the control panels, the ionization detection system alerts the operators and automatically positions dampers to pass all the supply air delivered to the conditioned spaces through normally bypassed adsorbers for smoke and odor removal. Smoke detection in the outside air duct automatically starts the Emergency Makeup Filter Unit (EMU), and air is filtered through charcoal adsorbers. Provision is made in the system to clean up the inside environment by purging with 100% outside air. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

d. Four radiation monitor channels are provided for each outside air intake of the control room HVAC system to detect high radiation approaching the outside air intakes. These monitor channels alarm in the control room. The four monitor channels are divided into two trip systems. The high radiation actuation signal causes automatic closure of the normal outside air supply to the system and diverts the outside air through the emergency makeup air filter train before delivering it to the control room.

e. The emergency makeup air filter train, the charcoal adsorber in the supply air filter unit, and control room shielding are designed to limit the occupational dose below levels of 5 rem TEDE as required by 10 CFR 50.67.

f. The introduction of a minimum quantity of outside air to maintain the control room and other areas served by the control room HVAC system at a positive pressure with respect to surroundings, at all the plant operating conditions except when the system is in recirculation mode, precludes infiltration of unfiltered air into the control room.

g. The physical location of the two redundant outside air intakes provides the option of using either intake opening, which, due to separation has lower contamination levels during and after a LOCA.

h. Two ammonia detectors are provided in each redundant outside air duct to annunciate ammonia concentration of approximately 12.5 ppm and above on the main control panel.

i. For the closing of the outside air dampers during the abnormal conditions of high radiation detection, the single failure criterion is met with a combination of automatic and manual features.

9.4.1.1.4 Testing and Inspection

All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements, and applicable codes.

System ductwork and erection of equipment were inspected during various construction stages for quality assurance. Construction tests were performed on all mechanical components and the system was balanced for the design airflows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

Provisions are made for periodic inservice testing of the equipment and filters as discussed in Section 6.4. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations. Operation of each redundant equipment train is rotated to provide on-line checking and testing of the performance.

The emergency makeup filter trains and recirculation filters are subjected to the factory, preoperational, and subsequent periodic tests described in Subsection 6.4.5.

9.4.1.2 Auxiliary Electric Equipment Room HVAC System

The auxiliary electric equipment room HVAC system, common to both Units 1 and 2, serves the auxiliary electric equipment rooms (Units 1 and 2). The computer room is served by a separate HVAC system independent from the auxiliary electric equipment room HVAC system.

9.4.1.2.1 Design Bases

The system, an engineered safety feature, is designed to provide habitability in the Auxiliary Electric Equipment rooms during both normal and abnormal station conditions.

9.4.1.2.1.1 Safety Design Bases

a. The auxiliary electric equipment room HVAC system is designed with sufficient redundancy to meet the single failure criteria.

b. The system monitors radioactive contamination in both outside air intakes and limits the introduction of potential contaminants into the system by filtering the contaminated air.

c. The system monitors ammonia concentration in the outside air intakes and alarms in the main control room.

d. The system is designed to Seismic Category I requirements with the exception of heating equipment, which is not Seismic Category I, but is seismically supported. The heating equipment is not essential to the safety of operating personnel and the function of safety-related equipment.

e. The equipment is powered from redundant essential buses and the instrumentation and power supply to the system is designed to meet IEEE 279 and IEEE 308.

f. The auxiliary electric equipment room HVAC system is provided with approximately 2500 cfm filtered outdoor air at all times except in the recirculation mode. This quantity of outside air is sufficient to maintain positive pressure, with respect to the surrounding potentially contaminated areas, inside the areas served by this system. The positive pressure precludes the infiltration of potentially contaminated air into the conditioned space.

g. All the equipment, ducts, and accessories for the auxiliary electric equipment room HVAC system are housed within a missile protected structure; the outside air intake air openings are also missile protected.

h. The recirculation filter is a part of the Emergency Filtration System, and is credited for inlet air humidity levels below 70%. At higher humidity levels, the charcoal efficiency at removing radionuclides decreases, resulting in higher dose to control room personnel post-LOCA. Relative Humidity greater than 70% entering the Recirculation charcoal filter could temporarily degrade the efficiency of the Recirculation charcoal filter. Operation in the normal or pressurization mode with the Recirculation charcoal filter online for 10 hours will restore the efficiency of the Recirculation charcoal filter.

i. Each AEER HVAC subsystem has a supply air filter unit that contains a charcoal filter unit, called the recirculation filter. Each filter unit consists of a pre-filter and a normally bypassed charcoal filter. Upon detection of smoke in the return ductwork, the charcoal filter is automatically placed in service. Within 2 minutes of detection of high ammonia concentration in the air intake, the Operator will align the CRE HVAC systems in recirculation mode and will don a self-contained breathing apparatus.

9.4.1.2.1.2 Power Generation Design Bases

The auxiliary electric equipment room HVAC system provides habitability for the auxiliary electric equipment rooms (Units 1 and 2) for both normal and abnormal conditions; thereby, initiating like design bases for both safety and nonsafety functions. The auxiliary electric equipment room HVAC system is designed to maintain the temperature between 65° F and 85° F in the auxiliary electric equipment room for personnel comfort, and to ensure integrity of the equipment and components. Provision is made in the system to clean up the inside environments when smoke is detected via the ionization detectors, by introduction of 100% outside air. The HVAC system for the computer room is designed to provide a temperature of 73° F. Since the computer equipment is not safety-related, the HVAC system is not designed to function during or after an accident.

9.4.1.2.2 System Description

a. The auxiliary electric room HVAC system is comprised of two full capacity, redundant HVAC systems. Each system has a 100% capacity air handling equipment train consisting of a supply air filter, which contains a charcoal adsorber for smoke and odor removal (normally bypassed), supply air fan, and blow-through type coil cabinet containing direct expansion cooling coils. All the air handling equipment is located in the auxiliary building at an elevation of 786 feet 6 inches. Each individual zone has an electric heating coil and an isolation damper. Individual zone ducts from each train are cross- connected to common ducts and supply air to the corresponding zone. Return air ducts from each zone are connected together, and then through two 100% capacity redundant return air fans, discharging into the respective mixing box upstream of the supply air filters on each air handling equipment train. Provision is made to exhaust all the system air through the return air fan into the Auxiliary Building general area of 815 feet 0 inches, then relieved to the atmosphere via the Auxiliary Building roof louvers upon remote manual initiation. The auxiliary electric equipment room HVAC system provides independent environmental control to the following two zones:

    1. auxiliary electric equipment room - Unit 1,

    2. auxiliary electric equipment room - Unit 2.

b. The outside air supply for the AEER is brought in through independent and separate missile-protected roof openings to each air handling equipment train mixing box. Each outside air intake opening is sized to introduce 100% outside air into the system. The minimum quantity of outside air (approximately 2500 cfm) required to maintain positive pressure in the auxiliary electric equipment rooms with respect to surrounding potentially contaminated areas, is introduced under all plant operating conditions, except in the recirculation mode. There are two emergency makeup air filter units of the control room HVAC system, as described in Subsection 9.4.1.1, which provide approximately 2500 cfm treated outside air during emergency conditions. The emergency filter trains are capable of removing 99.95% including filter bank bypass of all particulate matter 0.3 micron and larger, and at least 95% of all radioactive and non-radioactive forms of iodine. A supply air filter unit charcoal filter is capable of removing 70% of all radioactive and non-radioactive forms of iodine when placed online with the EMU in the pressurization mode.

c. The cooling for the two redundant air handling systems is provided through corresponding direct expansion refrigeration systems. Each refrigeration system is comprised of direct expansion coils mounted in the air handling unit, a reciprocating compressor unit, an air cooled condenser, a refrigerant receiver, and all associated refrigerant piping and specialties. The air cooled condenser is comprised of a vaneaxial fan and a condensing coil cabinet with an air filter. The air cooled condenser fan induces outdoor air through the condensing coil and exhausts into the station vent stack through a duct system. Air cooled condenser fans are provided with recirculation ductwork to assure stable fan operation in the event snow is inducted into the condensing unit. A balancing damper in the recirculation flowpath is adjusted open during winter conditions to provide the required flow. The recirculation balancing damper is closed during non-winter system operation. The compressor units and air cooled condensers are located in the auxiliary building at an elevation of 802 feet. The refrigeration compressor capacity is based upon normal and accident room heat loss loads, including pressurization mode with either normal or Emergency Makeup Unit (EMU) outside airflow. Dependent upon the outside air temperature and humidity levels when the systems are in the purge mode (100% outside air) the total outside air-cooling load can exceed the refrigeration unit's capacity potentially tripping the refrigeration unit.

d. Deleted

e. The system monitors smoke in the AEER environment. In the event of smoke or products of combustion in the AEER, the ionization detection system alerts the operators and automatically positions dampers to pass all the supply air delivered to the conditioned spaces through normally bypassed adsorbers for smoke and odor removal. Smoke detection in the outside air duct automatically starts the Emergency Makeup Filter Unit (EMU), and air is filtered through charcoal adsorbers. Provision is made in the system to clean up the inside environment by purging with 100% outside air. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

f. Electric and electronic controls and instrumentation are used for the auxiliary building HVAC system. Each system has a local control panel, and important operating functions are monitored in the auxiliary building for Units 1 and 2. Abnormal conditions, i.e., ammonia and high radiation detection at outside air intakes and ionization detection in return air ducts are annunciated on the HVAC panels in auxiliary building. Refer to Subsection 7.3.4.3 for a more detailed description.

g. Deluge valves are provided for the normally bypassed charcoal absorbers in the main air handling trains.

9.4.1.2.3 Safety Evaluation

a. The auxiliary electric equipment room HVAC system is designed to maintain a habitable environment and to ensure the operability of all the components in the auxiliary electric equipment rooms under all the station normal and abnormal operating conditions. The system is provided with redundant equipment. The redundant equipment is supplied from separate essential power sources and is operable during loss of offsite power. The power supply and control and instrumentation meets IEEE 279 and IEEE 308 criteria. All of the HVAC equipment and surrounding structures are designed for the Seismic Category I requirements, except heating equipment which is only seismically supported.

All the equipment for the auxiliary electric equipment room HVAC system is rated to operate in the ambient conditions specified in Section 3.11.

A failure analysis is presented in Table 9.4-4.

b. A local equipment fire in the auxiliary electric equipment rooms does not cause the abandonment of the auxiliary electric equipment rooms and does not prevent a remote shutdown of the reactors, because early detection is provided, fire fighting apparatus is available, and air filtration and purging capabilities are provided.

c. The system monitors smoke in the AEER environment. In the event of smoke or products of combustion in the AEER, the ionization detection system alerts the operators and automatically positions dampers to pass all the supply air delivered to the conditioned spaces through normally bypassed charcoal adsorbers for smoke and odor removal. Smoke detection in the outside air duct automatically starts the Emergency Makeup Filter Unit (EMU), and air is filtered through charcoal adsorbers. Provision is made in the system to clean up the inside environment by purging with 100% outside air. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

d. A radiation monitoring system is provided to detect high radiation in outside air intakes. These monitors alarm in the control room. The high radiation at the intake air louver will automatically close the normal outside air supply to the system and divert the outside air through the emergency makeup air filter train before delivering it to the auxiliary electric equipment rooms.

e. The emergency makeup air filter train, the charcoal adsorber in the supply air filter unit, and auxiliary electric equipment shielding are designed to limit the occupational dose below levels of 5 rem TEDE as required by 10 CFR 50.67.

f. The introduction of a minimum quantity of outside air to maintain the auxiliary electric equipment rooms at a positive pressure with respect to the surrounding potentially contaminated areas, at all the plant operating conditions except when the system is in recirculation mode, precludes infiltration of unfiltered air into the auxiliary electric equipment rooms.

g. The physical separation of the locations of the two redundant outside air intakes provides the option of using whichever intake opening has lower contamination levels during and after a LOCA.

h. Ammonia detectors are provided in each outside air intake to annunciate ammonia concentration of approximately 12.5 ppm and above. On detection of high ammonia concentration at the outside air intake, an alarm is annunciated in the main control room.

i. The isolation dampers in the computer room HVAC system ductwork are seismically qualified and supported to ensure that the integrity of the computer room boundaries are maintained during all station operating conditions.

9.4.1.2.4 Testing and Inspection

All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements and codes.

System ductwork and erection of equipment were inspected during various construction stages for quality assurance. Preoperational tests were performed on all mechanical components and the system was balanced for the design airflows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the Proper sequence of operation.

Provisions are made for routine inservice testing of the equipment and filters as discussed in Section 6.4. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations. Operation of each redundant equipment train is rotated to provide on-line checking and testing of the performance.

The emergency makeup filter trains and recirculation filters are subjected to the factory, preoperational, and subsequent periodic tests described in Subsection 6.4.5.

9.4.2 Spent Fuel Pool Area Ventilation System

The spent fuel pool area ventilation system is an inseparable part of the reactor building ventilation system. This system serves cubicles and various areas in the reactor building fuel storage, steam dryer, and separator pools. Each Unit 1 and 2 possesses an independent reactor building ventilation system.

9.4.2.1 Design Bases

The reactor building ventilation system limits the temperature within served areas, thereby conforming with equipment recommendations. Additionally, this system provides protection from radioactive particulates by maintaining the airflow patterns from accessible to potentially contaminated areas. The operation of this system is non-safety-related; however certain aspects of this system are safety related as described below.

9.4.2.1.1 Safety Design Bases

a. This system is not required to function under any but normal plant operating conditions, and therefore, has no safety design bases except for those parts of the system associated with the secondary containment isolation valves, main steam tunnel isolation, and fuel pool exhaust ducts.

b. The system supply and exhaust air duct penetrations for both Units 1 and 2 through the secondary containment boundary are equipped with two isolation valves in series to ensure secondary containment isolation on high radiation signals. The fuel pool exhaust ducts for Units 1 and 2 are required during a fuel drop accident. The main steam tunnel airflow check dampers are required to isolate the steam tunnel in the event of a pipe break in the tunnel. A pressure relief damper is included in the exhaust air ducts downstream of the reactor building ventilation isolation valves. This relief damper opens to relieve pressure resulting from a main steam line break that could propagate to the ducts and plenum before the isolation dampers fully close. In addition, an excess flow check damper is installed to isolate the duct and plenum from HELB pressures. These actions ensure the structural integrity of the Seismic Category I exhaust plenum walls. The reactor building ventilation isolation valves and intermediate duct between penetrations and isolation valves are required during and after abnormal plant operating conditions to maintain the secondary containment boundary integrity. The isolation valves are powered from essential buses and meet the single failure criteria. These parts of the system are designed for Seismic Category I classification.

9.4.2.1.2 Power Generation Design Bases

a. The reactor building ventilation system for both Units 1 and 2 is designed to limit the maximum temperature in generally accessible areas of the reactor building to 104° F. The potentially contaminated cubicles and steam tunnels are maintained at 122°F. The temperature maintained in each area conforms to the equipment ambient requirements in that area.

b. The system provides ventilation to the ECCS equipment cubicles during normal plant operation and limits the temperature to a maximum of 104° F.

c. The system provides a quantity of filtered outdoor air to purge the facility of possible contamination. Ventilation air is routed from accessible clean areas to areas of potential contamination before exhausting to the station vent stack.

d. The system exhausts air from the fuel storage pool and steam dryer and separator storage pools for both Units 1 and 2 and provides personnel protection by entraining all the effluents rising from the pools at their periphery and exhausting them to the station vent stack. It also provides a means of high radiation alarm from the fuel pool exhaust signals for isolation of the secondary containment.

e. The system components are designed with sufficient redundancy to ensure meeting the power generation objective.

9.4.2.2 System Description

a. Two independent and identical ventilation systems are provided for the Unit 1 and 2 reactor buildings.

b. The reactor building ventilation system for each Unit 1 and 2 is of a once through type supplying 100% outside air by a built-up fan system.

c. The reactor building ventilation system for each Unit 1 and 2 is comprised of an outside air intake louver, a medium-efficiency filter (Note: Some supply air filters may be removed to prevent high differential pressure conditions caused by occasional snow buildup), a heating/chilled glycol cooling coil, an evaporative cooler (Note: The evaporative coolers are abandoned-in-place.), an electric heating coil, and three 50% capacity supply air fans, all arranged in sequence. The redundant supply air fans are connected to a common duct system. The supply air duct is provided with two redundant isolation valves at the point of penetration to the secondary containment. A branch from the supply air feeds directly to the refueling floor area. The second branch of the supply air duct provides ventilation air distribution to the rest of the plant areas.

d. Ventilation air is supplied to accessible areas on all the reactor building floors and is induced to areas of greater potential contamination through the system exhaust ducts and fans.

e. The air from the refueling floor is exhausted through the exhaust boxes provided at approximately 4-foot intervals around the periphery of the fuel storage, steam dryer, and separator pools. These exhaust boxes are connected to a ring header and a common exhaust duct leading to the exhaust plenum inside the reactor building for both Units 1 and 2.

f. The exhaust from other potentially contaminated areas of the individual Unit 1 and 2 reactor buildings is routed to the respective exhaust plenum through separate ducts. The reactor buildings for both Units 1 and 2 are provided with independent exhaust air systems. Each reactor building exhaust system is comprised of an exhaust air filter, heat recovery coil, and three 50% capacity exhaust air fans, each installed in sequence.

g. The exhaust duct from the refueling floor for each Unit 1 and 2 are provided with four radiation monitors, (2 redundant monitors per division), to automatically initiate secondary containment isolation, on high radiation signal. The time required to close the isolation valves completely after the high radiation signal is less than 10 seconds.

h. The length of the exhaust duct from the refueling floor radiation monitors to the isolation valves for each Unit 1 and 2 and the average velocity of potentially contaminated effluents inside the exhaust duct are designed to have a travel time of a minimum of 12.5 seconds. On this basis, no contaminated air can be exhausted to the outside atmosphere.

i. The reactor building ventilation isolation valves are designed to fail-safe operation. These valves are operated by air cylinders with instrument air controlled by an air solenoid valve.

j. Each reactor building is maintained, by the corresponding reactor building ventilation system during normal plant operating conditions, at a minimum of 1/4-inch H_2O negative pressure with respect to outdoor atmosphere. During abnormal plant operating conditions, following secondary containment isolation, the reactor buildings are maintained at a minimum of 1/4-inch H_2O negative pressure with respect to the outdoors by the standby gas treatment system (SGTS) as described in Subsection 6.5.1.

k. More air is exhausted from the refueling floor than is supplied, to draw air from adjacent accessible areas. This minimizes the possibility of potentially contaminated air from the fuel pool migrating to clean areas of the reactor building.

l. Controls and instrumentation:

1. Each fan is controlled by a handswitch located on the main control board. Local controls and instruments are mounted on local control panels.

2. Instrumentation is provided for monitoring system operating variables during normal plant operating conditions. The loss of airflow, high and low system

temperature, reactor building differential pressure, differential pressure across supply air filters, high radiation in fuel pool exhaust duct, and high radiation in the reactor building exhaust plenums for each Unit 1 and 2 are annunciated on the main control board.

3. Standby fans are started manually from the main control board on loss of a companion fan.

4. Controls are electric and pneumatic.

9.4.2.3 Safety Evaluation

a. The system is non-safety-related; however some components are exceptions. The secondary containment isolation dampers, installed in the supply air and exhaust air ducts, are exceptions since they penetrate the secondary containment boundary. The fuel pool exhaust air duct is also an exception. The main steam tunnel airflow check dampers are also exceptions since they limit the spread of radiation and high temperatures to areas outside the main steam tunnel where these effects could jeopardize the functions of essential components. The exhaust duct pressure relief damper and excess flow check damper are exceptions since their action ensures the integrity of the Seismic Category I plenum walls.

b. Pressure differential between accessible clean areas and potentially contaminated areas is maintained by the positive exhaust system. In the event of loss of the reactor building ventilation system, the pressure differential control check dampers close and remain fail closed. This minimizes the possibility of backflow of contaminated air.

c. The system incorporates features to ensure its reliable operation over the full range of normal plant operations. These features include the installation of redundant principal system components. The failure analysis is presented in Table 9.4-6.

d. The reactor buildings are maintained at approximately 1/4-inch H_20 negative pressure with respect to the outdoors during normal plant operating conditions to preclude the escape of potentially contaminated air.

e. The reactor buildings negative pressure is assured by the SGTS following shutdown of the reactor building ventilation systems as a consequence of any plant abnormal operation. In addition, the vent and purge system may be used during normal plant conditions if reactor building ventilation must be shut down.

f. Normally closed type pressure differential control check dampers and gravity shutters are employed between clean and contaminated areas. This minimizes the possibility of backflow of contaminated air to the clean areas in the event of ventilation shutdown or loss of control power.

g. The isolation valves in each reactor building ventilation supply and exhaust duct, at the secondary containment penetration, are designed to fail closed. Thus, on a loss of control power or control air, the valves are closed.

h. Potentially contaminated effluents rising from the surface of the fuel pools is drawn into the exhaust openings located above the water level. The radiation monitor trip in either of the pool's exhaust duct causes isolation of the reactor buildings and activates the SGTS. The size and length of the exhaust ducts from each fuel pool are designed to ensure that the travel time of effluents from the radiation monitor to the isolation valve is a minimum of approximately 12.5 seconds, which is more than the closure time of the isolation valves (10 seconds).

i. Airflow check dampers are provided in the main steam pipe tunnel to check the steam flow in the reactor building following the pipe break in the main steam pipe tunnel. The steam is released through the blowout panels to the turbine building and outdoors, and through the pressure relief damper to the auxiliary building HVAC equipment area.

j. The ductwork between reactor building and secondary containment isolation valves for each Unit 1 and 2 is designed to conform to Seismic Category I requirements to maintain the integrity of the secondary containment on abnormal plant operating conditions.

k. A pressure relief damper and an excess flow check damper are included in the exhaust air ducts downstream of the reactor building ventilation isolation valves. The relief damper opens to relieve excess pressure from a main steam line break that could challenge the structural integrity of the Seismic Category I exhaust plenum walls.

9.4.2.4 <u>Testing and Inspection</u>

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements, and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests are performed on all mechanical components, and the system was balanced for the design airflows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation. A final integrated preoperational test was conducted with all equipment and controls operational to verify the system performance.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

c. The system is in operation during normal plant operation. Operation of standby equipment is occasionally rotated to provide on-line checking and testing of performance.

d. Periodic inspections and/or testing of the airflow check dampers, pressure relief damper, and the excess flow check damper ensures that these components will properly perform heir required functions in the event of a pipe break in the main steam tunnel.

9.4.3 Auxiliary and Radwaste Area Ventilation Systems

The auxiliary and radwaste area ventilation systems are comprised of the following four systems:

a. auxiliary building HVAC equipment area ventilation system,

b. auxiliary building office HVAC system,

c. auxiliary building laboratory HVAC system, and

d. radwaste area ventilation system.

9.4.3.1 Auxiliary Building HVAC Equipment Area Ventilation System

The auxiliary building HVAC equipment area ventilation system serves the general HVAC equipment areas (auxiliary building, elevation 786 feet 6 inches and 815 feet) during normal station conditions. Each unit has it own independent auxiliary building HVAC equipment area ventilation system.

9.4.3.1.1 Design Bases

The non-safety-related system is designed to limit the inside temperature range in conformance with equipment requirements.

9.4.3.1.1.1 Safety Design Bases

The auxiliary building HVAC equipment area ventilation systems are not safety related; therefore they do not possess safety design bases.

9.4.3.1.1.2 Power Generation Design Bases

a. The auxiliary building HVAC equipment area ventilation systems for Units 1 and 2 operate on a year-round basis during normal plant operating Conditions.

b. The systems limit the temperature to a maximum of 104° F and a minimum of 65° F in conformance with the equipment ratings.

c. On loss of offsite electric power, the systems are shut down.

9.4.3.1.2 System Description

a. [Deleted]

b. Two 100% capacity fans induce air through outside air intake louvers and medium efficiency filters.

c. The supply air is distributed in the equipment areas by ducts and induced back to the system for recirculation or discharge to the atmosphere, depending on outside air conditions.

d. The outside air dampers and recirculation dampers are modulated to limit the temperature to a maximum of 104° F and minimum of 65° F in the equipment areas in conjunction with electric unit heaters provided to offset the transmission heat losses in the winter.

e. Controls and instrumentation:

    1. Each supply fan for Units 1 and 2 is controlled by a handswitch located on a local control panel.

2. Signals for high-pressure differential across the supply air filter and low airflow, after the start of the supply fan, are annunciated on the local control panel for both Units 1 and 2.

3. An ionization detector is provided in the return air duct to provide alarm and isolate the ventilation system on detection of products of combustion in the return air duct.

4. Controls are pneumatic and electric.

9.4.3.1.3 Safety Evaluation

The auxiliary building HVAC equipment area ventilation system is not safety related.

9.4.3.1.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system was balanced for the design airflows and system operating temperatures and pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations.

9.4.3.2 Auxiliary Building Office HVAC System

The system, which is common to both Units 1 and 2, serves the auxiliary building offices and other adjoining areas at elevation 786 feet. (Note: The Auxiliary Building office HVAC systems humidifiers and minimum outside air damper are abandoned-in-place).

9.4.3.2.1 Design Bases

The system is designed to maintain controlled temperature and humidity for the comfort of operating personnel in the auxiliary building offices.

9.4.3.2.1.1 Safety Design Bases

The auxiliary building office HVAC system is not a safety-related system; therefore, it has no safety design bases.

9.4.3.2.1.2 Power Generation Design Bases

a. The auxiliary building office HVAC system is designed to maintain a quality environment suitable for personnel comfort, health, and safety in the offices located in the auxiliary building.

b. The system maintains the offices at approximately 75° F and 45% relative humidity on a year-round basis.

c. All the areas served by this system are provided with a minimum quantity of outside air for ventilation, odor dilution, and to offset exhaust air requirements.

d. The auxiliary building office HVAC system operates on a continuous basis during normal plant operating conditions.

9.4.3.2.2 System Description

a. The Auxiliary Building HVAC Main Outside Air Damper is abandoned-in-place.

b. The system is comprised of an outside air louver, a mixing plenum, a supply air filter, a blow-through type of air handling unit, a hot air duct, a cold air duct, and individual zone mixing boxes. The blow-through type of air handling unit consists of a fan, a steam humidifier, direct expansion cooling coils in the cold deck, and an electric heating coil in the hot deck.

c. The air is distributed throughout these areas via a dual duct system to local mixing boxes, where hot and cold air are mixed to meet individual office load demands.

d. The return air fan picks up air through a network of return air ducts and discharges to the return air plenum.

e. Exhaust fans for locker room, lunch room, and women's locker and toilet room are provided.

f. The offices are maintained at slightly positive pressure with respect to outdoors and the adjacent turbine building area.

g. The minimum outside air intake provides all mechanical exhaust and exfiltration.

h. The system operates with minimum outside air on the year-round basis. However, provision is made to supply 100% outside air and exhaust it to atmosphere by manually operating a control switch.

i. Mechanical refrigeration is provided by one full capacity water cooled condensing unit which provides cooling in conjunction with the direct expansion cooling coil installed in the air handling unit. The refrigerant piping is covered in Subsection 9.2.10.

j. Controls and instrumentation:

    1. System control switches and instruments are mounted on a local control panel.

    2. High-pressure differential across supply air filter and low airflow signals, after supply air fan and return air fan start, are annuciated on the local control panel.

    3. An ionization smoke detector is provided in the return air duct to provide alarm and isolate the HVAC system on detection of products of combustion in the return air duct.

    4. Controls are pneumatic and electric.

9.4.3.2.3 Safety Evaluation

The auxiliary building office HVAC system is not a safety-related system.

9.4.3.2.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system was balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.3.3 Auxiliary Building Laboratory HVAC System

The auxiliary building laboratory HVAC system, common to both Units 1 and 2, functions during normal station conditions.

9.4.3.3.1 Design Bases

The non-safety-related system maintains comfort conditions inside the laboratory and exhausts through fume hoods located in both cold and hot laboratories and the sample preparation room. The air from the hot fume hoods is filtered of particulates before exhausting outdoors. The counting room is served by a recirculating HVAC system and is pressurized with HEPA filtered air.

9.4.3.3.1.1 Safety Design Bases

The auxiliary building laboratory HVAC system is not safety related; therefore, it has no safety design bases.

9.4.3.3.1.2 Power Generation Design Bases

a. The auxiliary building laboratory HVAC system is designed to maintain a quality environment suitable for personnel comfort, health, and safety in the station laboratories and ensure integrity of equipment operation.

b. The system maintains the laboratories and offices at approximately 75° F and 45% relative humidity and the counting room at approximately 70° F and 40% relative humidity on a year-round basis.

c. The system provides tempered outdoor makeup air directly to the fume hoods, and exhausts and filters the air from the hoods before it is released to the atmosphere via the reactor building vent.

9.4.3.3.2 System Description

a. [Deleted]

b. The auxiliary building laboratory HVAC system consists of four sets of equipment trains as follows:

1. Laboratory Air Conditioning Train - This train consists of outside air intake louvers, supply air filter, electric preheat coil, and a package air handling unit, consisting of supply air fan, steam humidifier, and heating and cooling coils. The dual duct system distributes air through local mixing boxes. The return air fan discharges air to HVAC equipment room or to the system for recirculation.

2. Fume Hood Makeup Air Train - This train consists of outside air intake louvers, makeup air filter electric heating coil, and two 50% supply air fans. Tempered air is directly supplied to the fume hoods.

3. Laboratory Exhaust Trains - Following are the two laboratory exhaust trains:

    a. Cold Lab Exhaust Train - It consists of two 100% exhaust fans discharging air to the reactor building ventilation stack.

    b. Hot Lab Exhaust Train - It consists of two 50% filter units each comprised of prefilter and HEPA filter, and an exhaust fan discharging air to the station vent stack.

4. Counting room HVAC system - this system consists of a packaged recirculating air handling unit with a recirculating air fan, filters and direct expansion cooling coil. A separate humidification system is provided and also a HEPA filter with booster fan for supply of tempered pressurization air.

c. The laboratories are maintained at slightly negative pressure with respect to the surrounding areas.

d. Water cooled condensing units are provided for cooling the laboratory. The condensing units condenser is supplied with service water to remove rejected heat.

e. Two-thirds of the exhaust air requirement of each fume hood is directly supplied to a connection on the hood, with the balance induced from the laboratory rooms.

f. The counting room and offices are maintained at a slightly positive pressure with respect to the surrounding areas.

g. Controls and instrumentation:

   1. System handswitches and controls are provided in a locally mounted control panel. Pertinent system flow rates and temperatures are monitored and displayed on this panel.

   2. Controls are pneumatic and electric.

9.4.3.3.3 Safety Evaluation

The auxiliary building laboratory HVAC system is not safety related.

A failure analysis is presented Table 9.4-10.

9.4.3.3.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications, and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system was balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.3.4 Radwaste Area Ventilation System

The radwaste area ventilation system, common to both Units 1 and 2, serves the liquid and solid radwaste facilities, and the radwaste control room during normal station conditions.

9.4.3.4.1 Design Bases

The system is designed to provide protection from the radioactive contaminants by proper airflow patterns from accessible areas to potentially contaminated areas. The system also ensures that the temperature is kept within an allowable range; thereby providing conformance with equipment requirements. The exhaust air from the system is filtered to remove the radioactive particulates before discharge to the outdoor atmosphere.

9.4.3.4.1.1 Safety Design Bases

The radwaste building ventilation system and radwaste facility control room HVAC system are not safety-related systems and therefore, have no safety design bases.

9.4.3.4.1.2 Power Generation Design Bases

a. The radwaste area ventilation system components are designed with sufficient redundancy to ensure the continuous power generation objective.

b. The radwaste area ventilation system is designed to limit the maximum temperatures in generally accessible areas to approximately 104° F, and 122° F in potentially contaminated cubicles in conformance with equipment ambient temperature requirements.

c. The spray pumps for the evaporative coolers are not operated. Area temperatures may exceed these limits for a short time on days when the outside air temperature is greater than 95° F.

d. The ventilation system provides a quantity of outdoor air, which is filtered, heated, or cooled to purge the facility of possible contamination. Ventilation air is routed from accessible clean areas to areas with progressively greater potential contamination.

e. Pressure differential control dampers are used to maintain negative pressures in potentially contaminated cubicles. The exhaust fans are designed to maintain a building negative pressure of not less than approximately 1/8-inch H_2O with respect to the outside atmospheric conditions.

f. The radwaste area exhaust system is designed to induce all the ventilation air through the potentially contaminated areas and process this air through prefilters and HEPA filters before release to the atmosphere.

g. In the event of a loss of offsite electric power, the radwaste area ventilation system is shutdown.

h. The radwaste facility control room HVAC system is designed to maintain an approximate 75° F ambient temperature.

i. A minimum quantity of outdoor air is continuously provided to maintain a positive pressure in the control room with respect to the surrounding radwaste areas to preclude the infiltration of potentially contaminated air.

9.4.3.4.2 System Description

a. The radwaste area ventilation system functions to supply outside air to the accessible areas and provide secondary air supply to areas of potential contamination as required. Ventilation air is provided through a central fan system consisting of outside air intake, filters (Note: Some supply air filters may be removed to prevent high differential pressure conditions caused by occasional snow buildup), preheat coils, evaporative cooler, electric blast coils, and three supply air fans.

b. Ventilation air flows from accessible areas to areas of greater potential contamination through the radwaste building pipe tunnel by induction action of two of the system exhaust fans. Exhaust air is routed through prefilters and HEPA filters before release to the outdoors via the reactor building ventilation stack.

c. Demineralized domestic water is provided for initial water fill and for all makeup for the evaporative coolers (abandoned-in-place).

d. Pressure control dampers employed between clean and potentially contaminated areas are of the backflow type and fail closed. This minimizes the backflow of contaminated air to clean areas in the case of a loss of electric power and subsequent fan system shutdown.

e. The radwaste facility control room HVAC system functions to provide cooling to the control room on a year-round basis through a central system consisting of a package water cooled air conditioning unit and supply air filters.

f. Provisions are incorporated to manually provide ventilation air to the control room on loss of the air conditioning unit.

g. Controls and instrumentation:

    1. Each fan is controlled by a handswitch located on the control board of the radwaste control room. Local instruments are provided in a locally mounted control panel. Pertinent system flow rates and temperatures are indicated on the control board and local control panels.

    2. Fan failure is alarmed on the radwaste control board and redundant fans are then manually started.

3. Controls are pneumatic and electric.

9.4.3.4.3 Safety Evaluation

a. The radwaste area ventilation system is not a safety-related system.

b. A failure analysis is presented in Table 9.4-12.

9.4.3.4.4 Inspection and Testing

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system is balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

c. Provisions are made to allow change out of filters while the system is in operation.

9.4.4 Turbine Building Area Ventilation System

This system serves the turbine building, housing various cubicles, and operating floor areas during normal station conditions. Units 1 and 2 have an independent turbine building area ventilation system.

9.4.4.1 Design Bases

The turbine building ventilation system, maintains allowable temperature limits in conformance with equipment requirements. By maintaining airflow patterns from accessible areas to potentially contaminated areas, this system provides protection from radioactive particulates. The operation of this system is non-safety related; however certain aspects of this system are safety related as described below.

9.4.4.1.1 Safety Design Bases

a. This system is not required to function under any but normal plant operating conditions, and therefore, has no safety design bases except for those parts of the system associated with the steam tunnel check dampers.

1. These dampers are designed to close in response to an increase in air velocity or steam tunnel pressure due to a high energy line break in order to prevent rupture of the VT duct wall adjacent to the HPCS switchgear room. A rupture of this wall could significantly affect the design basis environment of the switchgear room. The actuators which open the dampers are passive safety related components because they are only required to open the dampers.

9.4.4.1.2 Power Generation Design Bases

a. The turbine building area ventilation system components are designed with sufficient redundancy to ensure the continuous power generative objective.

b. The turbine building area ventilation system is designed to limit the maximum bulk temperatures in generally accessible areas to approximately 104° F. The potentially contaminated cubicles, including low-pressure and high-pressure feedwater heater cubicles, turbine areas, and condenser cavity are limited to 122° F bulk maximum. The temperature maintained in each area conforms to the equipment ambient requirements.

c. Ventilation air is routed from accessible clean areas to areas of increasingly potential contamination.

d. The turbine building ventilation system will normally operate on a continuous basis during plant operation. In the event of a loss of offsite electric power, the system will shutdown.

9.4.4.2 System Description

a. [Deleted]

b. The turbine building ventilation systems for each Unit 1 and Unit 2 supply 100% outside air through a supply air equipment plenum. The turbine building ventilation supply air equipment plenum is comprised of two 50% outside air intakes, two 50%

capacity filter banks (Note: Some supply air filters may be removed to prevent high differential pressure conditions caused by occasional snow buildup), two 50% capacity glycol solution heating/chilled glycol cooling coils, two 50% capacity evaporative coolers and three 50% supply fans. The evaporative coolers or cooling coils operate to reduce supply air dry bulb temperature and increase the cooling capability of the systems.

c. Domestic water is provided for initial water fill and all makeup water for the evaporative coolers.

d. Of the three supply fans provided for each Unit 1 and Unit 2 turbine building ventilation system, two are required for normal operation to furnish the cooling for each turbine building.

e. The ventilation air is supplied to accessible areas in the main, mezzanine, grade, upper basement, and basement floors and is induced through potentially contaminated areas. All the exhaust air is routed to the condenser cavity and then ducted to the turbine building vent riser for each unit and to the respective Unit 1 and 2 turbine building exhaust fans which discharge the air to the atmosphere via the common station vent stack.

f. Three 50% exhaust fans are provided for each Unit 1 and 2 turbine building ventilation exhaust system. The turbine building ventilation exhaust systems are designed and controlled to maintain negative pressure in the turbine buildings with respect to the outside atmosphere and discharge through the common station vent stack.

g. Exhaust air filters and heat recovery glycol coils are provided upstream to exhaust fans for each Unit 1 and 2 turbine building exhaust systems. The turbine building exhaust air filters are used to protect the heat recovery coils from air-side fouling.

h. Controls and instrumentation:

    1. Each major supply and exhaust fan is controlled by a handswitch located on the main control board. Local handswitches and instruments are provided on a local control panel.

    2. Standby fans are operated manually from the main control board on loss of the companion operating fans.

    3. Controls are pneumatic and electric.

9.4.4.3 Safety Evaluation

a. The system is non-safety related; however some components are safety related. The steam tunnel check dampers are safety related because they form the pressure boundary between the main steam tunnel and the HPCS switchgear room.

   1) The steam tunnel check dampers are held open by a latch mechanism on the damper that requires abnormally high velocity or pressure across the damper to release the blades allowing them to close.

   2) There is no credible failure mode for the steam tunnel check dampers which would prevent their closing during a HELB. Therefore, the steam tunnel check dampers are not included in Table 9.4-14, Turbine Building Area Ventilation Failure Analysis.

b. A failure analysis is presented in Table 9.4-14.

c. The ventilation air supplied in accessible areas is induced through potentially contaminated cubicles by a positive exhaust system. Isolation check dampers of fail closed type are provided in the airflow path to the potentially contaminated areas to preclude backflow of contaminated air into clean areas on loss of ventilation system.

d. The system incorporates features to assure its reliable operation over the full range of normal station operations. These features include the installation of redundant principal system components.

9.4.4.4 Testing and Inspection

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system is balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

The system is in operation during normal plant operation. Operation of the standby equipment is rotated occasionally to provide on-line checking and testing of performance.

9.4.5 Engineered Safety Features Ventilation Systems

The engineered safety features ventilation systems are comprised of the following:

a. diesel-generator facilities ventilation system,

b. switchgear heat removal system, (SWGR recovery fans are abandoned-in-place) and

c. ECCS equipment area cooling system.

9.4.5.1 Diesel-Generator Facilities Ventilation System

The diesel-generator ventilation system provides year-round ventilation of the diesel-generator rooms, day tank rooms, and the diesel oil storage tank rooms. In addition, the system removes equipment heat and provides combustion air when diesel generators are operating. All the diesel generators for Units 1 and 2 and all the diesel generators common to Units 1 and 2 are provided with independent ventilation systems.

9.4.5.1.1 Design Bases

This system, an engineered safety feature, limits the room temperatures in order to conform to equipment requirements, and provide ventilation to the diesel generators.

9.4.5.1.1.1 Safety Design Bases

a. The diesel-generator facilities ventilation systems for both Units 1 and 2 are designed to operate under all normal and abnormal plant operating conditions.

b. The systems conform to Seismic Category I requirements.

c. Each fan is powered from the essential bus corresponding to the diesel generator it is serving. The controls, instrumentation, and power supply for the system are designed to meet IEEE 279 and IEEE 308.

9.4.5.1.1.2 Power Generation Design Bases

a. The diesel-generator facilities ventilation system is normally inoperative during normal plant operating conditions, except for the diesel fuel storage tank room ventilation fans, which draw a nominal quantity of ventilation air through the corresponding diesel- generator room, diesel oil day tank room, and diesel fuel storage tank room. This is done independent of diesel-generator operation to maintain a clean environment.

b. Each diesel-generator facilities ventilation system for Units 1 and 2 is designed to limit the maximum temperature to 122° F in conformance with diesel- generator equipment rating.

c. Each system uses outside air for heat removal.

d. Sufficient ventilation air is supplied to each diesel-generator room to provide room cooling.

9.4.5.1.2 System Description

The diesel-generator facilities ventilation system consists of the following independent ventilation systems for both Units 1 and 2.

a. diesel-generator room 1A and diesel fuel storage room ventilation system;

b. diesel-generator room 1B and diesel fuel storage room ventilation system;

c. diesel-generator room 0 and diesel fuel storage room ventilation system;

d. diesel-generator room 2A and diesel fuel storage room ventilation system;

e. diesel-generator room 2B and diesel fuel storage room ventilation system;

f. HPCS switchgear and pump room ventilation - Unit 1; and

g. HPCS switchgear and pump room ventilation - Unit 2.

The systems mentioned in a. through e. previously are identical and correspond to the five diesel-generator rooms and diesel fuel storage rooms. Each system consists of a 100% capacity intake air louver, a medium efficiency air filter bank, a vaneaxial vent fan and associated intake, recirculating, and exhaust air dampers. The fan automatically stops when the diesel generator is shutdown and the temperature in the room is below 104° F.

When the system operates, outside air is mixed with recirculated room air to limit the minimum temperature to 50° F, or more, inside the diesel-generator room. The exhaust air is forced by positive room pressure to the outdoors through a missile-protected exhaust outlet.

During normal plant operating conditions, when the diesel-generators are not working, a nominal quantity of ventilation air is induced through the same missile-protected intake and medium efficiency filters as mentioned in 'a' in Subsection 9.4.5.1.1.2 by the fuel storage tank ventilation fan. This nominal quantity of ventilation air is drawn through the diesel-generator room, tank room, and diesel oil day tank room and forced by positive pressure to the outdoors through the missile-protected exhaust outlet, thus keeping the environment purged all the time. The quantity of purge air flow can be adjusted during seasonal temperature changes by opening or closing the manual bypass blades located on the inlet air dampers. It is not necessary to take the diesel-generator ventilation system out of service to adjust the manual bypass blades.

The missile-protected intake and medium efficiency filters for each diesel-generator room are designed large enough to admit primary combustion air in addition to 100% ventilation air for cooling during operation of the diesel-generator unit.

Fire dampers are provided in the ventilation openings in diesel fuel storage tank walls for isolation purposes during a fire. This system works in conjunction with the fire protection system to isolate the diesel room on activation of the fire protection system.

A minimum temperature of 50° F is maintained by unit heaters.

The HPCS switchgear and pump room ventilation system for both Units 1 and 2 are identical. Each system consists of a supply air fan, which induces filtered outside air. A return air fan exhausts air from the room and recirculates/exhausts to the atmosphere. An exhaust fan is provided for the battery room.

Controls and instrumentation:

a. Each diesel-generator facilities ventilation system is interlocked to start when its respective diesel generator starts and can be controlled by handswitches located on the local control board.

b. Temperature controllers located in each room control the ventilation systems supply, recirculation, and exhaust air motor-operated dampers, and thereby, the room temperature.

c. The temperature of each room is indicated and high room temperature is annunciated on the main control board.

d. All controls are electric or electronic.

9.4.5.1.3 Safety Evaluation

a. All power and control circuits meet IEEE 279 and IEEE 308 criteria.

b. All equipment and surrounding structures are designed for Seismic Category I.

c. The loss of any ventilating fan does not affect the safe shutdown capability of the station, since a ventilation fan is provided for each diesel generator.

d. A failure analysis is presented in Table 9.4-16.

9.4.5.1.4 Inspection and Testing

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements, and codes. System ductwork and erection of equipment were inspected during various construction stages for quality assurance. Construction tests were performed on all mechanical components and the system was balanced for the design air and system operating pressures.

   Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance will be performed on a scheduled basis generally in accordance with the equipment manufacturer's recommendations and station practices.

c. System and equipment operation is monitored during periodic testing of the diesel-generator units. Diesel-generator room temperatures are monitored each shift when the diesel-generator is required to be operable.

9.4.5.2 Switchgear Heat Removal System

The system serves the essential switchgear areas, the reactor protection system motor-generator set room, and battery rooms under normal and abnormal station conditions. Outside air is provided for each unit via a common intake shaft for heat removal. Each switchgear and RPS M-G set room has an independent heat removal system. Discharge air is vented to the air shaft, which connects with the outside atmosphere through a missile protected louver, and into areas in the turbine building. (Note: The SWGR heat recovery fans are abandoned-in-place).

9.4.5.2.1 Design Bases

The system removes equipment heat to maintain temperatures in accordance with equipment requirements. The system is an engineered safety feature.

9.4.5.2.1.1 Safety Design Bases

a. The switchgear heat removal systems for Units 1 and 2 are designed to operate under all plant operating conditions and to limit switchgear room temperatures to 104° F maximum and 65° F minimum. Each system is designed to conform to Seismic Category I requirements.

b. Each heat removal system is powered from the essential bus serving its associated essential switchgear. The controls, instrumentation, and power supply for the system are designed to meet IEEE 279 and IEEE 308.

c. The system exhausts sufficient air from the battery rooms of Units 1 and 2, to preclude the possibility of the formation of an explosive hydrogen atmosphere.

9.4.5.2.1.2 Power Generation Design Bases

The ventilation systems for the ESF systems provide the same functions for both normal and abnormal conditions; thereby initiating the design bases for both safety and non-safety functions. Consequently, the power generation design bases are identical to the safety design bases, shown in Subsection 9.4.5.2.1.1.

9.4.5.2.2 System Description

a. [Deleted]

b. The heat removal systems for Units 1 and 2 circulate air continuously to maintain temperature within the approximate limits of a maximum of 104° F and minimum of 65° F.

c. Each system is designed to operate during a design-basis accident and is connected to the essential bus serving the equipment in its respective area.

d. Each heat removal system is designed to admit 100% outside air, but outside air dampers and return air dampers are modulated to maintain temperatures within the limits. Any excess air is relieved through the exhaust air riser. If an outside air actuator fails during cold weather months, the outside air dampers may be temporarily wired closed to prevent the switchgear and battery temperatures from going below their allowed temperatures. If a recirculation actuator fails, the recirculation dampers may be temporarily wired open to ensure that there is a constant flow of supply air to the fan. Manual modulation of the damper is allowed until the normal mode of modulation is returned.

e. One exhaust fan is provided for purging each battery room of Units 1 and 2 of hydrogen generated during battery charging. The battery rooms are maintained at a negative pressure with respect to the switchgear room.

f. Fire dampers with fusible links are provided in any duct penetrations and any ventilation openings in fire walls.

g. All switchgear heat removal system equipment is physically separated by virtue of its location within the separate switchgear areas.

h. The heat recovery unit consists of a high efficiency filter, heat recovery coil, and two 50% fans for each Unit 1 and 2. The air, thus induced by heat recovery fans is either recirculated or discharged to the atmosphere.

i. Controls and instrumentation:

    1. Each switchgear heat removal system has a control panel containing all starters, relays, and controls necessary for the operation and monitoring of its respective air handling unit.

2. Ionization smoke detectors are located in each switchgear room to provide main control room annunciation in the event of detection of combustion products.

3. Handswitches for manual starting of heat removal units and exhaust fans are provided locally. (Note: The SWGR heat recovery fans have been abandoned-in-place).

4. Controls are electric or electronic.

9.4.5.2.3 <u>Safety Evaluation</u>

a. All power and control circuits for each package heat removal unit meet IEEE 279 and IEEE 308 criteria.

b. All equipment and surrounding structures are designed for Seismic Category I.

c. The loss of any single heat removal unit does not affect the safe shutdown capability of the station since independent units are provided for each division of switchgear.

d. A failure analysis is presented in Table 9.4-18.

9.4.5.2.4 <u>Inspection and Testing</u>

All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements, and codes. System ductwork and erection of equipment were inspected during various construction stages for quality assurance. Construction tests were performed on all mechanical components and the system was balanced for the design air flow and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

Equipment and systems operation are demonstrated during normal plant operation since this system operates continuously.

9.4.5.3 <u>ECCS Equipment Areas Cooling System</u>

This system serves the emergency core cooling system (ECCS) equipment cubicles whenever the ECCS equipment is required for service. Each Unit 1 and 2 is provided with independent ECCS area cooling systems.

9.4.5.3.1 Design Bases

This system removes equipment heat from ECCS equipment areas and maintains temperatures within equipment limits. The ECCS equipment areas cooling system is designated an engineered safety feature.

9.4.5.3.1.1 Safety Design Bases

a. The ECCS equipment area cooling system for both Units 1 and 2, consisting of fan-coil units for each ECCS equipment cubicle, is designed for removing equipment heat under all normal and abnormal station operating conditions with the exception of residual heat removal (RHR) service water pump cubicles, located in the diesel building. The cooling is provided by outside air.

b. Each system is designed to conform to Seismic Category I requirements.

c. Each fan-coil unit is powered from essential buses serving its associated ECCS equipment. The instrumentation and power supply for the system are designed to meet IEEE 279 and IEEE 308 criteria.

d. The ECCS system is designed with redundancy for both Units 1 and 2, thus the fan-coil units provided for each area are comprised of singular components.

e. Each ECCS fan-coil unit is provided with cooling water from the ECCS equipment cooling water system.

f. Each fan-coil unit is capable of dissipating the heat produced by the operation of corresponding ECCS equipment and limiting the inside temperature to a maximum of approximately 148° F after a design-basis accident.

g. The fan-coil unit in the Southwest ECCS equipment area limits the inside temperature to a maximum of 153° F (Reference 36, Section 6.2)

9.4.5.3.1.2 Power Generation Design Bases

a. The ECCS equipment area cooling system is not required to operate during normal station operating conditions except when the ECCS equipment or the ECCS equipment area cooling system itself is in the "test" mode.

b. A small quantity of ventilation air is purged through each ECCS equipment cubicle within the secondary containment to limit the inside temperature to approximately 104° F during normal station operation by the reactor building ventilation system, described in Subsection 9.4.2.

9.4.5.3.2 System Description

a. Each of the ECCS equipment area fan-coil units consists of a cooling coil and a fan, both built up in a housing. Supply air ducts are provided for air distribution in each cubicle. The air circulated through each cubicle is cooled by its respective fan-coil unit.

b. RHR service water pump cubicle fans limit the temperature to a maximum of 122° F. Operation of the ventilation fans are interlocked with the operation of the RHR service water pumps, located in the CSCS-ECW cubicles. The ventilation fans automatically stop when the pumps are shutdown. Fans are also capable of being manually operated.

c. Water from the ECCS equipment closed cooling water system with a maximum inlet water temperature of 107° F is used in the cooling coils.

d. Ventilation air for the ECCS equipment cubicles during normal station operating conditions is provided by the reactor building ventilation system with exhaust air induced from each cubicle to ensure air circulation and proper pressure differentials between areas of lesser and greater potential contamination. During abnormal station conditions, the fan-coil units operate by circulating reactor building air through the cooling coils. The fan-coil units are automatically started when the associated ECCS or RCIC pumps start. In the event the reactor building air reaches approximately 149°F, the condition is alarmed in the main control room.

e. Controls and instrumentation:

    1. The flow of cooling water in each fan-coil unit located in each of the ECCS cubicles within the Reactor Building is maintained all the time during the system operation and is not modulated. The fan in each fan-coil unit is

electrically interlocked with respective ECCS equipment operation. The fan-coil units can also be operated manually by switches provided on the local panel. However, the auto start signal from the operation of ECCS equipment overrides the manual switch.

2. Each fan-coil unit is shut down by a temperature switch located in the respective cubicle. The switch is interlocked with the ECCS pump to preclude fan-coil shutdown when the pump is operating.

3. Instrumentation is provided to monitor the temperature of air entering and leaving the cooling coil. The temperature inside each ECCS cubicle is both indicated and high temperature annunciated on the main control board. High temperature in each CSCS-ECW cubicle is also annunciated on the main control board.

4. All the controls and instruments are electric or electronic.

9.4.5.3.3 <u>Safety Evaluation</u>

a. All power and control circuits for each fan-coil unit meet IEEE 279 and IEEE 308 criteria.

b. All the fan-coil units and piping meet the criteria of the appropriate system of Quality Group C.

c. High temperature inside each ECCS cubicle is alarmed on the main control board. The loss of an ECCS equipment area fan-coil unit, causing high temperature inside the cubicle, does not preclude equipment operation and the operator may continue to operate the corresponding ECCS equipment or may start the standby ECCS equipment or system, with their corresponding fan-coil units.

d. The failure analysis of the ECCS equipment area cooling system is presented in Table 9.4-20.

9.4.5.3.4 <u>Inspection and Testing</u>

All equipment was factory inspected and tested in accordance with the applicable equipment specifications, quality assurance requirements, and codes. System ductwork and erection of equipment were inspected during various construction stages for quality assurance. Construction tests were performed on all mechanical components and the system is balanced for the design air and water flows and system design pressures. Controls, interlocks, and safety devices on each fan-coil unit were cold checked, adjusted, and tested to ensure the proper operation.

Maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

Equipment operation and performance is observed during functional testing of LPCS, RHR, HPCS, and RCIC systems.

9.4.6 <u>Pump House Ventilation Systems</u>

The pump house ventilation systems are comprised of the following two systems:

a. lake screen house ventilation system, and

b. river screen house ventilation system.

9.4.6.1 <u>Lake Screen House Ventilation System</u>

The lake screen house ventilation system serves the lake screen house for Units 1 and 2. Each Unit 1 and 2 is provided with an independent system.

9.4.6.1.1 <u>Design Bases</u>

This system, which is non-safety-related, limits the lake screen house temperature in accordance with equipment requirements.

9.4.6.1.1.1 <u>Safety Design Bases</u>

Since this system is not safety related, there are no safety design bases.

9.4.6.1.1.2 <u>Power Generation Design Bases</u>

a. The lake screen house ventilation system for Units 1 and 2 operates on a continuous basis during normal plant operating conditions. In the event of a loss of offsite electric power, the system is shut down.

b. The system maintains a maximum temperature of 104° F and a minimum temperature of 65° F in conformance with equipment temperature requirements.

c. The exhaust fans for Units 1 and 2 maintain ambient temperature conditions inside the diesel driven fire pump cubicles when the fire pump is activated.

9.4.6.1.2 System Description

a. Two 50% supply air fans induce air through the outside air intake louvers and discharge air to the lower level of the lake screen house for each Unit 1 and 2.

b. The air rises to the upper level and is relieved to the atmosphere through backdraft dampers.

c. Each lake screen house ventilation system is designed to admit 100% outside air, but outside air dampers and return air dampers are modulated to maintain an approximate maximum and minimum temperature of 104° F and 65° F, respectively. Any excess air is relieved to the atmosphere.

d. An exhaust fan for each diesel driven fire pump cubicle induces air through outside air intake louvers and discharges to the atmosphere when the fire pump is running and the temperature is at or above 88° F.

e. Controls and instrumentation:

    1. Handswitches for each supply and exhaust fan are mounted on a local control panel.

    2. Outside air intake dampers are provided with open and close indication.

    3. Temperature above 110° F is alarmed on the local control panel.

    4. Controls are electric.

9.4.6.1.3 Safety Evaluation

The lake screen house ventilation system is not safety related.

9.4.6.1.4 Inspection and Testing

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system is balanced for the design air flow and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.6.2 River Screen House Ventilation System

The river screen house ventilation system is common for both Units 1 and 2, and operates during normal station conditions.

9.4.6.2.1 Design Bases

This non-safety-related system is designed to maintain temperatures in the river screen house within limits of equipment requirements.

9.4.6.2.1.1 Safety Design Bases

Since the river screen house ventilation system is not a safety-related system, it has no safety design bases.

9.4.6.2.1.2 Power Generation Design Bases

a. The river screen house ventilation system is designed to operate on a continuous basis during normal plant operating conditions. In the event of a loss of offsite electric power, the system is shut down.

b. The system maintains a maximum temperature of 104° F and a minimum temperature of 65° F in conformance with ambient equipment requirements.

c. The temperature inside the instrument room is maintained at approximately 75° F.

9.4.6.2.2 System Description

a. The system includes three exhaust fans. Each exhaust fan induces airflow through a set of four outside air dampers and three exhaust air dampers and discharges to the atmosphere to limit inside temperatures to 104° F in the summer.

b. The unit heaters limit the minimum temperature to approximately 65° F in winter.

c. The package air conditioning unit provides cooling by recirculating air in the instrument room.

d. Controls and instrumentation:

   1. Control switches for each exhaust fan are mounted on a local control panel.

   2. Each outside air intake damper position is provided with open and close indication.

   3. Temperature above approximately 104° F is alarmed on the local control panel.

   4. Controls are electric.

9.4.6.2.3 Safety Evaluation

The river screen house ventilation system is not safety related.

9.4.6.2.4 Inspection and Testing

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system is balanced for the design air flow and system operating temperatures and pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.7 Machine Shop Ventilation System

The machine shop ventilation system, common to both Units 1 and 2, operates during normal station conditions. The Machine Shop Sandblast Exhaust Fan was abandoned-in-place.

9.4.7.1 Design Bases

This non-safety-related system maintains an allowable temperature range on a year-round basis. It filters the exhaust air of particulates and exhausts the result to the atmosphere through the station vent stack.

9.4.7.1.1 Safety Design Bases

The machine shop ventilation system is not a safety-related system; therefore, it has no safety design bases.

9.4.7.1.2 Power Generation Design Bases

a. The machine shop ventilation system is designed to limit the temperature to a maximum of 104° F in each area.

b. A minimum quantity of outside air is continuously supplied during normal operating conditions for ventilation and exhaust air makeup. (The supply and return fans are abandoned. HEPA units are still used).

c. The machine shop ventilation system provides continuous exhaust from potentially contaminated areas and filters the air through HEPA filters before exhausting it through the station vent stack.

d. The machine shop ventilation system normally operates on a continuous basis during plant operation. In the event of a loss of offsite electric power, the system will shut down. (Abandoned)

9.4.7.2 System Description

a. The machine shop ventilation system supplies a maximum of 100% outdoor air for cooling through a central fan system consisting of outside air intake, outside air dampers, return air dampers, filters, heating coil, and supply air fan. (Abandoned) The outside air damper is abandoned open, exhaust damper abandoned closed.

b. During normal operation the outdoor air and return air dampers are modulated to maintain minimum supply air temperature. A nominal quantity of outdoor air is continuously supplied for ventilation and exhaust air makeup. (Abandoned)

c. Supply air is distributed through the machine shop by means of a duct system with the air provided to the various areas for cooling and ventilation. (Abandoned)

d. Individual exhaust filter trains consisting of prefilters, HEPA filters, and an exhaust fan induce ventilation air through the laundry room, machinery room, cave room, sandblast area, (sandblast exhaust fan is abandoned-in-place) decontamination area, and welding shop and discharge air to the reactor building ventilation stack via a common duct.

e. The paint and oil room fan and damper are abandoned-in-place. Air from the paint and oil room is vented to the main machine shop area.

f. A packaged air-conditioning unit is provided in the laundry area to provide cooling.

g. Controls and instrumentation:

    1. Each supply and exhaust fan is controlled by a handswitch located on a local control panel. Temperatures and other pertinent data are displayed on the local control panel.

    2. Controls are pneumatic and electric.

9.4.7.3 Safety Evaluation

The machine shop ventilation system is not a safety-related system.

9.4.7.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system is balanced for the design air and water flows and the system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.8 Off-Gas Building HVAC System

The off-gas building HVAC system, common to both Units 1 and 2, serves the off-gas building and operates during normal station conditions.

9.4.8.1 Design Bases

The system performs the following functions:

a. maintains the temperature in various areas in conformance with equipment requirements,

b. dehumidifies the air to preclude moisture condensation on charcoal adsorbers, and

c. after filtering all air of radioactive and nonradioactive particulates, the system exhausts the air to the station vent stack.

9.4.8.1.1 Safety Design Bases

The off-gas building HVAC system is not a safety-related system; therefore it has no safety design bases.

9.4.8.1.2 Power Generation Design Bases

a. The off-gas building HVAC system is designed with sufficient redundancy to ensure the continuous power generative objective.

b. The system will operate on a continuous basis during normal plant operating conditions. In the event of a loss of offsite electric power, the system is shut down.

c. The accessible areas are maintained at a negative pressure of approximately 0.1 inch water gauge and the airflow is maintained from accessible areas to potentially contaminated areas.

9.4.8.2 System Description

a. [Deleted].

b. The off-gas building HVAC system provides 100% outside air which is filtered, preheated or mechanically cooled, and reheated to maintain ambient temperature requirements. Independent temperature control is provided for the following zones:

   1. charcoal adsorber room - Unit 1;

   2. HVAC equipment room;

   3. upper and lower accessible areas; and

   4. charcoal adsorber room - Unit 2.

c. Two 100% supply equipment systems are provided. Each system consists of a filter, preheating coil, and air handling unit consisting of two direct expansion cooling coils mounted in a series, and a supply fan. The cooling coils are connected to the respective water cooled condensing unit. The discharge ductwork from each air handling unit is connected to a common supply duct system which is then split into zone ducts. Each zone is equipped with two 100% capacity duct reheat coils.

d. Exhaust air from the charcoal adsorber vaults is routed directly to the exhaust duct. Supply air to accessible areas flows through each of the potentially contaminated cubicles and the exhaust duct from each cubicle is connected to the common main exhaust duct. Two 100% capacity exhaust filter units are provided, each consisting of a prefilter, HEPA filter, and exhaust fan.

e. The system is designed to maintain required approximate maximum and minimum temperatures of 104° F and 65° F, respectively in the accessible areas. The charcoal vaults for both Units 1 and 2 are maintained at an approximate inside temperature of 77° F. The dew point of air inside the charcoal vaults is maintained, so that there is no condensation of moisture on the charcoal surface inside vaults.

f. Controls and instrumentation:

1. Handswitches for each supply fan and exhaust fan are mounted on the main control panel.

2. Standby fans are operated manually from the main control panel upon loss of the companion fans.

3. Controls are pneumatic and electric.

9.4.8.3 Safety Evaluation

a. The off-gas building HVAC system is not safety related.

   A failure analysis is presented in Table 9.4-25.

b. Supply air delivered to accessible areas is induced through potentially contaminated cubicles by a positive exhaust system. Gravity dampers are provided in the airflow path to preclude backflow of contaminated air into clean areas on loss of the supply system.

c. The system incorporates features to assure its reliable operation over the full range of normal plant operations. These features include the installation of redundant principal system components.

9.4.8.4 Inspection and Testing

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system is balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

c. The system is in operation during normal plant operation. Operation of the standby equipment is occasionally rotated to provide on-line checking and testing of performance.

9.4.9 Primary Containment HVAC System

The primary containment HVAC system serves the drywell area during normal station conditions. Each Unit 1 and 2 is provided with an independent primary containment HVAC system.

9.4.9.1 Design Bases

The system, which is non-safety-related, maintains temperature conditions within limits of equipment requirements.

9.4.9.1.1 Safety Design Bases

a. The primary containment HVAC system for both Units 1 and 2 is not required to function in any but normal plant operating conditions, and therefore, has no safety design basis.

b. The primary containment HVAC system components for Units 1 and 2 and the ductwork are supported in accordance with Seismic Category I criteria to preclude damage to the safety-related equipment during the design basis earthquake (DBE).

c. The safety design basis for the chilled water system serving the primary containment HVAC system is discussed in Subsection 9.2.9.

9.4.9.1.2 Power Generation Design Bases

a. The primary containment HVAC system for Units 1 and 2 is designed with sufficient redundancy to ensure continuous operation under normal plant operating conditions.

b. The primary containment HVAC system is designed to limit the maximum average temperatures of the return air to the fan cooler to 135° F.

c. During a loss of offsite electric power, a portion of the primary containment HVAC systems for Units 1 and 2 are available for operation.

9.4.9.2 System Description

a. [Deleted]

b. The primary containment HVAC system for both Units 1 and 2 operates continuously during normal plant operating conditions to maintain the required drywell temperatures. Appropriate failure analysis of the key components of the primary containment HVAC and chilled water (PCCW) systems are presented in Table 9.4-27. Thus, depending on the actual containment heat load, the HVAC and PCCW systems have the capability to operate in the following modes of operations:

   1. One Train Operation - This operating mode consists of one fan-coil unit (filter (installed during outages and removed before startup), cooling coil, and supply fan), five area coolers, one chilled water pump and either one or two chillers. The back-up train consists of the other fan-coil unit and the sixth area cooler supplied with chilled water from the second chilled water pump and the second and/or third chiller of the PCCW system.

   2. Two Train Operation - This mode consists of two fan-coil units, five area coolers, one chilled water pump and two chillers. The redundant chiller serves as standby. In this mode, the total air circulation inside the drywell increases resulting in greater heat removal capability.

c. The fan-coil units for each primary containment are ducted to common supply but have a separate unducted air return.

d. The area coolers, which are located at the upper drywell elevations, have independent suction and discharge paths. They cool and recirculate air in the upper regions of the drywell.

e. System description for chillers and chilled water piping, which provide chilled water to the fan-coil units and area coolers for cooling, is discussed in Subsection 9.2.9.

f. Controls and Instrumentation

   1. Control switches and instruments are provided for each fan-coil unit on the main control board as well as on a locally mounted control panel.

2. Control switches for the area coolers are provided on a locally mounted control panel in the reactor building.

3. Standby equipment is operated manually from the control room or locally mounted control panels.

4. Controls are electric, electronic, or pneumatic.

9.4.9.3 Safety Evaluation

a. The primary containment HVAC system is not safety related.

b. The system incorporates features to ensure its reliable operation over the full range of normal plant operations. These features include the installation of redundant principal system components capable of parallel operation.

c. Loss of airflow from the HVAC system is alarmed on the main control board.

d. Instrumentation is provided to monitor temperature in various zones in the drywell.

e. The primary containment HVAC system components and ductwork are supported to conform to Seismic Category I requirements.

f. The failure analysis is presented in Table 9.4-27.

g. The filters for the fan coil units and the area coolers are removed before unit startup to meet the requirements of NRC Bulletin 93-02.

9.4.9.4 Testing and Inspection

a. All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Construction tests were performed on all mechanical components and the system is balanced for the design air and water flows, and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

b. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations.

c. The system is in operation during normal plant operation. Operation of standby equipment is occasionally rotated to provide on-line checking and testing of performance.

9.4.10 Primary Containment Purge System

The primary containment purge system serves the drywell and suppression pool chambers during normal station conditions. These purge systems for both Units 1 and 2 are interconnected in order to be used interchangeably.

9.4.10.1 Design Bases

This non-safety system provides personnel accessibility for maintenance by purging contaminated air from the inside environments of the drywell or suppression pool chamber thus keeping the accumulated exposure to ALARA levels. The system also provides a means of inerting and pressure control for the drywell and suppression chamber during power operations. The operation of this system is non-safety-related. Certain parts of this system are safety related as described in section 9.4.10.1.1 below. (Post accident purging for primary containment atmosphere cleanup may be routed via the Standby Gas Treatment (VG) system or the Primary Containment Purge (VQ) system.).

9.4.10.1.1 Safety Design Bases

a. Primary and secondary containment isolation valves close on isolation signal.

b. Should a LOCA occur while the primary containment is being purged, the blowdown through the 26" valves will not over pressurize safety related components. VG is isolated from VQ by a normally closed isolation valve. The nonsafety-related VQ ductwork on the 786' elevation of the Auxiliary Building will fail. The failure of this ductwork will result in a maximum 10-second steam release on the 786' elevation of the Auxiliary Building. This steam release is terminated by the closure of the primary containment isolation valves. Those portions of the Auxiliary Building affected by this steam release are part of harsh environmental zone H10 which is described in section 3.11. Equipment in the Auxiliary Building is unaffected as long as the temperature, as measured on elevation 786' of the Auxiliary Building, remains less than 98 degrees F during the purging evolution. Operation of the system will be administratively controlled to ensure that the system is not used to purge the primary containment with the reactor at power when the temperature on the 786' elevation of the Auxiliary Building is greater than 96 degrees F.

c. All the piping and valves for the primary containment purge system within the drywell, suppression pool chamber areas, and secondary containment up to and including the secondary containment isolation valves are safety related and designed to conform to Seismic Category I requirements.

d. During operations involving inerting, de-inerting and pressure control, only the drywell or suppression chamber purge supply and exhaust isolation valves may be open to prevent the creation of a bypass path between the drywell and suppression chamber.

e. Technical specification SR 3.6.1.3.1 identifies purposes for containment purging as inerting, deinerting, pressure control, ALARA, or air quality considerations for personnel entry and surveillances that require valves to be open, TS 3.6.3.2 provides limitations on the use of inerting and deinerting at power. Therefore, these constraints meet the definition of non-routine purging and no further analysis of purging coincident with a LOCA has been performed.

The only portions of the system required to operate following a LOCA are the primary and secondary containment isolation valves. The primary containment isolation valves are full closed within 10 seconds after a LOCA.

9.4.10.1.2 Power Generation Design Bases

a. The primary containment purge trains are designed to ensure availability of containment environment purging for either Unit 1 or 2.

b. The primary and secondary containment isolation valves, forming part of the primary containment purge system, are designed to function during station abnormal conditions and are designed to conform to Seismic Category I requirements.

c. All the piping for the primary containment purge system within the drywell, suppression pool chamber areas, and secondary containment up to the secondary containment isolation valves is designed to conform to Seismic Category I requirements.

d. The primary containment purge system is designed to purge radioactive contamination from the drywell and suppression pool prior to personnel entry to perform maintenance.

e. The primary containment purge air is induced through prefilters, HEPA filters, charcoal filters, and again through HEPA filters for removal of radioactivity before discharge into the station vent stack.

f. The primary containment purge system provides a means to inert the drywell or suppression chamber.

9.4.10.2 System Description

a. The primary containment purge system is used prior to maintenance to purge the drywell or suppression pool chambers of both Units 1 and 2. The system has the provision to purge the reactor drywell of either unit. By a separate valving scheme, it may also be used to purge all the reactor water cleanup cubicles and other exhaust air from the reactor building.

b. The primary containment purge system is comprised of two full-capacity filter units, mutually interconnected to serve both Units 1 and 2. The filter units are located in the auxiliary building.

c. Each package filter unit consists of a prefilter, charcoal and HEPA filters, and an exhaust fan.

d. Purge air is exhausted through the station vent stack.

e. Isolation valves are provided for all purge penetrations to provide containment isolation during abnormal conditions. Debris screens are provided for all purge penetrations.

f. Controls and instrumentation:

    1. Each exhaust fan is controlled by a control switch located on the main control board of the corresponding Unit 1 and 2. Local handswitches and instruments are provided in a locally mounted control panel.

    2. Instrumentation is provided for monitoring system operating variables during normal station operating conditions. The loss of airflow and differential pressure across the exhaust air filters are annunciated on the main control board.

3. Controls are pneumatic and electric.

9.4.10.3 Safety Evaluation

a. The primary containment purge system is not safety related.

b. All piping within the drywell is designed to conform to Seismic Category I requirements.

c. All containment penetration isolation valves are designed to conform to Seismic Category I requirements.

d. A water deluge nozzle is provided for fire protection of the charcoal filters.

e. A failure analysis is presented in Table 9.4-29.

9.4.10.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system is balanced for the design airflows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation. The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.11 Service Building HVAC System

The service building HVAC system, common to both Units 1 and 2, serves the upper basement and the first and second floors of the service building during normal station operation.

9.4.11.1 Design Bases

The service building HVAC system is comprised of three subsystem. This non-safety-related system is designed to maintain controlled temperature for the comfort of personnel.

9.4.11.1.1 Safety Design Bases

Because the service building HVAC system is not a safety-related system, it has no safety design bases.

9.4.11.1.2 Power Generation Design Bases

a. The service building HVAC system is designed to maintain a quality environment suitable for personnel comfort, health, and safety in the areas served by this system.

b. The system maintains the offices and service areas at approximately 75° F on a year-round basis.

c. All the areas served by this system are provided with a minimum quantity of outside air for ventilation, odor dilution, and to offset exhaust air requirements.

d. The service building HVAC systems operate on a continuous basis during normal plant operating conditions.

9.4.11.2 System Description

a. The service building HVAC system is comprised of three independent subsystems which serve their respective areas as follows:

   1. Service building HVAC system-1: this subsystem serves the second floor of the service building.

   2. Service building HVAC system-2: this subsystem serves the first floor and some second floor areas of the service building.

   3. Service building HVAC system-3: this subsystem serves upper basement and first floor offices of the service building.

b. The schematic diagram of the service building HVAC systems is shown in Figure 9.4-1. Equipment parameters of principle system components are listed in Table 9.4-30.

c. Each service building HVAC system is comprised of an outside air louver, a mixing plenum, a supply air filter, a blow-through type of air handling unit, a hot air duct, a cold air duct, and individual zone mixing boxes. The blow-through type of air handling unit consists of a fan, direct expansion cooling coil in the cold deck, and an electric heating coil in the hot deck.

d. Each service building HVAC system uses dual duct systems for air distribution to the local mixing boxes, where hot and cold air are mixed to meet individual area load demands.

e. Each service building HVAC system has a return air fan which picks up air through a network of return air ducts, and discharges it either to the return air plenum or to the outdoors through the exhaust louvers.

f. Exhaust fans are provided for the toilets and lunch rooms.

g. A positive pressure of approximately 0.1 inch water gauge with respect to the outdoors is maintained inside the offices and other areas served by individual service building HVAC system.

h. The minimum outside air intake provides makeup air for all mechanical exhaust and exfiltration.

i. Two exhaust fans provide ventilation for the service building HVAC equipment room to remove equipment heat by inducing air through outside air intake louvers and then discharging it to outdoors.

j. Each service building HVAC system operates with minimum outside air on the year-round basis. However, provision is made to supply 100% outside air and exhaust it to the atmosphere by manually operating a control switch or by automatic controls.

k. Each service building HVAC system is provided with an independent refrigeration system. Each refrigeration system comprises one full capacity water cooled condensing unit which provides cooling by direct expansion cooling coils installed in the air handling unit.

l. Controls and instrumentation:

   1. System control switches and instruments are mounted on a local control panel.

   2. High-pressure differential across supply air filter and low airflow signals, after the supply air fan and return air fan start, are annunciated on the local control panel.

3. An ionization detector is provided in the return air passage to sound an alarm and isolate the system on detection of products of combustion.

4. Controls are digital, pneumatic and electric.

9.4.11.3 Safety Evaluation

The service building HVAC system is not safety related.

9.4.11.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system was balanced for the design air and water flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations.

9.4.12 Service Building Storeroom Ventilation System

The service building storeroom ventilation system, common to both Units 1 and 2, operates during normal station conditions.

9.4.12.1 Design Bases

The non-safety-related system provides ventilation and limits the minimum temperature to 65° F.

9.4.12.1.1 Safety Design Bases

Since the system is not safety related, it has no safety design bases.

9.4.12.1.2 Power Generation Design Bases

a. The service building storeroom ventilation system operates on a year-round basis during normal plant operating conditions.

b. The system provides a minimum amount of outside air for ventilation purposes and later exhausts this air outdoors.

c. On loss of offsite electric power the system is shut down.

9.4.12.2 System Description

a. The system is of once through design type and consists of outside air intake louvers, supply air filters, electric heating coil, and a supply fan. An exhaust fan discharges air to the atmosphere.

b. The system limits the maximum and minimum temperatures to approximately 104° F and 65° F, respectively. Electric heating coils provide the necessary heat.

c. Controls and instrumentation:

    1. Supply and exhaust fans are controlled by handswitches located on a local control panel.

    2. Controls are pneumatic and electric.

9.4.12.3 Safety Evaluation

The service building storeroom ventilation system is not safety related.

9.4.12.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system was balanced for the design airflows and system operating temperatures and pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations and station practices.

9.4.13 Interim Radwaste Storage Facility Ventilation System

9.4.13.1 Design Bases

The Interim Radwaste Storage Facility HVAC system is comprised of three subsystems. This non-safety-related system is designed to maintain temperature within the facility for storage of radwaste, control and mechanical equipment ventilation; and limits the minimum IRSF temperature to 50° F.

9.4.13.1.1 Safety Design Bases

Because the IRSF HVAC is not a safety-related system it has non safety design bases.

9.4.13.1.2 Power Generation Design Bases

a. The IRSF HVAC system is designed to maintain a quality environment suitable for personnel comfort, health, and safety in the areas served by this system.

b. The system is designed to maintain the control room at 75° F nominal; the equipment room at 70-120° F; and the storage area/truck bay at 50-120° F.

c. All areas served by this system are provided with a minimum quantity of outside air for ventilation, and to offset exhaust air requirements.

d. The IRSF HVAC systems operate on a continuous basis during normal plant operating conditions.

9.4.13.2 System Description

a. The IRSF HVAC system is comprised of three independent subsystems which service their respective areas as follows:

    1. Storage area/truck bay system - 1(HV-1); this subsystem serves the IRSF radwaste storage area and the truck bay.

    2. Control room system -2(AC-1); this subsystem serves the IRSF control room.

    3. Equipment Room System - 3 (EF-2); this subsystem serves the IRSF equipment room.

b. Deleted.

c. The IRSF system is designed to function with variable quantities of outside air intake, from maximum recycle to 100% outside air intake.

d. Deleted.

e. Deleted.

f. The IRSF equipment room is provided with a roof-top exhaust fan (EF-2) to remove equipment heat by inducing air through outside air intake louvers and then discharging it to outdoors.

g. The IRSF storage area has a perimeter distribution/central return ductwork arrangement.

h. The IRSF storage area/truck bay is heated with a combination of the electrical heater in the HV-1 air handler and electrical duct heater DH-1. Additional fan-forced electrical unit heaters are supplied in the truck bay for local area heating.

i. The IRSF control room is heated with electrical duct heater DH-2.

j. The IRSF equipment room is heated with fan-forced electric unit heaters.

k. Controls and Instrumentation

    1. Temperature is controlled by electric type thermostats with local display.

    2. Consistent with the ALARA principle, all IRSF HVAC equipment and controls are located in accessible locations outside of the storage area for servicing.

    3. An ionization-type detector is provided in each return air passage of the IRSF Storage Area/Truck Bay and Control Room systems.

9.4.13.3 Safety Evaluation

The IRSF HVAC system is not safety related.

9.4.13.4 Inspection and Testing

All equipment was factory inspected and tested in accordance with the applicable equipment specifications and codes. System ductwork and erection of equipment were inspected during various construction stages. Preoperational tests were performed on all mechanical components and the system was balanced for the design air flows and system operating pressures. Controls, interlocks, and safety devices on each system were cold checked, adjusted, and tested to ensure the proper sequence of operation.

The maintenance is performed on a basis generally in accordance with the equipment manufacturer's recommendations.

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TABLE 9.4-2
CONTROL ROOM HVAC SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply or return fans	Failure of fan resulting in loss of supply air or return airflow	*Should an operating fan fail, resultant loss of duct pressure actuates alarm, operator manually starts standby fan and refrigeration unit.
Refrigeration unit	Failure of refrigeration resulting in loss of cooling capacity	Following loss of refrigeration unit visual and audible alarms are annunciated in the main control room. Defective unit would be manually shutdown; stand by air-handling and refrigeration unit, fans started.
Supply air filter unit	High-pressure drop due to heavy particulate loading	*Pressure differential switch trips causing visual and audible alarm in the main control room. Standby air handling units, fans and refrigeration unit manually started.
Radiation monitor in outside air duct	Failure resulting in loss of radiation monitoring capability, low scale trip	Visual and audible alarms are annunciated on failure of radiation monitoring capability. Redundant radiation monitors are activated.

*A 20-minute time delay for operator action to start the redundant HVAC train has been credited within the operator dose calculation. The calculation demonstrates that 10 CFR 50.67 dose limits are maintained

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TABLE 9.4-4

AUXILIARY ELECTRIC EQUIPMENT ROOM HVAC SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply or return fans	Failure of fan resulting in loss of supply or return airflow	*Should an operating fan fail, resultant loss of duct pressure actuates alarm. Operator shuts down other working components manually and starts standby system
Refrigeration unit	Failure of refrigeration resulting in loss of cooling capacity	Following loss of refrigeration unit visual and audible alarms are annunciated. Defective and other working components of this system would be manually shutdown and standby system started
Supply air filter unit	High pressure drop due to heavy particulate loading	*Pressure differential switch trips causing visual and audible alarm. Operator shuts down this system and starts standby system manually
Radiation monitor in outside air duct	Failure resulting in loss of radiation monitoring capability, low scale trip	Visual and audible alarms are annunciated on failure of radiation monitoring capability. Redundant radiation monitors are activated

*No AEER filtration has been credited within the operator dose calculation. The calculation demonstrates that 10 CFR 50.67 dose limits are maintained.

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TABLE 9.4-6
(SHEET 1 OF 2)

REACTOR BUILDING VENTILATION SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply or exhaust fan	Failure of a fan resulting in loss of duct pressure	Should an operating fan fail, the resultant loss of velocity pressure will trip a pressure differential switch across an air flow element actuating an alarm in the main control room. A redundant fan will be remote manually started from the main control room.
	Total loss of system airflow due to power failure	Pressure control dampers employed between clean and potentially contaminated areas are of the backflow type and fail closed. This minimizes the backflow of contaminated air to clean areas in the case of a loss of electric power and subsequent fan system shutdown.
Flow control damper on main supply	Fail closed	Low flow is detected by pressure switch on duct-mounted airflow element and alarmed in main control room. Supply fans will be manually shut down and an exhaust fan allowed to operate to maintain building negative pressure.
	Fail open causing possible loss of building pressure control	Low reactor building pressure differential pressure switch causes alarm in main control room.
Main steam tunnel airflow check dampers	Failure to close	These dampers close in response to airflow exiting the steam tunnel without any external assistance or signal. Their construction is such that there is no mechanical mechanism that can prevent closure of the damper plates when exposed to the large pipe break forces. This design combined with periodic inspections and/or testing ensures that this is not a credible failure mode for these components.
Exhaust air duct pressure relief damper	Failure to open	This damper opens in response to increasing pressure in the exhaust air duct without any external assistance or signal. Its construction is such that there is no mechanical mechanism that can prevent opening of the damper plates when exposed to the large pipe break forces. This design combined with periodic inspections and/or testing ensures that this is not a credible failure mode for this component.

TABLE 9.4-6
(SHEET 2 OF 2)

COMPONENT	MALFUNCTION	COMMENTS
Exhaust air duct excess flow check damper	Failure to close	These dampers close in response to increased flow in the exhaust air duct without any external assistance or signal. Their construction is such that there is no mechanical mechanism that can prevent closure of the damper plates when exposed to the large pipe break forces. This design combined with periodic inspections and/or testing ensures that this is not a credible failure mode for these components.

TABLE 9.4-7

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TABLE 9.4-8

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TABLE 9.4-9

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TABLE 9.4-10

AUXILIARY BUILDING LABORATORY HVAC SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Make up Air Supply Fan	Failure of supply fan, resulting in loss of airflow.	Airflow switch gives alarm on loss of supply air. The redundant fan is started.
Supply Fan	Failure of supply fan, resulting in loss of airflow.	Airflow switch gives alarm on the local control board.
Supply Air or Make up Air Filters	High pressure drop across filters.	High differential pressure across filters is alarmed.

TABLE 9.4-11

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TABLE 9.4-12

RADWASTE AREA VENTILATION SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply or Exhaust Fans	Failure of fan resulting in loss of supply air or exhaust airflow	Loss of duct pressure actuates alarm. Operator manually starts the standby fan.
Exhaust Air Filter Units	High differential pressure across filters	High differential pressure gives alarm. Operator shuts down that system; starts standby system.
Evaporative Cooler Circulating Pump	Failure of circulating pump	Operator starts the standby circulating pump.
Booster Fan	Failure of booster fan	Operator starts standby booster fan.

TABLE 9.4-13

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TABLE 9.4-14

TURBINE BUILDING AREA VENTILATION SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply or exhaust fan	Failure of fan resulting in loss of supply and exhaust airflow	Should an operating fan fail the resultant loss of velocity pressure will trip a pressure differential switch across an airflow element actuating an alarm in the main control room. A redundant fan will be manually started from the main control room.
	Total loss of system airflow due to power failure	Pressure control dampers employed between clean and potentially contaminated areas are of the backflow type and fail closed. This minimizes the backflow of contaminated air to clean areas in the case of a loss of electric power and subsequent fan system shutdown.
Flow control damper on main supply	Fail closed	Low flow is detected by pressure switch on duct mounted airflow element and alarmed in main control room.
	Fail open causing possible loss of building pressure control	Low turbine building pressure differential pressure switch causes alarm in main control room.

TABLE 9.4-15

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TABLE 9.4-16

DIESEL-GENERATOR FACILITIES VENTILATION SYSTEM

FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Ventilation Fans	Failure of a ventilation fan resulting in high temperatures.	Failure of any ventilation fan to start with the corresponding diesel generator is alarmed on high temperature. The ventilation system may be manually shutdown. The operator may continue to operate the corresponding diesel generator/system in accordance with the Technical Specification/Technical Requirement Manual or may start the redundant diesel generator/system. Full redundancy exists via redundant diesel generator/systems and supporting auxiliary systems.
Supply Air Filters	High pressure drop across supply air filters.	Pressure differential switch alarms. The ventilation system may be manually shutdown. The operator may continue to operate the corresponding diesel generator/system in accordance with the Technical Specification/Technical Requirement Manual or may start the redundant diesel generator/system. Full redundancy exists via redundant diesel generator/systems and supporting auxiliary systems.

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TABLE 9.4-18

SWITCHGEAR HEAT REMOVAL SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Ventilation Fans	Failure of supply fans resulting in loss of airflow.	On loss of airflow, an air flow switch gives an alarm. (SWGR recovery fans are abandoned-in-place)
Supply Air Filters	High-pressure drop across supply air filters.	High differential pressure switch causes alarm.

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TABLE 9.4-20

ECCS EQUIPMENT AREAS COOLING SYSTEM

FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Air Circulating Fans	Failure of any air circulating fan, resulting in high temperatures.	Failure of any fan to start with the corresponding ECCS pump is alarmed on high temperature. The operator may continue to operate the corresponding ECCS equipment or system or may start the redundant ECCS equipment or system depending on current plant conditions, (e.g. if needed for maintaining core cooling). Full redundancy exists.
Cooling Coils	Failure of any cooling coil resulting in high temperatures.	Air leaving the cooling coils with high temperature is alarmed. The operator may continue to operate the corresponding ECCS equipment or system or may start the redundant ECCS equipment or system depending on current plant conditions, (e.g. if needed for maintaining core cooling). Full redundancy exists.

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TABLE 9.4-23

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TABLE 9.4-24

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TABLE 9.4-25

OFF-GAS BUILDING HVAC SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Supply Fan or Exhaust Fan	Failure of supply or exhaust fans, resulting in a loss of airflow flow.	Air flow switch causes alarm on loss of airflow. The system is manually shut down; the standby system is started.
Supply or Exhaust Air Filters	High pressure drop across filters	High pressure differential is alarmed. The operator shuts down the system and starts the standby system.

TABLE 9.4-26

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TABLE 9.4-27

PRIMARY CONTAINMENT HVAC SYSTEM

COMPONENT	FAILURE ANALYSIS MALFUNCTION	COMMENTS
a) One Train Operation*:		
Supply Air Fan in Fan-Coil Unit	Failure of supply air fan resulting in loss of supply airflow.	Failure of supply fan causes alarm. Operator starts the redundant fan-coil unit.
Chilled Water Pump	Failure of chilled water pump resulting in loss of chilled water flow.	Failure of chilled water pump causes alarm. Operator starts redundant pump.
Chiller	Loss of Chiller.	Failure of chiller causes alarm. Operator starts the 550 ton standby chiller.
Area Cooler Fan	Fan failure results in partial loss of upper drywell cooling.	Failure of area cooler fan causes alarm. Operator starts fan in standby area cooler.
b) Two Train Operation**:		
Supply Air Fan in Fan-Coil Unit	Failure of supply air fan resulting in loss of supply airflow.	Failure of supply fan causes alarm.
Chilled Water Pump	Failure of chilled water pump resulting in loss of chilled water flow.	Failure of chilled water pump causes alarm. Operator starts redundant pump.
Chiller	Loss of chiller.	Failure of chiller causes alarm. Operator starts the standby chiller.
Area Cooler Fan	Fan failure results in partial loss of upper drywell cooling.	Failure of area cooler fan causes alarm. Operator starts fan in standby area cooler.

* Includes one fan-coil unit, five area coolers, one chilled water pump, and either one or two chillers.

** Includes two fan-coil units, five area coolers, one chilled water pump, and two chillers.

TABLE 9.4-28

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TABLE 9.4-29

PRIMARY CONTAINMENT PURGE

SYSTEM FAILURE ANALYSIS

COMPONENT	MALFUNCTION	COMMENTS
Purge Fan	Failure of purge fan resulting in loss of airflow	The failure of the purge fan is alarmed. Operator starts the redundant system.
Filter Units	High differential pressure across any filter bank	High differential pressure across any filter bank causes alarm. The operator shuts down the system and starts the standby system.
	Total loss of system airflow due to power failure	Pressure control dampers are the fail closed type. The dampers close on power failure so that leakage of contaminated air is minimized.

TABLE 9.4-30

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TABLE 9.4-31

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9.5 OTHER AUXILIARY SYSTEMS

9.5.1 Fire Protection System

The purpose of the fire protection system is as follows:

a. to prevent a fire from starting by use of fire resistant materials and by minimizing combustibles,

b. to quickly detect any fires; annunciating locally and in the control room,

c. to quickly suppress a fire in hazard areas by use of automatic fire protection equipment,

d. to prevent the spread of a fire by use of fire barriers between hazards,

e. to minimize the size of a fire and limit its damage, and

f. to provide fire fighting capability for manual fire extinguishment.

9.5.1.1 Design Bases

9.5.1.1.1 Identification of Fires

Appendix H to this document contains a detailed fire hazards analysis for the various design-basis fires.

9.5.1.1.2 Fire Characteristics

A detailed analysis of the fire potential in each fire zone of the station is included in Appendix H of this document. Also included is a discussion of materials used within the plant. A listing of combustible materials present is provided in Table H.3-2. Figure 9.5-1 shows the pertinent features relating to fire protection at LSCS, including the location of fire walls, major combustible hazards, safety-related equipment, and fire protection equipment. Figure 9.5-1a shows the locations of cable trays containing safety-related cables.

The maximum potential for fire affecting safety-related equipment is in the emergency diesel room, diesel day tank room, and diesel fuel storage room. A rupture of a high-pressure core spray (HPCS) diesel-generator day tank, the emergency diesel-generator day tank, or the main fuel lines to these diesels could release 1700 gallons or 750 gallons respectively of #2 diesel fuel. In the rooms below each emergency diesel are diesel fuel storage tanks with capacities of 34,000 and 40,000 gallons for the HPCS diesels and emergency diesel generators, respectively. Should a rupture occur, a high energy source of ignition at the floor level would have to be present to ignite this fuel. The potential for the affecting safety-related equipment is discussed in Appendix H of this document.

Each day tank room and storage tank room is provided with an automatic sprinkler system. These rooms are separated from each other and the plant by a 3-hour rated fire enclosure. Likewise, automatic low-pressure CO_2 fire extinguishing systems and 3-hour rated fire barriers are provided for each of the five diesel rooms. A sprinkler alarm or CO_2 actuation alarm, locally and in the control room, would bring Fire Brigade personnel to contain the fire within the time frame of the confinement rating. Adjacent to these rooms are emergency fire hose stations containing sufficient hose for manual fire fighting purposes.

Areas with hydraulic oils are not considered significant because these oils are of limited volumes and/or characteristically fire resistant (FYRQUEL). For example, the two hydraulic oil reservoirs on the recirculation pump control valve systems are located on elevation 761 feet of the secondary containment at quadrants 90° and 270°, respectively. This area is not normally occupied; nor is smoke and toxic contaminant removal an immediate concern. The potential for a fire is minimized through the use of fire resistant materials and hydraulic oils having a fire point in excess of 600° F per ASTM D-992-56. Cables and wiring are specified as fire-resistant cable and meet the standards of IEEE-383 (see cable routing criteria 8.3.1.4.2.2). Table 9.5-1 and H.3-2 list the combustibles used at LaSalle County Station. Piping in Fire Zone 5A3 for lubricating oil from the turbine oil tank package to the turbine is guarded with double-walled pipe to preclude oil leakages in the areas of steam pipes.

9.5.1.1.3 Facility Features

The Seismic Category I safety-related structures are of reinforced concrete construction with the exception of the steel superstructure above the refueling floor in the reactor building.

Due to structural or shielding requirements, many walls have a fire rating in excess of 3 hours. Other concrete walls have at least a 3- or 2-hour rating. Nonconcrete walls in the facility generally have at least a 2-hour fire rating. All openings through walls have door ratings which are consistent with required wall ratings. See Appendix H for a detailed description of the fire zone boundary walls.

Electrical cabling is suitably rated and cable tray loadings are designed to minimize internal heat buildup. Cable trays, generally filled to 50% of capacity, are suitably separated to avoid loss of redundant channels of safety-related cabling should fires occur. Piping and cable tray penetrations are provided with fire stops to preserve the fire rating of the walls that are penetrated. The arrangement of equipment in protection channels assigned to separate cabinets provides physical separation and minimizes the effect of a possible fire. Electrical system design is discussed in Chapter 8.0.

Equipment and building drains minimize accumulation of combustible substances from small persistent oil leaks. Drainage in the diesel buildings is to the diesel building sumps. Drainage in potentially radioactive areas is to the radwaste sump system outside of the diesel building. Drainage in the noncontaminated areas is piped to the oil separators or fire sumps for disposal.

Drainage is provided for all areas protected by water spray type fire protection to prevent the spread of combustible liquids.

Automatically actuating hatch type smoke and heat vents are provided in the turbine building roof at a ratio of 1 square foot of venting for every 100 ft of floor area. Smoke and heat venting is provided for in other plant areas by the ventilation systems.

The following areas are separated by 3-hour fire rated floors/ceilings, walls, and doors in accordance to Nuclear Electric Insurance Limited Property Loss Prevention Standards (see Figure 9.5-1 and Appendix H for details):

a. turbine building,

b. reactor buildings,

c. auxiliary building,

d. radwaste building,

e. diesel-generator buildings, and

f. off-gas filter building.

The station layout was arranged to isolate safety-related systems from unacceptable fire hazards. This is accomplished by either distance or a barrier. The safety-related systems are divisionally separated both mechanically and electrically. Safety-related pumps are located in separate cubicles. Hazardous material in these areas is kept as low as practical.

The reactor building has a low combustible loading throughout. No flammable materials are stored in this area, and the presence of lube oil has been minimized. The fire loading in this area is due primarily to cabling. The effects of the hazards are reduced by physical separation of cabling divisions (see Figure 9.5-1a).

In the diesel-generator building, items of safety-related equipment are physically separated (by division) from each other and from the oil tank rooms by minimum 3-hour rated fire barriers. Additional protection from fire is obtained by the use of automatic suppression systems. For a detailed analysis of the potential effects of fire hazards on safety-related systems, see Appendix H.

Reactor Unit 1 and reactor Unit 2 have separate cable spreading rooms. The Division 1 cables are spread over the control room panels and feed into the control cabinets from the top. The Division 2 cables are run in the cable spreading rooms under the control room and feed into the control cabinets from the bottom. The Unit 1 and 2 cable spreading rooms are isolated from each other and other areas of the plant by barriers having a 3-hour fire rating. The only barrier which is an exception is the floor slab, which has a 3-hour rating from an internal source and a 2-hour rating from an external source. The rooms below which could provide the external source each have a combustible loading equivalent to a fire severity of less than 2 hours. Therefore, the structural steel supporting the floor was provided with only 2-hour protection.

The majority of interior components used in construction are either noncombustible or treated to be fire-retardant. Not all materials used as interior finishes have been tested for flame spread, fuel contribution, and smoke density; those which have been tested are below the limits of 25. Exceptions are the vinyl base, vinyl asbestos tile, and the silicone foam sealant. Ratings for vinyl base and vinyl asbestos tile are flame spread, 30, fuel contribution, 0, and smoke developed, 50. In some instances the materials being used have no available test data. Use of those materials is believed to be very trivial and cannot contribute significantly to the fire loading. For fire hazard analysis purposes, interior/floor coverings and coatings are considered non-combustible if the material has a structural base of noncombustible material, with a nominal depth not over 1/8-inch thick, and has a flame spread rating not higher than 50 as defined by ASTM E-84. Fire Protection engineering evaluates exceptions to these guidelines for acceptability on a case-by-case basis using the NEIL criteria for interior/floor coverings and coatings.

A UL Class A roofing system is used. The roof assembly meets the requirements of Factory Mutual Class I system except that the purlin spacing exceeds Factory Mutual specification for decking spans and the perimeter of the roof insulation is not mechanically fastened to the deck.

The suspended ceilings are of negligible combustibility (acoustical tile in rooms 299, 300, 401, 404, 405, 406, 406A, 409, 410, 411, 412, 414, 417, 423, and 426 – flame spread, 0, smoke developed, 0; acoustical ceiling panels in auxiliary buiding rooms 419, 420, 421, 422, and 430 – flame spread, 25, and smoke developed, 50; all other acoustical tile - flame spread, 15, fuel contribution, 15, and smoke developed, 5; cement plaster - flame spread, 5, fuel contribution, 0, smoke developed, 0) and the supports are noncombustible. In the area above the laboratories in the auxiliary building where there are concentrations of cabling above the suspended ceiling, an automatic water spray system has been provided for the cable trays.

High-voltage, high-amperage transformers installed inside buildings containing safety-related systems are of the dry type.

The unit and systems auxiliary transformers are located within 50 feet of the turbine building, diesel-generator building, and reactor building. The walls of the reactor building which are within 50 feet of the transformers have no structural openings. The diesel-generator building has two openings within 50 feet of the transformers. One is a UL labeled "A" fire door, and the other is an intake louver located at elevation 736 feet 6 inches on the HVAC equipment floor. There is a block barrier separating the intake louvers and the transformers.

A drainage system is provided throughout the station. Automatic sprinkler protection is provided over the turbine building fire sumps and oil separators. Drainage which is potentially radioactive goes to the liquid radwaste area, where it is analyzed and processed. Electrical equipment is normally mounted flush with the floor for equipment removal purposes, but the base of the electrical cabinets usually provides 6 inches of floor clearance to electrical components.

The functions of the plant do not always make it possible to enclose separate fire zones by minimum 3-hour fire barriers. Some features which compromise the 3-hour barriers are open stairways and openings in the slabs for equipment operation or removal. In these instances the fire loading was examined, and it was determined that, due to the low fire loadings, propagation would not occur.

Deficiencies in the fire barriers have been identified where they exist. In areas where high loading exists in conjunction with inadequate barriers, automatic suppression systems have been installed. Fire barrier penetrations by conduit and piping are sealed with silicone foam sealant, grout or ceramic fiber. Fire barrier penetrations by electrical cable risers and cable trays are sealed with CT Gypsum or another suitable fire barrier penetration sealant. Penetrations through fire barriers for the ventilation system are equipped with fire dampers. Fire dampers are not provided in the ducts penetrating through 3-hour rated wall separating the reactor and auxiliary buildings as malfunction of the fire damper will disrupt the entire reactor building ventilation. These ducts, however, are provided with isolation dampers in series, whose construction (3/8 inch thick steel plate) is more sturdy than 3-hour rated fire dampers. Fire dampers are not provided in the turbine building air riser shaft.

The fire rated doors will be inspected in accordance with Station procedures. The doors are provided with self-closing mechanisms. Those fire rated doors which also serve as security-related doors are on the controlled access system. An alarm will annunciate in the central alarm station if the security door does not close after a specified time period.

9.5.1.1.4 Seismic Design Criteria

The fire protection system is not an engineered safety feature and as such is non-Seismic Category I. The water filled fire protection piping is classified as moderate energy. Appendix J discusses Moderate Energy Line Breaks (MELB).

9.5.1.1.5 Applicable Regulations, Codes, and Standards

a. 29 CFR 1910 - Occupational Safety and Health Standards,

b. 29 CFR 1926 - Safety and Health Regulations for Construction,

c. 10 CFR Part 50 - Fire Protection

d. Applicable National Fire Protection Association - National Fire Codes

e. Nuclear Electric Insurance Limited - Property Loss Prevention Standards For Nuclear Power Generating Stations, and

f. American Society for Testing Materials - D992-56 Classification of Flammability Standards.

9.5.1.2 System Description

9.5.1.2.1 General

The fire protection water distribution system is capable of supplying cooling lake water to the plant fire hydrants, the water sprinkler and deluge systems, and the hose valve stations under all conditions. The system is normally kept pressurized by one of two fire protection jockey pumps. Each pump has a 75 gpm capacity at a minimum total developed head of 370 feet. They are only used for system pressurization. If a system demand occurs, the intermediate pump is automatically activated. This pump has a 225 GPM capacity at a minimum total developed head of 370 feet. If the system demand exceeds the capacity of this pump the pressure decreases in the fire protection system, thereby automatically starting a diesel fire pump. If system demand is in excess of the capability of a single fire pump or if there is a pump failure, the second fire pump will engage automatically. Each fire pump has a capacity of 2500 gpm at 315 feet total developed head. The sizing basis for the fire pumps was NEIL standards, which assume one pump out of service, a break in the shortest pipe run, and the largest sprinkler system operating plus 500 gpm for fire hoses.

The controllers for these fire pumps are located in the fire pump rooms. They annunciate locally and in the control room the following conditions:

a. pump is running;

b. controller main switch is in the "Off" or "Manual" position; and

c. trouble exists on the engine or controller.

Following an automatic start, the engine can be shut down only by the local control panel pushbutton or by the emergency shutdown devices which operate only to prevent destruction of the engine. This installation conforms to NFPA 20, "Standard for the Installation of Centrifugal Fire Pumps."

The fire pumps take suction from the seismically designed water tunnel in the lake screen house. This tunnel has multiple intakes from the LSCS cooling lake. A failure in the fire protection system could not affect the ultimate heat sink. Both diesel-driven fire pumps are located in the lake screen house and take suction directly from the water tunnel. The diesel-driven fire pumps are located at opposite ends of the lake screen house in rooms enclosed by 3-hour fire enclosures and are protected by automatic sprinkler systems which alarm in the control room upon actuation. As a backup to the diesel driven fire pumps, water can be supplied from the service water system.

The fire hydrant system is supplied by separate header connections to each of the two fire pumps. The system consists of a 14 inch ring header surrounding the main buildings with strategic placement of the fire hydrants, located no more than 250 feet apart.

The common yard loop is sectionalized, permitting independence of each unit if desired. The underground piping consists of welded carbon steel piping buried below the frost line. If tuberculation deposits significantly reduce water pressure, a chemical flush of this piping can be performed through existing test connections. The lateral to each hydrant can be isolated by a key-operated valve, and a section of the loop can be isolated by a post-indicating valve (Drawing No. M-71).

Each fire hydrant has an associated hose house containing the following equipment:

a. 200 feet of 1-1/2-inch woven jacket lined hose,

b. two approved 1-1/2-inch adjustable spray nozzles,

c. two universal spanners,

d. two 2-1/2-inch to 1-1/2-inch adapters; and

e. one hydrant wrench.

The threads on all fire protection equipment are compatible with the local fire department equipment.

Multiple headers from the outside fire loop are brought into the building complex to feed the standpipe and sprinkler systems. Sprinkler systems can be isolated by an electrically supervised gate valve that will alarm in the auxiliary electric equipment room and the control room; all other major valves are locked open.

Actuation of any sprinkler deluge or pre-action system causes an alarm to sound locally and in the control room. Sprinkler systems are designed to NFPA 13 and fixed water spray systems to NFPA 15 (pre-action systems have closed heads). The design basis of these systems are discussed in “The Evaluation of the LaSalle County Station Fire Protection Water Distribution and Standpipe System Report.”

Interior manual hoses, which act as a backup to the automatic suppression systems, can serve all areas of the plant except portions of the steam and radwaste pipe tunnels and the primary containments. The pipe tunnels do not contain combustibles. The primary containment normally has hoses brought in during maintenance outages. It also has a containment spray system that can be used as a deluge system. The design of the standpipe system follows NFPA 14. The fire hose nozzles provided are adjustable nozzles suitable for either Class A, B, or C fires.

Nineteen carbon dioxide hose reels, seventeen with 100 feet of hose, two with 50 feet of hose are provided. CO_2 is supplied from a 10-ton refrigerated cryogenic storage vessel.

Portable fire extinguishers have been provided throughout the station in accordance with NFPA 10, with the exception of portions of the radwaste tunnel, the two steam tunnels, and primary containments. These areas are not normally occupied, contain little or no combustible material, and will have portable extinguishers brought in during maintenance periods. Consideration was given to the nature of the fire hazard and equipment in locating the number and type of extinguishers.

The fire detection system is designed to NFPA 72E. The detectors are electrically supervised and upon detection of a fire annunciate locally and in the control room. The fire detection system is normally powered from 120 Vac with automatic transfer to 125 Vdc on loss of power via inverters. The IRSF fire detection system will be normally powered from 120 Vac with automatic transfer to self-contained battery backup upon loss of power.

Where Halon 1301 Systems are utilized, the installation is in accordance with NFPA 12A. Halon 1301 use has been limited to two zones in the station (computer room in the south (new) service building and QA archives in the north (old) service building. The records storage building, separate from the station building, also utilizes a Halon 1301 system because of potential toxicity, decomposition, and particular soak time requirements. Audible and visual predischarge alarms and dead-man-type abort switches are provided. Where Halon 1301 systems are installed, double shot protection is provided.

Carbon dioxide flooding systems are provided for the five diesel-generator rooms and for the turbine-generator alternator exciters. Audible and visual predischarge alarms warn that the CO_2 flooding system is about to actuate so that personnel may leave the area. Manual actuation switches are provided. Actuation of either a

Halon 1301 or CO_2 flooding system automatically shuts down the local fans and closes local dampers. To prevent tampering, electrical and mechanical supervision is provided for the CO_2 flooding system actuation pilot valves.

9.5.1.2.2 Fire Protection For Areas Containing Safety-Related Equipment

The control room and the other areas of high cable concentration (both safety and non-safety-related) are provided with ionization detection equipment. Local hand held extinguishers are provided for these areas in conjunction with adjacent carbon dioxide and water hose reel stations.

The control room is surrounded on all sides by 3 hour rated fire barriers. The ionization detectors are located in the room and in the outlet plenum of the consoles to detect an incipient fire. Cables are not concealed in floor or ceiling spaces. Emergency air breathing apparatus is also provided in the control room.

A fixed, automatic extinguishing system is not supplied for the control room because the habitability of this room must be maintained in order to preclude evacuation. Fire protection is accomplished by a combination of good housekeeping, fire resistant cables, fire detection equipment, and hand held fire extinguishing equipment.

The cable spreading rooms, the diesel generator corridors, central file (in South Service Building) and the concealed cable space over the laboratories for LaSalle County Station are each equipped with automatic preaction sprinkler systems actuated by ionization detectors. Ionization detectors are installed on the ceilings. These detectors are sensitive enough to alarm at the very inception of a fire when combustion products are first being released. Actuation of one ionization detector causes an alarm locally and in the control room and trips the deluge valve, filling the system with water.

Preaction sprinkler heads are located adjacent to each cable tray. A heat source is then required for the sprinkler head to actuate and flood the tray. This system is also air supervised; and damage to the system or actuation of a sprinkler head actuates an alarm both in the auxiliary electric equipment room (AEER) and in the control room. If for some reason the ionization detection system was not in service or failed to function, the heat of a fire would cause a supervisory alarm and the deluge valve could be manually opened.

The preaction system is electrically supervised and alarms both locally and in the control room upon a failure. If there is a fire and the detectors do not function for any reason, the melting of the fusible links energizes an alarm both in the AEER and in the control room by releasing the supervisory air pressure maintained in the dry pipe.

An automatic carbon dioxide (CO_2) total flooding extended discharge system is provided for each of the five diesel generator rooms. Each system is activated by a fixed temperature rise detector system. Manual activation is also provided. CO_2 release is delayed and an audible alarm sounded to allow personnel who may be in these rooms ample time to escape. The diesel generator rooms have independent ventilation systems, with no cross connection to other diesel generator systems. These ventilation systems are of the once through type, therefore, auxiliary smoke removal systems are not needed. The activation of the CO_2 system automatically stops the ventilation system fans and closes the electro-thermal link fire dampers. The CO_2 system may also be manually actuated from either of two pushbutton stations for each diesel generator room. Automatic or manual actuation of the CO_2 system automatically sounds an alarm in the control room and in the vicinity of the hazard area. A wet standpipe hose reel is provided outside the main entrance of the diesel generator rooms to supply backup protection.

The diesel generator day tank rooms and oil storage tank rooms are separate from each other and from the diesel generator rooms by 3 hour rated fire barriers. The day tank and storage tank rooms are each protected by ordinary hazard automatic sprinkler protection. Each enclosure is ventilated to outside the building to prevent accumulation of oil fumes. Curbing and drains are provided to contain the oil in the unlikely event of a tank rupture. Manual fire hoses and portable fire extinguishers are provided as backups.

The auxiliary electric equipment rooms are provided with an electrically supervised low voltage ionization detection system, which alarms in the control room upon system detection. Locally mounted fire hoses, CO_2 hose reels, and portable fire extinguishers are provided for fire suppression. There is no provision for automatic fire suppression in this area.

The primary containment fire protection consists of the containment spray system that can act as a deluge system, automatic fire detection, fire hoses and portable fire extinguishers (which can be brought in during maintenance periods), and fire walls. The fire loading in the primary containment is due to cable insulation and lube oil in the recirculation pumps.

Fire detection is provided in the secondary containment in areas of high cable concentration. Other than cable insulation, the amount of combustibles in the secondary containment is limited to charcoal filters, ventilation seals, gaskets, some pump lubrication oil and some maintenance materials. Charcoal filters contain temperature detectors that alarm in the control room and remote (and local) manually actuated deluge systems. Hydraulic fluid used for the electrohydraulic control systems is fire resistant.

Safety-related pumps and heat exchangers are located in cubicles in the basement of the reactor building. These cubicles are separated from each other by 48-inch concrete walls and by distance. Each cubicle has its own safety-related ventilation system. The fire hazard analysis in Appendix H demonstrates that a fire cannot affect more than one cubicle leaving redundant systems unaffected; therefore automatic protection is not provided.

Manual fire hose protection and portable fire extinguishers are provided near the spent fuel pool and new fuel storage vault. The refuel floor contains an automatic ultraviolet detection system which alarms in the control room upon system actuation or trouble. A floor drain is provided to prevent accumulation of water in the new fuel storage vault.

Battery rooms are enclosed by 3-hour fire rated barriers and all safety-related battery rooms contain automatic fire detection systems. Ventilation systems in battery rooms are once-through types; the fan sizing is sufficient to prevent hydrogen buildup. Water and CO_2 hose reels and portable fire extinguishers are provided.

The bulk hydrogen storage facility, oriented parallel to the radwaste building, is located approximately 100 feet west of that building. The 20,000 gallon bulk liquid hydrogen facility for the HWC system is located approximately 2012 feet northwest of the nearest safety related structure (Unit 2 Diesel Generator Building. An 11,000 gallon bulk liquid oxygen facility, used in the past to supply the HWC system, and located approximately 680 feet northwest of the nearest safety related air intake (Unit 2 Diesel Generator Supply), has been abandoned in place or removed. There are no safety-related water tanks or cooling towers to protect.

Portable CO_2 fire extinguishers and/or dry chemical extinguishers are provided throughout the station.

Building steel is fire protected in the diesel-generator buildings and the auxiliary building. The reactor building is primarily structural reinforced concrete construction. The various buildings are separated by 3-hour fire walls.

9.5.1.2.2.1 Control Room Carpeting

The following summary of qualifications of the control room carpeting is recorded to indicate the design measures taken to control the combustibility in this vital area:

Manufacturer:	Milliken Carpet
Type:	P/2903; P/6380

The qualification tests for fire ignition, fire propagation, and smoke generation are summarized below, along with the obtained results:

a. Radiant Panel Test (ASTM E648)

Class 1 > .45 Watts/CM^2 Critical Radiant Flux required.

Result: 0.54 Watts/CM^2 Critical Radiant Flux (P/2903)
0.50 Watts/CM^2 Critical Radiant Flux (P/6380)

b. Ignition Test

Pill Test (Dept. of Commerce FF1-70) which is the ignition of explosive charge in contact with carpet.

Result: Self-Extinguishing (P/2903 and P/6380)

c. Smoke Development Rating (ASTM E662)

Standard of 450 or less.

Result:	While flaming –	399 (P/2903) 278 (P/6380)
	Non flaming –	154 (P/2903) 150 (P/6380)

The conclusion is that the control room carpeting does not constitute a fire propagation path, and that it does not ignite but rather is self-extinguishing upon removal of the source of intense flame.

9.5.1.2.3 Fire Protection For Power-Generation Equipment Areas

Separate individual automatic water deluge systems are used to protect the main power transformers, system auxiliary transformers, unit auxiliary transformers, hydrogen seal oil units, turbine bearings (preaction), turbine oil tank package areas, cable spreading rooms (preaction), diesel generator corridors (preaction), central file (preaction) and the cables over the laboratory area (preaction). Manual deluge systems are provided for the charcoal adsorbers in the standby gas treatment system, control room emergency makeup filters, auxiliary electric room supply air filters, primary containment purge air filters, TSC filters, HRSS filters, and control room supply air filters. Manual charcoal deluge valves are operated locally (The normally manual closed isolation valves upstream of the deluge valve, in all cases require local actions to initiate water flow) except for those for the auxiliary electric equipment room supply air filters, which are operated locally or outside the auxiliary electric equipment room and the TSC and HRSS filter deluge units, which are operated via the local panel handswitches. Each charcoal adsorber is also provided with temperature sensors which alarm in the control room due to abnormally high temperatures.

Automatic water suppression systems provide protection to the following areas:

a. dirty and clean oil tank room,

b. emergency diesel generator fuel storage tank rooms,

c. HPCS diesel fuel storage tank rooms,

d. emergency diesel generator day tank rooms,

e. HPCS diesel day tank rooms,

f. reactor feedwater pump rooms,

g. condensate pump rooms,

h. north (old) service building ground floor and basement floor storerooms,

i. north (old) service building machine and electric shops,

j. reactor feedwater pump exhaust duct rooms,

k. diesel fire pump rooms,

l. radwaste building truck bay and dry waste storage area,

m. all levels in the turbine building where oil piping is present and leaking oil could spread,

n. turbine oil tank package room,

o. hallway outside diesel generator rooms,

p. auxiliary building ground floor zone 4F3 cables above ceiling,

q. railroad entrance area of reactor building,

r. cable spreading room, and

s. security (CAS), and Diesel Generator Day Tank rooms.

t. south (new) service building

Preaction systems are actuated by ionization detectors with wet pipe sprinkler systems initiating by heat responsive sprinkler heads located in the hazard area. The computer room in the south (new) service building and QA archives in the north (old) service building are provided with automatic Halon 1301 fire protection systems. CO_2 flooding is provided for the generator alternator exciter housing.

All sprinkler systems are provided with alarm check valves to give an alarm in the main control room when the sprinkler system goes into operation. Tamper switches and/or locks are provided for the fire protection isolation valves.

Supervised ionization smoke detector systems are provided in the following power generation areas (unless noted otherwise) to alarm in the main control room:

a. inlet and outlet plenums of all air handling equipment as described in Section 9.4 and Appendix H,

b. computer room,

c. radwaste control room,

d. security control center,

e. reactor building areas of electrical cable runs and distribution centers,

f. electrical switchgear rooms,

g. 250 volt and 125 volt battery rooms (photo thermal),

h. concentrated cable areas,

i. river screen house (heat detectors),

j. refuel floor (ultraviolet),

k. containment (high voltage ionization),

l. lake screen house (heat detectors).

The turbine oil storage tank room and turbine oil tank package room are enclosed by 3 hour fire rated walls. Oxygen and acetylene are stored outside the station except for the amount in use.

9.5.1.2.4 Combustion and Combustion Products Control

Automatic heat and smoke vents are provided in the turbine building. The ventilation systems for the reactor building and radwaste building are the once-through type. The ventilation systems for all normally occupied areas of the plant may be manually switched to a once-through mode by the operator.

Additionally, recirculation air systems with charcoal adsorbers are provided for the control room HVAC system and auxiliary electric equipment rooms HVAC system. Smoke detection in the mixed return air duct automatically puts the corresponding HVAC recirculation charcoal adsorbers into service. Smoke detection in the minimum outside air duct automatically puts the corresponding Emergency Makeup Filtration Unit (EMU) into service. The operation of these systems is accompanied by an alarm in the main control room. Inadvertent operation of these systems does not affect the habitability of the areas served, since air flow to the rooms is maintained and redundant equipment is available. The inadvertent actuation of ionization detectors provided other HVAC systems in various plant areas does not affect the controlled areas of the plant, since the action in each case is to stop the HVAC system, isolate the area served, and alarm in the main control room. If smoke is detected at the minimum outside air intake during purge operation, the EMU will start, the purge outside isolation dampers will close and the recirculation cross-tie dampers will open, placing the control room and auxiliary electrical equipment room HVAC system in pressurization mode using outside air supplied by the EMU.

The switchgear heat removal system and auxiliary building equipment area system do not fully meet the criterion that the power supply and controls for mechanical ventilation systems should be run outside the fire zones served by the systems.

Manually operated water deluge fire protection systems are provided for all charcoal filters.

With the exception of the generator-alternator-exciter housing, wherever total gas flooding type fire protection systems are provided, fire dampers in the ventilation openings close, and ventilation fans are shut down on initiation of the fire protection system to maintain the gas concentrations.

9.5.1.2.5 Electrical Cable Fire Protection-System Description

This topic is further discussed in Section 8.3.

Fire Detection

The fire detection system utilizes ionization type fire detectors for detecting incipient fires and products of combustion in various plant zones. Each unit's fire detection system is divided into two groups:

a. warning zones where detectors provide warning; and

b. protection zones where detectors provide warning alarms and initiate the operation of a fire protection system.

The configuration of each area determines the number and actual location of fire detectors. The detectors shown in Figure 9.5-1 merely indicate that the area has detectors. The actual number and spacing of detectors is per NFPA 72E.

Upon detection of a fire, an annunciator lights on the main control board in the main control room. Also, a local alarm sounds. In the main control room, fire alarm status is displayed on the plant process computer.

The fire detection systems are electrically supervised and energize alarms both in the auxiliary equipment room and in the control room upon loss of supply voltage or malfunction of equipment.

Fire Barriers and Separation Between Redundant Cable Trays

For information on installation of fire barriers and separation between redundant cable trays, see Subsection 8.3.1.4.2.1 and 8.3.3.4 which include the following:

a. "In Protected Zones,"

b. "In Hazard Zones," and

c. "In General Plant Zone."

Fire Stops

a. Vertical Raceways

Fire stops are installed in the cable trays at all riser openings in floors. When penetrating a floor, the tray section is completely enclosed for a distance of 6 feet above the floor surface.

Within the tray section, fire stops are provided that satisfy the fire-resistance requirements for the application.

b. Horizontal Raceways

In areas where pressure integrity between walls is required, a sleeve penetration is filled with a nonflowing, fire-resistant material or other suitable fire stop is used. In other walls, cable tray penetrations utilize fire resistant seals similar to riser fire stops.

Cable trays, raceways, conduit trenches, or culverts are used only for cables. All cables entering the control room are terminated there.

Integrity of the Essential (ESF) Electrical Auxiliary Power and Controls

See Subsection 8.3.1.1.2 and Subsection 8.3.2.1.1. Also, see Tables 8.3-1, 8.3-11, 8.3-12, 8.3-13 and 8.3-14 for separation of redundant ESF loads, which ensures integrity of ESF equipment during fires, or other accident conditions.

The following provisions for maintaining integrity of ESF equipment needed for safe shutdown during fires have been incorporated into the design of the LaSalle County Station:

a. physical separation between redundant divisions of electrical auxiliary power equipment with fireproof walls separating redundant equipment;

b. ESF equipment located only in protected zones (Subsection 8.3.1.4.2.3) having a low probability of being subject to damage from missiles or fire;

c. independent sources of power and controls provided for each redundant ESF division;

d. use of fire barriers wherever there is a possibility of fires occurring; and

e. installation of ESF equipment in Seismic Category I buildings for protection against earthquakes (which can cause fires).

The following provisions for protection of ESF auxiliary power from the effects of fire-suppressing agents have been incorporated into the design of the LaSalle County Station:

a. The control and instrument cables installed in the cable spreading room are capable of being immersed in water without damage or loss of function. There are only two penetrations through the floor of the cable spreading room to the auxiliary equipment room below. These penetrations have been specially curbed and also sealed. Floor drains are provided.

b. Use of fireproof walls and barriers for separating redundant ESF equipment prevents spread of fire-suppressing agents such as water, CO_2, or fire- extinguishing chemicals.

c. See the previous item referring to fire barriers for description of barriers and separation between redundant ESF cable trays.

9.5.1.3 Safety Evaluation

See Appendix H for details of this evaluation. Materials selected for construction of the facility are noncombustible or are rated as having a flame spread rating of 25 or less. Hydraulic oils used within the facility, except diesel-generator rooms (outside the reactor complex), have been selected having a flash point in excess of 600° F per ASTM D-922.56. The systems using oils are in separate fire protected areas. Diesel oil storage in day tanks within the generator enclosures is designed in accordance with the requirements of NFPA 37-1975, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines. The propagation resulting from a fire in these fire protected areas would not jeopardize a safety-related system outside this area.

The control room and associated office areas are constructed of noncombustible materials, including those having a flame spread rating of 25 or less. There is no provision for automatic fire suppression in these areas.

Ample protected exits are provided in the stairwells as well as protection provided by the fire rated walls and doors. No travel distance greater than 100 feet is needed to get into a fire-safe area. Walls in the reactor building, auxiliary building, and radwaste building are of reinforced concrete which exceed the 3-hour fire ratings.

As required by the NFPA, loss of power to the fire protection system is prevented by using the unit's 125-Vdc power supply for a power source.

The fire protection system, including external storage, is not designed to Seismic Category I. The fire protection system is designed so that failure of the system or parts of the system does not result in failure of Seismic Category I systems.

A single failure in the fire protection system does not prevent the system from performing its design function. Two fire pumps are provided with one being sufficient for any plausible demand. If one pump fails to start, the other pump starts and provides water to the fire protection system. The plant is encircled by a 14 inch ring header which feeds the fire protection system inside the station. If pipe rupture occurs, the affected portion of piping can be isolated and water can still be supplied. The fire protection system forms several loops in the plant, permitting portions of the system to be valved-out, thereby assuring continued water supply for the balance of the station.

Automatic fire protection systems are electrically supervised, thereby producing system failure annunciation both in the AEER and in the control room. If a system fails to automatically actuate, it may be engaged manually or adjacent equipment (e.g., fire hoses, CO_2 hose reels, or hand held extinguishers) may be utilized.

9.5.1.4 Inspection and Testing Requirements

Initial construction and preoperational testing of the fire protection system were conducted in accordance with the preoperational test program defined in Chapter 14 of the FSAR.

Periodic inspections and operational checks to demonstrate integrity are routinely performed on all fire protection systems. These tests and inspections are identified in the Technical Requirements Manual.

The fire loss prevention program was operational prior to Unit 1 fuel loading. Administrative controls are used to delineate jurisdictional responsibilities between operations and construction activities when needed. These items are audited by the EGC corporate fire protection coordinator and independently by the insuring bodies.

The fire protection and detection equipment at LSCS are not classified safety-related, but they are classified as regulatory related to support the power generation objective of the station. Plant modification and plant maintenance controls are therefore exercised to assure integrity and functional responsiveness at all times.

9.5.1.5 Personnel Qualifications and Training

9.5.1.5.1 Design Phase Responsibility for Fire Protection

As a member of Nuclear Electric Insurance Limited (NEIL), EGC utilizes fire protection criteria and guidelines provided in the NEIL Property Loss Prevention Standards for Nuclear Generating Stations." Sargent & Lundy Engineers designed the fire protection systems for CECo. They are experienced in nuclear station design. During plant design, all drawings which are pertinent to fire protection were submitted to an independent fire protection consultant organization, Marsh & McLennen of Chicago for evaluation. Their comments on design for improvements, modifications, and corrections were submitted directly to CECo for action. A CECo station design engineer reviewed the corrective actions for design changes and judged their effectiveness for fire protection vs. the cost-benefit ratio to determine whether the particular fire protection feature is to be incorporated into the plant. EGC evaluation criteria for fire protection cover the following:

a. plant and personnel safety,

b. credibility of a fire or fire hazard,

c. loss of generation capacity due to fire loss, and

d. protection of surrounding equipment resulting from a fire.

An independent and separate evaluation of LSCS fire protection design was made by Sargent & Lundy Engineers, CECo station design engineers, and a graduate fire protection engineer from Schirmer Engineering Corporation, Niles, Illinois.

9.5.1.5.2 Construction Phase: Responsibilities for Fire Protection

The CECo supervisor of safety has a fire protection coordinator assigned to him with responsibilities for:

a. Adequacy of fire fighting equipment including its operation.

b. Conduct of fire inspections as required by CECo standards, underwriting bureau policies, and insurance company requirements.

c. Conduct of tests on new fire protection and fire fighting equipment; conducting and witnessing acceptance tests on fire equipment after the initial preoperational test is completed.

d. Maintaining CECo contacts with local fire departments and fire prevention organizations.

e. Issuing company policy and procedures for fire prevention and protection; supervising and coordinating the internal fire reporting forms and reports; advising departments on fire prevention rules and standards.

f. Supervising and assisting in the training of personnel in fire protection, including the use of fire-fighting equipment.

During construction, a fire inspection was performed at LSCS once per month by the CECo fire protection coordinator. Independently, the site was inspected bimonthly by the NEIL (formerly Nuclear Mutual Limited) Consultants. On-call fire inspections were conducted at the request of the station project superintendent or the LSCS station operations superintendent.

During the construction phase, the station project superintendent had onsite responsibility for fire loss prevention.

9.5.1.6 Other Administrative Requirements

All administrative controls for fire protection that were contained in the Technical Specifications, including the minimum required fire protection systems, limiting conditions for operation, compensatory actions, surveillance requirements, and minimum fire brigade staffing requirements, have been transferred to the Technical Requirements Manual. Changes to the fire protection Technical Requirements Manual are performed in accordance with the standard fire protection license condition(s).

9.5.2 Communication Systems

The purpose of the communications system is to provide reliable intraplant and plant-to-offsite communications. The communication system is designed to be centrally controlled from the main control room. During emergency conditions, when the main control room is not available, the following communication items are remotely provided in the auxiliary equipment room: the public address system, intraplant radio system, local dial telephones, and a plant-to-offsite radios system. Power supply for the public address system and emergency radio is obtained from buses which can be fed from the standby power system. All equipment within the communication systems is non-Class 1E.

9.5.2.2 System Description

The communication subsystems provided within the LSCS are as follows: a public address system, a dial telephone system, a sound-powered telephone system, an intraplant radio system, a plant-to-offsite radio system, a microwave system, the Nuclear Accident Reporting System, and the Federal Telephone System.

9.5.2.2.1 Public Address System

The public address system consists of five independent subsystems as follows:

Zone 1 – Unit 1
Zone 2 – Unit 2
Zone 3 – New and existing service buildings
Zone 4 – Main (and future receiving) warehouses
Zone 5 – Existing gatehouse, central alarm station, new main access facility, (future receiving warehouse security room).

The public address system integrates a system of speakers and handset paging units located throughout the facilities. Paging can be initiated from any single handset unit, from handsets within the control room, or from the dial telephone system. By manual selection, paging from the control room will override paging from any handset.

The public address system for the fire zones consists of approximately 130 handset stations, two merge isolator assemblies, an override transmitter assembly, a tone receiver/control switching assembly, a telephone interface, and about 170 speakers.

9.5.2.2.2 Dial Telephone System

The dial telephone system consists of local telephone company PBX equipment and telephone stations located throughout the plant including the main control room. The power supply to the telephone PBX equipment is obtained from either the Unit 2 non-ESF power system or the Technical Support Center diesel generator via an automatic bus transfer switch.

9.5.2.2.4 Microwave System

The microwave system consists of solid-state, battery-powered equipment designed and engineered primarily for the protective relaying of the transmission system. However, a voice channel is provided which serves as an additional offsite communication medium. The tones received via this channel have volume, fidelity, and freedom from extraneous noises comparable with the quality normally obtained on a commercial telephone.

9.5.2.2.5 Intraplant Radio System

The intraplant radio system provides five independent communications channels for the security system and operations personnel. Remote control consoles control the centrally located base stations. The base stations are cabled to remotely located antennas providing communications to portable radios throughout the plant. Communication from one portable radio to another is via redundant centrally located repeaters or radio to radio.

9.5.2.2.6 Plant-to-Offsite Radio System

Communication outside the plant is maintained through the local telephone company, with emergency offsite backup communication facilities being provided through a licensed, emergency two-way radio transmitter and receiver.

9.5.2.2.7 Sound-Powered Telephone System

Sound-powered telephones are used in special areas where instrumentation racks and controls are installed. Jacks for sound-powered telephones are installed at local instrument racks and panels, on the front of selected control room benchboards, and at two jack stations in each reactor containment. This type of communication is an aid to the instrument mechanics when testing and adjusting instrumentation and controls and it is also used for emergency communications.

9.5.2.2.8 Nuclear Accident Reporting System (NARS)

The NARS is a dedicated telephone voice communications system that has been installed for the purpose of notifying State and local authorities of declared nuclear emergencies. This system links the CR, EOF, and TSC with state and local authorities as appropriate.

9.5.2.2.9 Federal Telephone System (FTS)

The FTS bypasses the Public Switched Network (PSN) to provide telephone communication with the NRC even when the PSN is unavailable due to heavy communications traffic. The FTS consists of the following subsystems:

a. Emergency Response Data System (ERDS),
The ERDS provides direct electronic transmission of a limited set of station parameters from the main computer to the NRC during an emergency.

b. Emergency Notifications System (ENS),
The ENS consists of a dedicated telephone connected to the NRC. The ENS phone is located in the Main Control Room with an extension in the Technical Support Center.

c. Health Physics Network (HPN),
The HPN phone is used to establish communications with the NRC to discuss radiological and meteorological conditions (in-plant and off-site).

d. Reactor Safety Counterpart Link (RSCL), and
Phone used to conduct internal NRC discussions on plant and equipment conditions separate from the licensee without interfering with the exchange of information between the NRC and licensee.

e. Protective Measures Counterpart Link (PMCL)
Phone used to conduct internal NRC discussions on radiological releases and meteorological conditions, and the need for protective actions.

9.5.2.3 Inspection and Testing Requirements

The inspection and testing requirements for the communication systems are provided as follows:

The plant-to-offsite radio is given an operation check twice a year.

The other communication systems, including the intraplant radio system, are in daily use and are tested and repaired as needed.

9.5.3 Lighting Systems

The general purpose of the lighting systems is to provide sufficient lighting of desired quality in all areas of the station, indoors and outdoors, for normal, essential, and emergency conditions.

9.5.3.1 Design Bases

a. The lighting system is designed for the normal life (40 years) of the plant, with normal replacement of failed bulbs and ballasts.

b. Emergency lighting is supplied from the ESF buses and the normal lighting is supplied from the remaining buses.

c. Balance of plant (BOP) and safe shutdown 8-hour d-c battery pack units are wired directly to the ESF and non-ESF power sources and switch on automatically if a-c power fails. A sufficient number of BOP battery pack units are installed throughout the plant so as to be readily available to the operators for emergency purposes. In addition 8-hour emergency lighting battery packs required for safe shutdown are installed throughout the plant in accordance with 10 CFR 50 Appendix R, to provide illumination of safe shutdown equipment and access/egress routes in the event that the normal station lighting system is disabled by a fire.

d. The control room lighting systems are designed to prevent mechanical failure during design basis Seismic Class I conditions. The normal and essential lighting systems are independent and separate systems, supplied from separate sources.

e. The a-c emergency and d-c lighting power supplies (the sources and the distribution equipment) are Class 1E electrical equipment.

f. Lighting fixtures are not seismically qualified. The structural supports are seismically qualified in areas where seismic equipment failure could cause injury to operating personnel or to safety-related equipment.

9.5.3.2 System Description

9.5.3.2.1 Normal Lighting System

The normal lighting system consists of the following:

a. Incandescent fixtures and outlets are installed in the drywells to provide normal lighting and local lighting for maintenance work areas.

b. Mercury vapor or fluorescent fixtures are installed throughout the plant for normal lighting, essential, or standby a-c lighting. They are installed in the main control room, auxiliary equipment rooms, computer room, switchgear rooms, radwaste control room, offices, conference rooms, and laboratories.

c. Sodium vapor lighting is installed in the (outdoor) transformer area, switchyard area, and the roadway lighting area (including security lighting).

d. High-pressure sodium-vapor type lighting is installed in the turbine room (main, basement, and mezzanine floors), storerooms (general and bins), screen house, fuel handling areas, radwaste areas, machine shop, oil and diesel rooms, reactor building (ground and mezzanine floors), off-gas building, and the auxiliary building (main, mezzanine, and ground floors).

e. Security lighting is referenced in Section 13.7.

A-c station lighting is the normal lighting system used throughout the plant.

The normal a-c lighting cabinets are energized from the non-ESF 480-volt motor control centers. The normal lighting cannot operate if both the system and unit auxiliary transformers are out of service.

9.5.3.2.2 Emergency (or Standby) Lighting

A-C Lighting

A-c emergency (or standby) station lighting is the lighting provided for station operation during a loss of normal a-c auxiliary power. It is limited to the lighting required for the control and maintenance of ESF equipment (such as the ESF switchgear, emergency cooling equipment, control equipment, etc.) and for the access routes to this equipment. It represents approximately 7.5% of all station lighting. It is energized from the 480-Volt ESF motor control centers and thus receives power from the diesel generators when, and if, the sources of normal a-c auxiliary power fail.

The control room emergency lighting system is similar to the normal lighting system except that the source of a-c power is supplied from the engineered safety features power distribution system. These lights are normally in service at all times.

Emergency Battery-Operated Lighting

8-hour balance of plant and safe shutdown battery emergency lighting units are provided in various locations in sufficient quantity to provide supplemental lighting for maintenance and supervision of both BOP and safe shutdown equipment.

The battery emergency lighting system in the control room consists of battery operated lighting units located strategically within the control room. The units are normally de-energized and operated automatically upon failure of the ESF or non-ESF a-c lighting systems.

D-C Lighting

The d-c emergency lighting system in the control room consists of incandescent lighting fixtures installed in a manner similar to the normal lighting system. The system is normally de-energized and is automatically energized from the 125-volt battery system upon loss of a-c power to the ESF 480-volt buses.

D-c emergency lighting is limited to incandescent lamp fixtures at stairwells and at exit points of various areas of the plant, outside of the control room.

9.5.3.3 Reliability/Availability/Redundancy Requirements

Power supply for the a-c emergency lighting system comes from a group of 277/480-volt circuits which in turn are supplied from main ESF switchgroups having standby diesel-generator backup supplies. Incandescent lighting circuits are supplied at 120-volts from transformers connected to the 277/480-volts circuits.

In the event of a loss of normal onsite and offsite power, provision is made for automatically shedding all but approximately 10% of the normal lighting load so as to avoid excessive loading of the standby diesel-generator system. These lighting circuits can then be manually re-energized by operator action when load conditions permit.

Essential lighting in the ESF divisional (safety-related) areas is supplied from its respective diesel-generator feeds. The control room lighting is supplied equally from Unit 1 and Unit 2, (on a 50/50 basis).

In addition, provision is made for automatic transfer of approximately 2.5% of the normal lighting system to the 125-volt battery system in the event of a loss of a-c supply so as to provide emergency lighting for essential areas in the plant. The emergency lighting system includes the main control room, safety-related equipment and control areas, standby a-c equipment areas, and access and exit routes.

As a supplement to the station battery supplied emergency lighting system, additional self-contained, battery operated emergency lighting units of a portable or semiportable type are provided where required. These are equipped with 4-hour battery supplies.

9.5.4 Diesel-Generator Fuel Oil Storage and Transfer System

The design objective of the diesel fuel oil storage and transfer system is to supply fuel to the diesel generator during a loss-of-coolant accident (LOCA) as well as for all conditions of shutdown without a LOCA.

9.5.4.1 Design Bases

9.5.4.1.1 Safety Design Bases

Specific safety design bases for the five fuel oil storage and transfer systems are as follows:

a. The system is designed consistent with automatic startup of each diesel-generator set such that required loads can be accepted within the required time.

b. All system piping and components required to assure a 7-day supply of fuel to the diesel generators are designed to Seismic Category I and ASME Section III, Class 3 requirements and are protected from tornadoes, missiles, pipe whip, and floods.

c. The entire diesel-generator system consisting of five diesel generators including the associated fuel storage and transfer system is designed to meet single failure criteria. Each fuel system or diesel generator in itself does not need to meet the single failure criteria.

d. The usable diesel fuel volume required to support each Division 1 and 2 diesel generator continuous operation at rated load for 7 days is 32,200 gallons. The usable diesel fuel volume required to support each Division 1 and 2 diesel generator continuous operation at rated load for 6 days is 27,600 gallons. The onsite diesel fuel storage consists of the storage tank and the day tank.

e. The usable diesel fuel volume required to support each Division 3 diesel generator continuous operation at maximum expected load profile for 7 days is 30,000 gallons. The usable diesel fuel volume required to support each Division 3 diesel generator continuous operation at maximum expected load profile for 6 days is 25,900 gallons. The onsite diesel fuel storage consists of the storage tank and the day tank. The Division 3 diesel generator minimum required onsite diesel fuel volume requirement is based on the following:

1. High-pressure core spray (HPCS) pump operation at maximum power demand conditions for 25 hours, after which time the pump operates at runout flow for the balance of the 7-day period. All other Division 3 loads operate at maximum power for the full 7-day period.

2. The diesel fuel consumption rate at maximum expected load profile conditions is 185.3 gallons per hour for the first 25 hours, and 165.5 gallons per hour for both the remaining 143 hours of the7-day period and the remaining 119 hours of the 6-day period. These diesel fuel consumption rates are based on the use of API Gravity 27 Ultra Low Sulfur Diesel Fuel.

3. A 1000 gallon margin over the design basis fuel consumption based on item 1 operational requirements is provided which will allow for future modifications to the HPCS system which increase either the electrical load or the diesel fuel consumption rate. The margin also provides an operating margin to minimize required refilling while allowing for diesel generator testing, diesel fire pump day tank filling, diesel fire pump testing, sampling, and evaporation.

f. Fuel storage and day tanks have low levels annunciated in the main control room. Day tank low level alarm setpoints are such that a minimum of 50 minutes of fuel remains following alarm actuation. Storage tank low level alarms are set such that the minimum 7-day supply is available at alarm actuation.

g. Fire protection and provisions to prevent the spread of leaking fuel oil are incorporated. For further criteria and information concerning fire protection, see Subsection 9.5.1.

h. Environmental design bases are as follows: during diesel operation, temperatures are limited to 122° F maximum and 50° F minimum with a relative humidity of 0%-100%. When the diesels are not operating, temperatures are limited to 104° F maximum and 50° F minimum with 0%-100% relative humidity. A discussion of the diesel-generator facilities ventilation systems is provided in Subsection 9.4.5.

i. System equipment and piping design is based on a 40- year life considering the effects of corrosion, erosion, metal fatigue, and radiation.

j. The system is designed to be operable during all modes of plant operation when electrical power is available to permit verification of operability at any time without disrupting normal plant operations. System components and piping are designed and located to facilitate access for inservice inspection.

k. Consideration is given to the prevention of contaminants and sediment from being drawn into the diesel engine's fuel system. Sample points are provided at each day tank and storage tank to detect and drain off water or sediments which may accumulate.

9.5.4.1.2 Power Generation Design Bases

The diesel-generator units, including the fuel storage and transfer systems, are not required during power generation since provisions are made to transfer fuel from the HPCS diesel storage tanks to the diesel fire pump day tanks located in the lake screen house. Piping and equipment associated with this transfer system are not considered nuclear safety related and are therefore not designed to Seismic Category I or ASME Section III requirements except, where loss of integrity could affect the operability of the diesel-generator fuel storage and transfer system.

9.5.4.2 System Description

To meet the single failure criteria each diesel-generator unit is provided with a separate fuel storage and transfer system consisting of a day tank, storage tank, one transfer pump, and the associated piping valves, instrumentation and controls. Electrical separation is maintained by supplying electrical power to each system from the essential power supply division of the associated diesel generator. Each of the five fuel storage and transfer systems is completely independent.

The Division 1 and 2 diesel generator usable diesel fuel storage tank and day tank capacities are 37,724 gallons and 828 gallons each, respectively. The Division 3 diesel generator usable diesel fuel storage tank and day tank capacities are 33,127 gallons and 1,828 gallons each, respectively. All tanks are constructed of carbon steel. No internal tank coatings have been applied as these could detach and clog system strainers; effective corrosion protection is accomplished by the film of fuel oil which will exist on internal tank surfaces.

During operation each diesel engine requires 4.5 gpm of fuel; excess fuel not used for combustion is returned to the storage tank. Each diesel oil transfer pump has been sized to deliver a minimum of 20 gpm to the day tank with the storage tank at low level. The transfer pumps are constructed entirely of stainless steel and are driven by 5 hp, 460-volt, 3 phase, 60 Hz electric motors.

A strainer is installed in the piping between each storage tank outlet and the associated transfer pump to trap sediment particles before oil is transferred to the day tank. In addition, the day tank fuel outlet to the diesel engine is elevated 3 inches above the bottom of the tank and the entire tank is sloped slightly away from the fuel outlet towards a drain connection to permit condensation and fine sediments to be drained off. Storage tank outlet connections are similarly protected with suction intakes raised off the bottom of the tanks.

All system piping and components, except for fill piping, are located entirely within the diesel buildings. Each storage tank and the associated transfer pump is located in a separate room in the basement of the diesel building. Day tanks are located on the grade floor near the diesel-generator unit and are isolated from all other equipment in the diesel-generator room within liquid-tight compartments having a 3-hour fire rating. Each storage tank has its own Seismic Category I 3-inch fill pipe which is routed underground to one of two fill stations. The fill pipes terminate 4 feet above ground and are normally capped. Inside the diesel building, each fill pipe contains a normally closed isolation valve and a drain connection upstream of the isolation valve. Buried fill piping is protected by coal tar enamel and tape coatings.

Storage and day tank vents are fitted with flame arrestors and are located on an outside wall of the diesel building approximately 15 feet above grade.

The LaSalle diesel fuel oil storage and transfer system substantially conforms to the safety requirements of ANSI N-195 as indicated in the detailed discussion above. The only exceptions to ANSI N-195 are the following. The standard requires duplex strainers in the transfer pump suction pipe whereas the LSCS diesel engines have a fuel pump suction strainer and duplex filters upstream of the injectors. For Division 1 and 2, this duplex filter unit has a local alarm on high differential pressure. Such alarm is remotely indicated as a diesel engine trouble alarm in the control room. Division 3 does not have a high differential pressure alarm on the duplex filter unit. Additionally, the fuel lines are filtered at two other locations: one is on the fill line upstream of the separate bulk storage tank for each diesel generator; the second is upstream of the diesel fuel transfer pump which transfers fuel oil from the dedicated bulk storage tank to the day fuel tank for each separate diesel engine. These strainers are Y-pattern strainers with cleanout traps. See Drawing Nos. M-85, M-132, M-2085, and M-2132 for further details of the system. In addition, Drawing Nos. M-1 through M-17 show the arrangement of the diesel-generator building and of the equipment inside the diesel-generator rooms.

The permanent connection from the Division 3 fuel oil storage tanks to the diesel driven fire pumps is an exception as stated to ANSI N-195. Significant loss of fuel from the Division 3 storage tanks due to failure of the non-seismic diesel fire pump fuel transfer system is prevented by means of a fail-closed solenoid valve. In addition, the HPCS EDG minimum fuel inventory includes a 1,000 gallon contingency margin for manual diesel fire pump day tank filling, testing and/or sampling, etc.

9.5.4.3 Safety Evaluation

Only locked open manual valves are installed between the day tank and the diesel engine and each day tank contains sufficient fuel for several hours of operation. Thus, the system requires no electrical power to supply fuel to the diesel engine during starting and initial operation.

Each system is independent of the other four systems and is physically separated from the other systems. Electrical power for transfer pump operation and instrumentation is received from the power supply division of the associated diesel generator. Thus, a single failure within any one of the five systems will affect only the associated diesel generator and no others. The remaining four diesel generators provide sufficient electrical power to safely shut down both units or to mitigate the consequences of an accident in one unit while safely shutting down the other unit.

Sufficient fuel is stored for operation of the associated diesel-generator unit for the five large diesels at the maximum required load for 7 days. This allows sufficient time to replenish fuel supplies from offsite sources by truck or rail transport. Normally No. 2 diesel fuel is readily available from numerous offsite sources such as fuel oil wholesalers, distributors, and refineries located within a 100-mile radius of the site. Millions of gallons of diesel fuel are produced and stored in the Chicago area for normal consumption by the railroad and trucking industries serving the area.

Fuel oil can be delivered to the site either by truck or railroad and unloaded directly from the transport vehicle into the storage tanks. Also, there is a barge dock near the LSCS site which could be used as an emergency transport route for fuel oil, from which the station could be supplied. Public and site road and railway facilities are discussed in Chapters 1.0 and 2.0. Even assuming a local PMP flood as discussed in Chapter 2.0, fuel oil deliveries would be delayed for only a few hours, it at all, until flood levels receded. Unloading from the transport vehicle would not be affected by a PMP flood, since the fill pipes terminate well above the highest flood level.

The fire pump diesels utilize fuel which is transferred from the main plant diesel storage tanks. These two diesels each have a 550-gallon day tank which contains sufficient fuel to operate each fire pump for a minimum of 8 hours after the low level alarm is received. Additional time is available depending on the initial level in the tanks. Normal operation requires only one fire pump. This fire protection system was designed according to NFPA20 which requires system operation for a minimum of 8 hours. Even though sequential operation was not the reason for installing a two-pump system (reliability dictated the design), by sequentially operating the two fire pumps to fuel exhaustion (for a hypothetical case of day tank isolation) a minimum of 16 hours is available in which to refuel these day tanks by some method to overcome the isolation fault.

Tornado and missile protection is provided by locating all components within the reinforced concrete Seismic Category I diesel building. In the unlikely event that a missile should damage the exposed aboveground portions of the diesel oil storage tank fill pipes, the storage tanks can be filled directly from a truck transport by use of hoses. Also, since the storage and day tanks are each fitted with a separate vent line and the air spaces of the two tanks are connected via the day tank overflow, both tanks will vent through one vent pipe if the exposed part of one vent line is damaged by a missile. In the unlikely event that both day tank and storage tank vents are rendered inoperable by a missile, both tanks will still vent to the storage tank room via the storage tank overflow line.

Significant loss of fuel from the Division 3 storage tanks due to failure of the non-seismic diesel fire pump fuel transfer system is prevented by means of a fail-closed solenoid valve. This valve is normally closed except when the diesel fire pump fuel transfer pump is operating.

Water and solid contaminants are prevented from entering the system by locating the fill pipes well above the probable maximum flood level and capping the inlets. The flame arrestors on the tank vent lines are likewise located well above the flood level and the flame arrestor design prevents rain from entering. The normally closed fill pipe isolation valves located inside controlled access areas prevent inadvertent introduction of deleterious materials into the storage tanks.

All system components are designed to withstand the environmental operating conditions.

Day tank overflow nozzles are located at an elevation below the engine fuel injectors. This precludes the possibility of an engine cylinder becoming hydraulically locked during standby, should an engine mounted fuel block check valve fail to seat properly. To ensure a reliable fast start, the diesel generator day tank standby level is maintained at an elevation to assure slight positive pressure at the engine pumps. The fuel transfer pump start setpoint and low-level alarm setpoints are established to assure an adequate net positive suction head at the engine fuel pumps and to ensure that the fuel transfer pump will start and deliver the required fuel oil before the low level alarm actuates.

To preclude accidental ignition within the storage and transfer system, the storage and day tanks are isolated by locating them in separate fire-rated enclosures. No open flames are permitted in the diesel-generator rooms. The only hot surfaces in the diesel-generator rooms are in the diesel exhaust system, and these are insulated as completely as possible. All fuel oil system piping is separated from these hot surfaces by a minimum of 10 feet.

Day tank level instruments are Seismic Category I and Class 1E to assure automatic operation during an emergency. In the unlikely event of failure of the day tank instruments controlling the transfer pump, the pump can be operated manually to assure a continuous supply of fuel to the diesel generators. The non-Seismic Category I, non-Class 1E storage tank level instruments serve only to provide a means of remote storage tank level indication and to provide an alarm if the 7-day fuel requirement is in jeopardy. Although operation of these instruments can not be assured in an emergency or loss of offsite power, storage tank level can be determined at any time by visual observation.

9.5.4.4 Testing and Inspection

The diesel-generator systems provide standby power sources in the event of loss of offsite power. Readiness is demonstrated by periodic testing, simulating as far as possible actual operating conditions. The test program demonstrates the ability to start the diesel-generator units and to run under full load long enough to bring all components of the systems, including the fuel storage and transfer systems, to equilibrium conditions.

Components and piping, except for interconnecting piping between the day tanks and the diesel skids which is encased in the diesel room floor, are accessible for visual inspection.

Fuel oil quality requirements for the diesel generators are in accordance with applicable ASTM Standards and the manufacturer's recommendations. Samples are obtained from the storage tank periodically and analyzed in accordance with the plant technical specifications. Moisture and sediment accumulations in the storage and day tanks can be removed through drain connections.

9.5.4.5 Instrumentation and Controls

Fuel levels in each day tank and storage tank are indicated locally, and storage tank levels are also indicated at each storage tank filling station. Control room alarms annunciate high or low levels in each day tank and low level in each storage tank. All day tank level instruments and diesel-generator transfer pump controls are Seismic Category I and Class 1E. A local pressure indicator is connected to the discharge of each transfer pump to monitor pump discharge head. A local differential pressure indicator is connected across the transfer pump suction strainer to identify a clogged strainer.

Each diesel engine gauge panel includes local gauges for monitoring the following diesel-generator skid-mounted system fuel oil parameters: fuel oil temperature, fuel pump suction strainer inlet and outlet pressure (Divisions 1 and 2 diesel generators only), fuel pump discharge pressure, fuel filter inlet pressure, and fuel filter outlet pressures (for the Division 3 diesel generators, filter inlet and outlet pressure gauges are mounted on the engine and not on the gauge panel). In addition, pressure switches are installed in the skid-mounted systems to annunciate high fuel filter differential pressure for the Divisions 1 and 2 diesel generators and low fuel pump discharge pressure for the Division 3 diesel generators. The entire skid-mounted fuel oil system, including instrumentation, is supplied by the engine manufacturer as a part of the diesel engine.

Each diesel-generator fuel transfer pump is started and stopped automatically by day tank level control switches. The diesel fire pump fuel transfer pump is started manually; however, it is automatically shut down by day tank high level. Elapsed time instrumentation monitors diesel-generator transfer pump running time and, when the diesel engine is operating, pump shutdown time. This instrumentation actuates control room alarm lights if pump running time is excessive or shutdown time is too short to permit remote detection of possible fuel oil leaks at the day tank or diesel generator.

9.5.5 Diesel-Generator Cooling Water System

The function of the diesel-generator cooling water system is to transfer the heat rejected from the engine water jacket, the lube oil cooler and the engine air aftercooler to the CSCS equipment cooling water system (CSCS-ECWS).

9.5.5.1 Design Bases

9.5.5.1.1 Safety Design Bases

Cooling capacity of this system is based on a diesel-generator output of 2860 kW with an environmental temperature of 122° F maximum and a minimum and maximum lake water temperature of 32° F and 107° F, respectively. Total heat transfer by this system is approximately 7.8×10^6 Btu/hr per diesel-generator set at rated engine capacity. The Division I and II diesel cooling water heat exchangers are sized based on operation of 110% of rated load. The Division III diesel cooling water heat exchangers are sized based on operation of 100% of rated load.

High water temperature is alarmed at 200° F and the engine is automatically shut down if the cooling water temperature at the engine outlet exceeds 208° F in order to prevent engine damage due to overheating. This shutdown control is in effect only when the engine is started manually and bypassed when the diesel generator is started automatically during an emergency.

Heaters are installed in the cooling water piping below the lube oil cooler to maintain the engine water and lube oil in a warm standby condition while the engine is not operating; thus increasing the starting reliability of the diesel generator. Natural convection is employed to circulate the warm engine water through the lube oil cooler during standby.

Each system is designed based on Seismic Category I requirements and is protected from tornadoes, missiles, and flooding.

9.5.5.1.2 Power Generation Design Bases

The diesel-generator cooling water system is not required during power generation. Consequently, it possesses no power generation design bases.

9.5.5.2 System Description

Each diesel-generator cooling water system is a separate, independent closed loop system supplied with the diesel generator and located entirely on the diesel-generator skid. It consists of two parallel engine driven centrifugal circulating pumps, a low-pressure expansion tank, an AMOT temperature regulating valve, a lube oil cooler, and the engine cooling water heat exchanger. The expansion tank is fitted with a 7 psig relief cap which also will relieve vacuum. Engine coolant is demineralized water treated with an added corrosion inhibitor consistent with the engine manufacturer's recommendations.

During operation, cooling water at a flow of 1100 gpm per diesel-generator set is circulated by the engine driven pumps through the diesel engine cooling water passages to the lube oil cooler, through the temperature regulating valve, and then to the engine cooling water heat exchanger. See Figure 9.5-5 for additional details.

The engine cooling water heat exchanger is a two-pass shell and tube type heat exchanger having admiralty tubes with a carbon steel water box and shell. Engine cooling water is circulated through the shell side while strained lake water is pumped through the tube side by the CSCS-ECWS (Subsection 9.2.1). Design pressure and temperature is 150 psig and 300° F for both the shell and tube side. Heat exchangers for the Division 1 and 2 diesel generators are designed, fabricated, and tested in accordance with ASME Section III, Class 3 and TEMA C. The Division 3 diesel-generator heat exchangers are designed, fabricated, and tested in accordance with ASME Section VIII, Division I and TEMA C.

The AMOT temperature regulating valve is a thermostatic control valve which directs cooling water flow either to the cooling water heat exchanger or to a bypass around the heat exchanger. The thermal element employs a thermostatic wax which expands when heated and moves a piston connected to the sliding bypass valve. Movement of the piston is resisted by spring force. The design of the valve is such that flow resistance is constant regardless of valve position. The thermal element is self-contained and preset to maintain an operating engine cooling water temperature below 200° F.

The diesel cooling water expansion tank is located at the highest point of the system except for a portion of the cooling water return piping between the engine and the temperature-regulating valve. The system is arranged such that no heat transfer surface can become airbound, and piping high points are vented as necessary to the expansion tank.

9.5.5.3 Safety Evaluation

Each diesel engine's cooling water system is an independent self-contained system. A failure which would prevent operation of one diesel engine cannot affect operation of the remaining four diesel generators. Adequate power can be generated by four diesel generators to safely shut down both units or to mitigate the consequences of any of the postulated accidents in one unit while simultaneously shutting down the other unit.

To prevent metal fatigue, flexible connections are used where necessary to isolate engine vibration from the cooling water piping.

9.5.5.4 Testing and Inspection

The availability of the engine cooling water system is operationally verified as part of the monthly overall engine performance checks. The engine is operated for a sufficient length of time for system temperatures to stabilize.

The engine cooling water is also sampled at regular intervals and is treated or replaced as necessary to maintain water quality within the recommended limits established by the engine manufacturer.

9.5.5.5 Instrumentation and Controls

Engine cooling water temperature at the engine outlet and pressure at the circulating pump outlet are indicated on the engine gauge board. In addition, skid mounted instrumentation is provided to monitor engine water temperature at the engine outlet, engine inlet, heat exchanger outlet, and lube oil cooler outlet. Temperature switches installed at the engine outlet actuate local and control room alarms at 200° F and automatically trip the engine at a temperature of 208° F. This automatic trip is bypassed, however, when the engine is started automatically during an emergency.

A temperature switch installed in the lube oil cooler controls the electric immersion heater used to keep the engine in a warm standby condition. Low-temperature switches on the Divisions 1 and 2 diesel generators actuate local and control room alarms if engine temperature drops below 85° F to detect failure of the diesel cooling water heaters.

9.5.6 Diesel-Generator Starting Air System

The purpose of the diesel-generator starting air system is to provide a quick, reliable, and automatic start of the generators.

9.5.6.1 Design Bases

9.5.6.1.1 Safety Design Bases

The design objective of each diesel starting air system is to automatically start the associated diesel-generator unit such that rated frequency and voltage is achieved and the unit is ready to accept required loads within the required time.

Each Diesel Generator is provided with its own starting air system which is independent of the starting air systems for the other diesel generators.

The system design is based on Seismic Category I requirements and incorporates protection from tornadoes, external missiles, floods, and other natural phenomena.

The starting air system, for each diesel-generator consists of two starting subsystems. The air storage capacity of each subsystem is based on a minimum of five normal cranking cycles in rapid succession without the use of the air compressor for the Division 1 and Division 2 diesel generators and three normal cranking cycles in rapid succession without the use of the air compressor for the Division 3 diesel generators, assuming the second subsystem fails to operate. A normal cranking cycle is assumed to be when the diesel generator will start and accelerate to 900 rpm +5%, -2% within 13 seconds. The minimum receiver pressure at initiation of the starting sequence is less than or equal to the air compressor auto start setpoint of approximately 200 psig.

The minimum air receiver pressure required to assure a single normal cranking cycle is approximately 165 psig when starting with one subsystem and approximately 140 to 155 psig when starting with both subsystems. Therefore, a low air pressure alarm is set at about 200 psig to ensure prompt notification to the control room of an abnormal pressure condition below approximately 210 psig normal minimum header pressure.

9.5.6.1.2 <u>Power Generation Design Bases</u>

Since the diesel generators are not required during plant power generation, the diesel-generator starting air system has no power generation bases. The system, which is available for operational testing during any mode of plant operation, is required to remain in a standby condition.

9.5.6.2 <u>System Description</u>

Each diesel generator has its own independent starting air system consisting of two full capacity subsystems. All system piping and components, except for interconnecting piping to the diesel, are located on the diesel-generator skid and the associated starting air compressor skid.

Basically, each subsystem includes an air compressor and a receiver tank on the compressor skid; on the diesel-generator skid, each subsystem includes a pressure regulating valve, a strainer, a three-way solenoid valve, an air relay valve, an in-line lubricator, and two pneumatic starting motors. To prevent oil and moisture accumulations, each subsystem is provided with a moisture separator and refrigerated air dryer between the air compressor and air receiver tank. In addition oil, moisture, or rust carry-over is prevented by locating the air receiver outlets approximately 5 feet above the bottom of the air receivers. Air receivers are checked and drained periodically via their drain valves. Fouling of the air starting valves is prevented by the strainer downstream of the pressure regulating valve. For further details, see Drawing No. M-83.

On receipt of a start signal, both starting air subsystems are engaged simultaneously. Air from the receiver tanks is reduced in pressure to 185 psig by the air regulator valve. The start signal realigns the three-way solenoid valve from the vented position to the start position, which supplies control air to the starting motor pinion actuators and to the air relay valve. Porting of the pinion actuators is such that control air is not supplied to the air relay valve until both pinions engage with the flywheel ring gear. The air relay valve is opened by control air pressure and air is then supplied to the starting air motors. Cranking is terminated by deenergizing the three-way solenoid valve which returns to the vented position. This vents air from the air relay valve operator thereby shutting off air to the starter motors and disengaging the starter pinions.

Each system includes two air compressors which are both driven by 460-volt, 3-phase electric motors. Electric power is supplied to air compressor motors from the essential power supply division of the associated diesel generator to maintain electrical separation. Each compressor is automatically started and stopped by a pressure switch on the corresponding air receiver tank.

Each subsystem for the Division 1 and 2 diesel generators is provided with a 32 ft^3 air receiver tank and a 35 ft^3 air receiver tank which have been designed, fabricated, and tested to ASME Section III, Class 3 requirements. Design pressure is 340 psig and the maximum working pressure is 250 psig. The Division 3 diesel generator starting air systems are provided with two 16-ft^3 receivers in each subsystem. These tanks have been designed, fabricated, and tested to ASME Section VIII, Division I requirements.

Interconnecting piping between the compressor skid and diesel-generator skid is ASME Section III, Class 3 for all five diesel generators. Wire braid type flexible hoses are provided at each compressor skid and diesel-generator skid connection with off skid air piping to isolate vibration and prevent metal fatigue.

9.5.6.3 Safety Evaluation

The starting air systems for each of the five diesel generators are independent and separated from the remaining systems by reinforced concrete walls. Thus, a single failure which could render the starting air system of one diesel inoperative will not affect the remaining four starting air systems. Four diesel generators will provide sufficient power to safely shut down both units or to mitigate the consequences of an accident in one unit while safely shutting down the other unit.

Each diesel-generator's starting air system is located entirely within the reinforced concrete Seismic Category I diesel-generator building and is thereby protected from tornados, missiles, and flooding.

9.5.6.4 Testing and Inspection

The starting air system for each diesel generator is operationally tested any time the diesel generator is started.

System components are accessible for visual inspection at any time during plant operation.

9.5.6.5 Instrumentation and Controls

Local pressure indicators are installed on each receiver tank but not auxiliary receiver tanks for Division 1 and 2 diesel generators. Pressure switches located on the receiver outlet for the Division 1 and 2 systems and immediately upstream of the air relay valve for the Division 3 systems actuate local (Division 3 only) and control room alarms on low air pressure.

Each air compressor is controlled by a pressure switch connected to the corresponding air receiver. The compressor is started at approximately 210 psig and is stopped at approximately 240 psig.

For the refrigerated air dryers provided, indicators are installed to identify a malfunction of the air dryer unit.

9.5.7 Diesel-Generator Lubrication System

The function of the diesel-generator lube oil system is to supply lube oil to the engine bearing surfaces at controlled pressure, temperature, and cleanliness conditions.

9.5.7.1 Design Bases

9.5.7.1.1 Safety Design Bases

a. The system is based on reliable fast starting such that the diesel generator can accept loads within the required time. A minimum lube oil temperature of 85° F is required for reliable fast starting. To accomplish this, the lube oil is heated above 100° F when the engine is not operating by an immersion heater in the engine cooling water system (Subsection 9.5.5). The warm lube oil is circulated to the turbocharger bearing, engine crankshaft bearings, and oil filter during shutdown by two electric circulating pumps.

b. To meet the single failure criterion, each diesel-generator lube oil system is independent and located entirely on the diesel-generator skid.

c. System piping and components are designed to meet Seismic Category I requirements. Tornado, missile, and flood protection is provided by locating the diesel-generator skid within the Seismic Category I reinforced concrete diesel-generator building. Protection against pipe whip is not necessary as the only high energy piping located within the diesel-generator building is the diesel-generator starting air system piping. The diesel generators and their associated auxiliary systems are separated from each other by reinforced concrete walls.

9.5.7.1.2 Power Generation Design Bases

Since the diesel generators' sole function is to provide an onsite source of standby power to safely shut down the plant and mitigate the consequences of an accident, the diesel generators are not required to operate during plant power generation except to verify operability. Consequently, there is no power generation design basis for the diesel-generator lube oil system.

9.5.7.2 System Description

The entire diesel-generator lube oil system is designed and supplied by the engine manufacturer. Each system actually consists of four separate subsystems each having a different function. These are the scavenging oil system, main lubricating system, piston cooling system, and the oil circulating and soak-back system. The complete lube oil system is shown schematically in Figure 9.5-6.

The scavenging oil system's function is to supply cooled and filtered oil to the main lubricating and piston cooling systems. Oil is drawn from the oil pan sump through a six mesh strainer and is pumped through the oil filter and oil cooler to the oil strainer tank. The scavenging oil pump is a positive displacement helical gear type pump driven directly by the diesel engine. The full-flow oil filter has a 13 micron retention rating and is provided with an automatic bypass to assure a continuous supply of oil to the engine. The lube oil cooler consists of a steel housing with brass oil cooler cores. Engine water flows through the cores while lube oil flows around the outside of the cores through extended finned surfaces.

The main lubricating oil system takes suction from the oil strainer tank and supplies oil under pressure to the various moving parts of the engine, including the turbocharger during diesel operation. The main lube oil pump is a positive displacement helical gear-type pump driven directly from the engine. A relief valve on the pump discharge limits the pump discharge pressure by venting excess oil to the oil pan.

The piston cooling oil system supplies oil for piston cooling and lubrication of the piston pin bearing surfaces and cylinders. The system also takes suction from the oil strainer tank through a forty mesh strainer which is shared with the main lube oil system. The piston cooling oil pump is also a positive displacement helical gear-type pump which is mounted in tandem with and is driven by a driveshaft common with the main lube oil pump. Oil is pumped through each of two cooling oil manifolds extending the entire length of the engine. A cooling oil pipe at each cylinder directs a stream of oil through the piston carrier to the piston pin and underside of the piston.

The oil circulating and soak-back system circulates oil through the lube oil cooler, oil filter, and engine crankshaft and maintains oil pressure on the turbocharger bearings during standby. The lube oil is heated in the lube oil cooler by immersion heaters in the engine cooling water system as described in Subsection 9.5.5. One 6 gpm electrically driven pump is provided to circulate oil to the oil cooler, oil filter, and engine crankshaft, and two 3 gpm electrically driven pumps are provided in parallel to accomplish the soak-back function. The 6 gpm circulating oil pump is driven by a 1-hp, 460-Vac, 3-phase motor and one of the 3 gpm soakback pumps is driven by a 3/4-hp, 460 VAC, 3-phase motor. Both of these pumps are normally operating at all times while the diesel generator is shut down or operating. The other 3 gpm soak-back pump is driven by a 3/4-hp, 125-Vdc motor. This pump is energized when the AC soakback oil pump is not running to prelubricate the turbocharger bearings. A 75-psi check valve installed between the circulating and soakback lines to insure proper oil flow during engine shutdown and operation. A separate filter is provided for the turbocharger oil supply.

9.5.7.3 <u>Safety Evaluation</u>

The diesel-generator lubrication system is an integral part of each diesel unit. The total diesel power system meets the single failure criterion in that if a failure in this system prevents the satisfactory operation of the associated diesel generator, the other four divisions of the emergency power system, described in Section 8.3, will provide adequate power to safely shut down the station or to mitigate the consequence of any of the postulated accidents.

To protect the engine in the unlikely event of a crankcase explosion, the crankcase handhole covers will blow off. This will effectively relieve crankcase pressures before serious damage is done to the engine. Handhole covers are light-gauge sheet metal weighing a total of approximately 5 pounds. Consequently, they will not pose a threat to the reinforced concrete missile barriers separating adjoining diesel generators.

9.5.7.4 Instrumentation and Controls

Local indication is provided for lube oil filter inlet and outlet pressure, main lube oil manifold pressure and temperature, and soakback lube oil pressure. During engine operation switches provide local alarms for main lube oil low pressure and high temperature, lube oil filter high-differential pressure (Division 1 and 2 only) and high crankcase pressure. When the engine is shutdown, local alarms are provided for low oil cooler outlet temperature, low circulating oil pressure, and low soakback oil pressure. All local alarms are annunciated in the main control room. Other pressure switches provide low oil pressure cranking lockout and low oil pressure engine shutdown when the diesel generator is operated manually; during operation after an automatic start these shutdown controls are bypassed.

9.5.7.5 Testing and Inspection

Satisfactory operation of the entire diesel-generator lubrication system is verified as part of the regularly scheduled overall engine performance test.

Engine lube oil is sampled periodically per the engine manufacturer's recommendations to detect dilution by fuel oil or excessive oxidation, as well as water contamination. If oil is not within the engine manufacturer's specifications, it is drained completely and replaced.

External system leakage is readily detected by visual observation. Internal leakage through interfacing components can be detected by a decreasing or increasing engine lube oil level and a corresponding increasing or decreasing engine coolant level. Excessive internal leakage not resulting in a net loss of lube oil (e.g., a stuck-open relief valve) can be detected by low oil pressure instrumentation.

9.5.8 Diesel-Generator Air Intake and Exhaust System

The function of the diesel-generator air intake system is to supply filtered air to the diesel engine for use in combustion. The diesel-generator exhaust system directs the exhaust gases out of the diesel building and reduces the noise level of the exhaust. Exhaust silencing is not a safety-related function. The intake and exhaust systems are shown in Figure 9.5-7.

9.5.8.1 Design Bases

9.5.8.1.1 Safety Design Basis

a. Sizing of the intake system is based on supplying sufficient air for diesel operation at rated capacity with system pressure loss below the diesel manufacturer's recommended maximum. Similarly, the sizing basis for the exhaust system is diesel operation at rated capacity with exhaust back pressure within the engine manufacturer's recommended limit.

b. To meet single failure criteria, each diesel engine has its own completely separate and independent intake and exhaust system.

c. Intake and exhaust system piping and component classifications are as given in Section 3.2. Protection against tornados, floods, and missiles is provided for the air intake and exhaust system by locating the system within the reinforced concrete diesel-generator building.

d. The air intakes and exhaust outlets are located to minimize the possibility of recirculating the exhaust gases. Additionally, pressurized gases are not stored in the vicinity of the diesel building nor are there any high or moderate energy fluid systems near the intakes.

9.5.8.1.2 Power Generation Design Bases

The diesel generators and consequently the air intake and exhaust system are not required during power generation except to be available for operational testing and immediate startup upon loss of power.

9.5.8.2 System Description

Each diesel generator is provided with a separate air intake and exhaust system. The intake system consists of an intake filter and 24-inch carbon steel piping connecting the filter to the diesel engine turbocharger. A 24-inch wire braid type flexible hose is installed between the diesel engine and the interconnecting piping to isolate engine vibration. The dry type intake filter is located on the floor above the diesel-generator unit and is supplied with filtered outside air through the diesel building ventilation system intakes.

The exhaust system consists of an exhaust silencer and 22-inch and 30-inch alloy steel piping. An exhaust expansion bellows is installed at the turbocharger outlet to permit unrestrained expansion of the exhaust piping and to isolate engine vibration. The silencer is suspended from the ceiling above the diesel generator and the exhaust piping is routed to the roof of the diesel building where the gases are discharged horizontally away from ventilation system intakes. A 1/4-inch mesh stainless steel screen is fitted over the open end of the exhaust pipe to prevent birds and small animals from entering the exhaust system while the diesel engine is not operating.

9.5.8.3 Safety Evaluation

Since each diesel generator's air intake and exhaust system is independent, a single failure which could prevent satisfactory operation of the associated diesel generator would not affect the remaining four diesel generators. As described in Section 8.3, four diesel generators can provide adequate power to safely shut down the station or mitigate the consequences of any of the postulated accidents.

Due to the arrangement of the air intake and exhaust outlets, dilution of intake air by recirculated exhaust gases in quantities sufficient to affect diesel operation is not possible. The diesel engine intake air is supplied through the diesel building ventilation system; this provides double filtration of airborne particulates. The Division 2 and 3 ventilation system intakes are located on the diesel building wall facing the auxiliary building, and the Division 1 intake is extended up to the Auxiliary Building roof level, thus making complete blockage highly improbable.

The intake system is completely protected against missiles by locating the entire system within the diesel-generator building. The small amount of exhaust piping on the diesel building roof is protected against missiles from all directions except in line with the exhaust pipe discharge. Therefore, missile damage to an exhaust pipe is very unlikely due to the small projected area and, since the exhaust pipes are physically separated, damage to more than one exhaust pipe by a single missile is not possible. Pipe whip or internally generated missile damage to the intake and exhaust system is not possible as there are no high or moderate energy systems (except the diesel-generator starting air system, Subsection 9.5.6) located in the vicinity of the air intake and exhaust system. A failure in the starting air system which could damage the intake and exhaust system would in itself prevent operation of the associated diesel generator and would constitute the single failure. The diesel generators and their associated auxiliaries are separated by reinforced concrete walls.

Low barometric pressure at the site would have no effect on diesel-generator output since the particular diesel engines used retain their full rated output up to an altitude of 7000 feet assuming a minimum sea level barometric pressure of 28.25-inch Hg.

9.5.8.4 Testing and Inspection

The diesel-generator air intake and exhaust system is operationally tested as part of the regularly scheduled diesel-generator performance tests. A restriction indicator on the intake filter identifies a filter element needing replacement.

All portions of the system are readily accessible for visual inspection when necessary.

To assure an unrestricted exhaust and a ready supply of combustion air, no flow control devices are installed in the intake or exhaust flow paths. In addition, no part of the diesel intake and exhaust system is located so as to be exposed to adverse environmental conditions such as ice, freezing rain, or snow which could cause restriction of intake or exhaust flow.

9.5.9 Containment Inerting System

The containment inerting system is designed to maintain the containment atmosphere at less than 4% of oxygen. If large quantities of hydrogen are generated following a postulated LOCA, the inerted containment atmosphere will not have sufficient oxygen to support the combustion of hydrogen.

9.5.9.1 Design Bases

The following design bases were used for the containment inerting system design:

a. The inerting system is not a safety-related system and is not designed to meet seismic and other related criteria except where containment penetration and isolation is concerned,

b. Inert the primary containment (drywell) and wetwell prior to power operation,

c. Maintain the oxygen content of the primary containment below 4% during power operations, and

d. Provide nitrogen storage for two containment purges or re-inerting operations.

9.5.9.2 System Description

The containment inerting system is designed to provide gaseous nitrogen automatically to both of the reactor containments. This system will provide gaseous nitrogen at 200,000 (SCFH) prior to power operation when it is necessary to purge the containment atmosphere of oxygen to a concentration less than 4% by volume. Gaseous nitrogen will also be provided as needed during reactor operation at rates of up to 5000 scf/day to maintain oxygen concentration at less than 4% by volume.

The liquid nitrogen will be stored in one 11,020 gallon tank and one 9025 gallon tank, piped together. See Drawing Nos. M-92, M-1466, and M-138.

For high flow requirements (inerting), liquid nitrogen is drawn from both tanks simultaneously and fed to an electric water bath vaporizer rated to provide gaseous nitrogen at 200,000 scfh. This vaporizer will feed the gaseous nitrogen to a high flow pressure-temperature control manifold unit.

For low flow requirements (makeup), gaseous nitrogen is drawn simultaneously from the gaseous space of both tanks and fed to an ambient air vaporizer which will warm the nitrogen. For both the high flow and low flow requirements, gas pressure is regulated to below the design pressure of the downstream piping. Downstream piping is also protected from low temperature by flow isolation at -20°F.

The flow of nitrogen into containment is controlled by a pressure control circuit that senses containment pressure and compares it to a manually adjustable setpoint at a manual/auto station and positions a supply valve accordingly. A handswitch in the circuit allows the choice of controlling either the inerting (high flow) supply or the makeup (low flow) supply as required. The handswitch as well as the containment pressure indicator and the manual/auto station are located in the control room.

9.5.9.2.1 Cryogenic Liquid Storage Vessels

One 11,020 gallon tank and one 9025 gallon tank are provided. Both tanks combine to give a total system storage of 1,866,300 scf of nitrogen.

The storage vessels consist of an aluminum inner tank supported by a carbon steel outer tank. Cryogenic liquid is stored in the aluminum inner vessel. The annular space is filled with dry powered perlite insulation and then evacuated to a high vacuum to minimize heat leakage. The tank is constructed so that it can be filled from the top and bottom alternately or simultaneously, without discontinuing service. The top and bottom fill allows the tank pressure to be maintained constant during fill operations.

a. Economizer Circuit

A pressure control valve is included in the tank piping system of each tank and will bleed gas from the vapor spaces of the tanks preferentially to withdrawing liquid for vaporization. Thus, the gas which accumulated in the tank during periods of low flow will be withdrawn before the liquid for low flow requirements.

b. Pressure Buildup Circuit

During high flow withdrawal, as liquid level decreases, the vapor space increases. In order to maintain the required tank pressure, a pressure buildup circuit is provided in the electric water bath vaporizer. The pressure buildup circuit draws liquid from the bottom of both storage vessels, vaporizes it through a coil in the water bath vaporizer and returns the gas thus generated to the vapor space of the storage vessels to build and maintain pressure at a suitable level above feed line pressure. In addition, each storage vessel has its own externally mounted pressure buildup coil in a circuit which automatically vaporizes liquid nitrogen and returns it to its vapor space. These three circuits ensure that the common storage vessel pressure is maintained at a suitable level above the houseline pressure.

9.5.9.2.2 Vaporizer

a. 200,000 scfh High Flow Requirement

For a high flow of 200,000 scfh over an 8-hour period, an electric water bath vaporizer is provided. Nine 120 kW electric heaters are used to heat a water-glycol mixture, coils carry the nitrogen through this mixture which vaporizes and heats the nitrogen.

b. 5000 scf/day Low Flow Requirement

For low makeup flow, the economizer circuit will be used.

9.5.9.2.3 Pressure-Temperature Control Manifold

a. 200,000 scfh High Flow Requirement

For a 200,000 scfh flow rate, a high flow-pneumatic controlled nitrogen pressure temperature control manifold is provided. A low temperature shut off control valve (TCV) senses temperature of the nitrogen and throttles gas flow to protect downstream piping from liquid nitrogen. The TCV is totally shut off at -20°F. Downstream nitrogen pressure is used to control a pressure control valve (PCV) that regulates the downstream pressure to less than piping design pressure.

b. 5000 scf/day Low Flow Requirement

The low flow nitrogen Pressure-Temperature control Manifold is skid mounted. A low temperature shut off control valve (TCV) senses temperature of the nitrogen and throttles gas flow to protect downstream piping from liquid nitrogen. The TCV is totally shut off at -20°F. Downstream nitrogen pressure is used to control a pressure control valve (PCV) that regulates the downstream pressure to less than piping design pressure.

9.5.9.3 Safety Evaluation

The containment inerting system is not a safety-related system. All lines penetrating the primary containment are provided with containment isolation valves which meet the requirements of General Design Criterion 56 of Appendix A of 10 CFR 50. Containment isolation is discussed in detail in Section 6.2.

9.5.9.4 Testing and Inspection

Inspection of equipment is made and system performance verified periodically and after maintenance.

9.5.10 References

1. Letter from Commercial Testing Company dated June 20, 1990 on Standard Test Method for Surface Burning Characteristics of Building Materials. Action Item Number 373-160-91-00021.

2. Letter from A.T. Gody, Jr., NRR, to D.L. Farrar, CECo, Issuance of Amendment 97 to LaSalle Unit 1 Facility Operating License No. NPF-11 and Amendment 81 to LaSalle Unit 2 Facility Operating License No. NPF-18 and including Safety Evaluation Report dated March 10, 1994.

TABLE 9.5-1

LARGE LIQUID COMBUSTIBLES USED AT LA SALLE COUNTY STATION

COMBUSTIBLE	AMOUNT	LOCATION	REMARKS
Recirculation pump control valve systems	236 gallons	Adjacent to control rod driver modules	FYRQUEL electro hydraulic control fluid
HPCS diesel day tanks	1,700 gallons	In tank room near diesel-generator	#2 diesel oil, enclosed by 3-hour barriers, sprinkler system
HPCS diesel storage tanks	34,000 gallons	In tanks, inside vault below HPCS diesel-generator room	#2 diesel oil, enclosed by 3-hour barriers, sprinkler system
Emergency diesel-generator day tanks	750 gallons	In tank room near diesel-generator	#2 diesel oil, enclosed by 3-hour barriers, sprinkler system
Emergency diesel-generator storage tanks	40,000 gallons	In tanks, inside vent below emergency diesel-generator room	#2 diesel oil, enclosed by 3-hour barriers, sprinkler system
Diesel fire pump day tanks	550 gallons	Lake screen house, 2 floors above the CSCS cooling water supply piping	#2 fuel oil, enclosed by 3-hour barriers, sprinkler system
Turbine oil tank packages	10,150 gallons	Not adjacent to any safety-related equipment	Automatic deluge system
H_2 seat oil units	575 gallons	Not adjacent to any safety-related equipment	Enclosed by curbing, automatic deluge system
Clean turbine oil tank	15,000 gallons	Not adjacent to any safety-related equipment	Automatic sprinkler protection plus CO_2 nozzle port
Turbine dirty oil tank	15,000 gallons	Not adjacent to any safety-related equipment	Automatic sprinkler protection plus CO_2 nozzle port
Turbine electro hydraulic control	800 gallons	Not adjacent to any safety-related equipment	FYRQUEL electro hydraulic control fluid
HPCS diesel-generator lubricating oil sump	465 gallons	HPCS diesel-generator	Lube oil, automatic CO_2 flooding provided
Standby diesel-generator lubricating oil sump	465 gallons	Diesel-generator rooms	Lube oil; automatic CO_2 flooding provided