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SECTION 10.0

AUXILIARY SYSTEMS

10.1 SUMMARY DESCRIPTION

This section describes the reactor and plant auxiliary systems that are required for operation, but which are not integral portions of the reactor and power conversion equipment or their safety systems.

10.2 NEW FUEL STORAGE

10.2.1 Introduction

New fuel is stored in high density storage racks located in the spent fuel pool.

10.2.2 Description

New fuel assemblies as received at the plant are stored in metal boxes inside an outer metal container. Each outer container and metal box holds two fuel bundles. After removing the box from the outer container, the boxes are hoisted to the refueling floor and the fuel bundles are receipt inspected and placed in the spent fuel pool using the fuel-handling equipment. If a bundle fails receipt inspection, it is tagged in accordance with procedure, placed back into the container, and left on the refueling floor. A GE inspector checks the bundle. He either repairs the problem at the site or returns the damaged bundle for a replacement. In the event that the new fuel cannot be taken to the refueling floor immediately, it can be off-loaded and stored in a roped-off area with a security guard posted.

10.3 SPENT FUEL STORAGE

10.3.1 Power Generation Objective

The power generation objective of the spent fuel storage arrangement is to provide storage space for the spent fuel assemblies which require shielding during storage and handling.

10.3.2 Power Generation Design Basis

1. Spent fuel storage racks for each reactor are designed to accommodate 3819 fuel assemblies.

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

3. Dry storage casks are designed so that spent fuel may be transferred from the wet storage racks into the casks in an efficient manner

10.3.3 Safety Design Basis

1. All arrangements of fuel in the spent fuel storage racks are maintained in a subcritical configuration having a $k_{eff} \leq 0.95$ for all conditions.

2. Each spent fuel storage rack loaded with fuel and the pool structure are designed to withstand seismic loading to minimize distortion of the spent fuel storage arrangement or loss of spent fuel pool level.

3. Fuel designated for dry cask storage will have a K_{eff} $\leq$ 0.95.

4. Dry storage casks are evaluated for design basis environmental events and are placed in configurations which do not impact the structural capabilities of the fuel pool, reactor building, or cask transport path.

10.3.4 Description

The high density spent fuel storage racks provide storage at the bottom of the fuel pool for the spent fuel received from the reactor vessel and new fuel for loading to the reactor vessel. The fuel storage racks at the bottom of the pool are covered with water (normally about 23 ft above the stored fuel) for radiation shielding. Sufficient shielding is provided by maintaining a minimum depth of water at all times. The racks are freestanding, full-length top entry and are designed to maintain the spent fuel in a space geometry which precludes the possibility of criticality (k_{eff} will not exceed 0.95) under any conditions.

The high density spent fuel storage racks are of the "poison" type, utilizing a neutron absorbing material to maintain a subcritical fuel array (see Figures 10.3.1, 10.3.2, and 10.3.3). The rack modules are rectilinear in shape and are of nine different array sizes. The racks are arranged in the spent fuel pool as shown in Figure 10.3.4 for Unit 2 and Figure 10.3.5 for Unit 3. A total of 3819 storage locations are provided per pool. The racks are capable of storing BWR fuel assemblies (with or without their channels) with a maximum incore k-infinity of 1.270. Maintaining the incore k-infinity ≤ 1.270 will assure that the rack k-effective will be equal to or less than that determined in the safety design basis. TS Amendment Nos. 175/178 demonstrated a k-infinity limit of ≤ 1.362 using an analysis of the criticality aspects of the storage of PBAPS fuel assemblies having a fuel enrichment up to 4.5 weight percent of U-235. The analysis methodology and results were described in the GE report, GENE-512-92073, "Peach Bottom Atomic Power Station Spent Fuel Storage K-infinity Conversion Analyses," November 1992. The method and the cross-section library used consist of the GE MERIT computer code, using the ENDF/B-IV cross section set, which is stated to have been verified against extensive critical experiments. The MERIT program is a three-dimensional Monte Carlo neutron tracking code that calculates the system effective neutron multiplication factor (K-effective) using a 190 group cross-section library with the Haywood scattering kernel of water. A spent fuel storage criticality validation is performed for each reload to demonstrate that the reload fuel assemblies meet incore K-infinity and rack K-effective storage criticality requirements. Rack module data is given in Table 10.3.2.

TS Amendment 287/290 approved use of neutron absorbing inserts in the spent fuel pool (SFP) storage racks for the purpose of criticality control in the SFPs. This amendment modified TS 4.3, "Fuel storage" and added a new license condition 2.C(14) to support the installation of NETCO-SNAP-IN® neutron absorbing inserts into the individual cells of the existing PBAPS SFP storage racks. The installation of inserts addresses the degradation of the neutron absorbing material (Boraflex) previously installed in the SFP racks. The rack inserts are manufactured by NETCO using an aluminum and boron carbide composite material produced by Rio Tinto Alcan, Inc.

Analyses of the safety considerations concerning the high density spent fuel storage racks are set forth in a document entitled "Design Report of High Density Spent Fuel Storage Racks for PECO Energy Company (PECO), formerly Philadelphia Electric Company, Peach Bottom Atomic Power Station Units 2 and 3, Revision 2," dated July 21, 1986. This document describes the high density spent fuel storage racks in detail and contains analyses for seismic events, criticality concerns, structural requirements, thermal and hydraulic requirements, and postulated accident conditions associated with the high density spent fuel racks. Additional analysis has been performed that justifies application of the results of this document for Spent Fuel Pool water temperatures as low as 40°F.

The technical evaluation that allowed the use of GE-14 fuel in the Peach Bottom reactors is contained in ECR PB 99-02682. The acceptability of storing GE-14 fuel in the Spent Fuel Pool is documented in "GE14 Spent Fuel Storage Rack Analysis for Peach Bottom Atomic Power Station," Global Nuclear Fuel Document No. J11-03761-00-SFP, July 2000. GNF2 Fuel was evaluated in TS Amendment 287/290 for use of the NETCO-SNAP-IN® inserts.

The dry storage cask consists of a fuel basket, a cask body, a protective cover, an overpressure system, penetrations with bolted and sealed covers for leak detection and venting, closure bolts and locating pins. The cask is designed to be lifted in a single failure proof configuration.

Analysis of the safety considerations concerning the usage of the dry cask storage system is documented in the PBAPS Independent Fuel Storage Safety Analysis Report (IFSSAR) and PBAPS 10CFR 72.212 Report. These documents discuss in detail the various design basis cask storage at PBAPS.

10.3.4.1 High Density Spent Fuel Storage Racks

The high density spent fuel racks are constructed of stainless steel materials and each rack module is composed of cell assemblies, base plate, and base support assembly.

10.3.4.1.1 Cell Assembly

Each cell assembly is composed of (1) a full length enclosure constructed of 0.075 inch thick stainless steel, (2) sections of Bisco Boraflex which is neutron absorbing material, and (3) wrapper plates constructed of 0.020 inch thick stainless steel. Additionally, NETCO-SNAP-IN® inserts provide augmented neutron absorbing capability.

10.3.4.1.1.1 Cell Enclosure

The primary functions of the enclosure are to house fuel assemblies, to maintain the necessary separation between assemblies for subcriticality and to provide structural stiffness for the rack module. The inside square dimension of the cell enclosure is 6.070 inches nominal which accommodates either channeled or unchanneled fuel or consolidated fuel assemblies. A partial plan view is shown in Figure 10.3.6 and a partial elevation view is shown in Figure 10.3.7.

10.3.4.1.1.2 Neutron Absorbing Material

The Bisco Boraflex manufactured by Brand Industrial Services provided the additional neutron absorbing media required above that inherent in the rack structure material. The Boraflex is fabricated to safety-related nuclear criteria of 10CFR50, Appendix B, and it consists of boron carbide particles as neutron absorbers held in place by a nonmetallic binder. Boraflex contains an initial minimum B^{10} areal density of 0.021 gm/cm^2. It is a continuous sheet centered on the length of the active fuel. Depending on the location of the cells in a rack module, some cells have the Boraflex on all four sides, some of three sides and some on two sides. Cells with four wrappers are located in the interior of the rack, cells with three wrappers are located on the periphery of the rack, and cells with two (adjacent) wrappers are located at the corners of the rack.

Since NETCO SNAP-IN® rack inserts have been fully installed in the Peach Bottom Units 2 and 3 Spent Fuel

Pool racks, Boraflex is no longer credited as a neutron absorbing material.

10.3.4.1.1.3 Wrapper Plate

The wrapper plates are attached to the outside of the cell enclosure by intermediate spot welding along the entire length of the wrapper, forming the encapsulation of the Boraflex. A water tight seal is not provided between the wrappers and enclosures.

10.3.4.1.1.4 Neutron Absorbing Inserts

The NETCO-SNAP-IN® neutron absorbing inserts are manufactured by NETCO using an aluminum and boron carbide composite material produced by Rio Tinto Alcan, Inc. The material contains 19% by volume of boron carbide. The minimum certified areal density is 0.0105 grams/cm^2. An AA1100 aluminum alloy is used as a metal matrix to retain the boron carbide.

The inserts are designed to be an integral part of the existing PBAPS spent fuel racks. The inserts are nominally 0.075 inch-thick, are chevron shaped and have a vertical length which is equal to the cell height of the existing PBAPS spent fuel racks (169 inches). The aluminum and boron carbide composite inserts function by maintaining a greater than 90 degree bend angle when formed, but are subsequently compressed to a 90 degree bend angle when installed in the individual spent fuel rack cells, which provides a bearing force against the inside of the cell walls to retain the inserts in place.

10.3.4.1.1.4.1 Seismic and Structural Integrity

A combination of analysis and testing has been used to demonstrate acceptable structural and seismic performance of the inserts.

The impact load of a fuel assembly on the neutron absorbing inserts, generated by the horizontal acceleration of a fuel assembly during a design-basis seismic event, was determined to be 403 pounds per square inch (psi). Given that the NETCO-SNAP-IN® insert yield stress is approximately 8000 psi, the deformation and subsequent failure of the insert due to seismically-induced impact loads will not occur.

To determine the stresses imparted on the cells of the existing PBAPS spent fuel racks by the inserts, the limiting case involves the installation of the inserts into the cells. The stresses imparted on the cell walls during installation are not expected to exceed the allowable stress. The additional stress that occurs during installation of the inserts will have no effect on the cell wall structural integrity and the stress remains below the allowable value.

The increased load on the fuel racks from the inserts, which weigh approximately 18 pounds each, will be insignificant and bounded by the existing design.

Analytical and confirmatory numerical analysis were used to evaluate the stresses on the inserts during installation. The stresses remained below the insert material ultimate stress limit. Some instances were identified of plastic deformation, particularly in the wing and bend sections of the insert. However, sufficient elastic margin exists in the inserts, such that adequate retention force is maintained between the insert and cell walls.

Pre-installation testing demonstrated that adequate retention force is maintained by the inserts, such that they remain in place during normal (i.e., fuel handling) and abnormal (i.e., design-basis seismic event) loading conditions. In the unlikely event of warping or bowing of an insert, any additional drag on a fuel assembly will be recognized by a hoist load cell, which is typically used during normal fuel handling activities.

Withdrawal testing showed that the inserts maintained a static friction-based retention force well above the established 200 pounds minimum removal criteria. During a design-basis seismic event, the inserts must maintain a retention force of 40.8 pounds to ensure that the insert configuration remains unchanged, which is a 79.6% reduction of the 200 pound minimum removal force criteria. Over the 20-year expected life of the inserts, it is expected that the inserts will experience a stress relaxation of approximately 50%.

10.3.4.1.1.4.2 Fuel Handling Accidents

The inserts have no effect on previously evaluated fuel handling accidents. This is based on the fact that the installation of the inserts does not reduce the ability of the cell wall or rack base plate to resist dynamic impact loads resulting from a dropped fuel assembly, nor does it affect whether a fuel assembly may become stuck at the bottom of the existing racks.

An evaluation was performed to identify any previously unanalyzed fuel handling accidents resulting from the use of the tool used for installing and removing the inserts. Due to similarities in geometry and the lower weight of the insert tool and inserts compared to a fuel assembly and grapple device used for normal fuel handling activities, a postulated drop of the insert tool and insert is bounded by previously analyzed fuel handling accidents.

10.3.4.1.1.4.3 Criticality Analysis

A SFP criticality analysis crediting the NETCO-SNAP-IN® inserts was provided by Global Nuclear Fuel (GNF) report NECD-33672P, Rev. 1, "Peach Bottom Atomic Power Station: Fuel Storage Criticality Safety Analysis of Spent Fuel Storage Racks with Rack Inserts." The analysis determined a maximum k-effective of 0.92552 at a 95% probability and 95% confidence level, and provides an adequate reactivity margin to the regulatory k-effective limit of 0.95.

Two computational methods were used by GNF in the criticality analysis. GNF lattice design code TGBLA06 was used to calculate burned fuel compositions and the in-core k-infinity values. The burned fuel compositions were then used in MCNP-05P, the GNF proprietary version of MCNP5, to obtain fuel storage rack k-effective values.

Tables 12, 13, and 14 of NEDC-33672P provide the biases and uncertainties used to determine the maximum in-rack k-effective. Biases are arithmetically added to the calculated k-effective to account for conditions not directly modeled in the base case analysis. Biases are added for operational variables, abnormal or accident conditions, and additional configurations. Uncertainty components are statistically summed and then added to the calculated k-effective. Uncertainties include manufacturing tolerances as well as computational uncertainties.

10.3.4.1.1.4.4 Abnormal or Accident Conditions

The following abnormal accident conditions were considered in the PBAPS SFP criticality analysis.

1. Missing NETCO-SNAP-IN® insert,
2. Dropped fuel,
3. Damaged fuel,
4. No NETCO-SNAP-IN® inserts on rack periphery,
5. Misplacement of a fuel assembly,
6. Lateral movement of a rack module,
7. Loss of SFP cooling, and
8. Inaccessible storage locations.

Analysis has determined the reactivity impact for the above conditions and determined that they are either bounded by other conditions or the corresponding reactivity increase has been added to the calculated k-effective.

10.3.4.1.1.4.5 Boraflex Credit for the Interim Period

As part of a Peach Bottom license amendment (287/290, 5/21/16) for the NETCO SNAP-IN rack inserts, a license condition took credit for Boraflex during an interim period prior to installation of all inserts. Since NETCO SNAP-IN® rack inserts have been fully installed in both Peach Bottom Unit 2 and Unit 3 Spent Fuel Pool racks, Boraflex is no longer credited as a neutron absorbing material.

GNF report 000N6365-R0, Revision 0, "Peach Bottom Atomic Power Station Units 2 and 3 Spent Fuel Pool Criticality Analysis Gap Sensitivity Study," provides a supplement to NEDC-33686P, Revision 1 that evaluates additional gap configurations. This analysis demonstrates that the results of NEDC-33686P, Revision 1 are bounding when compared to actual gap distributions in the pool.

10.3.4.1.2 Base Plate

The base plate is a 0.50 inch thick stainless steel plate with chamfered through holes centered at each storage location which provides for a seating surface for the fuel assemblies. These holes also provide passage for coolant flow for each fuel assembly.

10.3.4.1.3 Base Support Assembly

Each rack module is provided with base support assemblies which are located at the center of the four corner cells within the module and at interior module locations to distribute pool floor loading.

Each base support assembly is composed of a leveling block assembly, a leveling screw, and a support pad (see Figure 10.3.7). The top of the leveling block assembly is welded to the bottom of the base plate. The leveling block assembly is threaded at the bottom to accept the leveling screw which sits in the support pad providing support for the rack. The screw is remotely adjustable at rack installation to obtain a level condition. The screw has an adjustable range up to 1 inch. The leveling pad has a swivel joint to accommodate a maximum of 2° out-or-level condition of the pool liner.

The base support assemblies are welded to the bottom of the base plate at their appropriate support locations for each rack (refer to Figure 10.3.7). The cell assemblies are then positioned and welded to the top surface of the base plate. The cell assemblies are positioned in a checkerboard pattern with the space between four cell assemblies forming a fifth storage locations. In addition to being welded to the base plate, the vertical corners of adjacent cells are welded to each other at two locations along their length to form a integral structure. Along the peripheral rows of the rack module, stainless steel cover plates are welded between the cell assemblies to enclose the non-cell locations. Some cover plates have wrapper plates with Boraflex, identical to those used on the cells, affixed to their inward side to satisfy adjacent rack module criticality concerns. Each rack has provisions for attachment of a lifting fixture for installation and/or removal of the racks in the spent fuel pool. The base plate has slotted holes at four locations designed to accept lift rods which are inserted down through the storage cells. The lift rods are connected at the top of a lifting fixture.

The structure of the racks is designed to maintain the required spacing between stored fuel assemblies in the event of impact of a fuel bundle dropped on the racks from an elevation of 24 inches (maximum). For this case, the integrity of the storage rack is not compromised and damage to the racks is above the poison area; therefore, the criticality requirements are not violated. The structure of the racks is also analyzed for effects of the impact of a fuel bundle dropped through an empty storage cavity. The fuel drop accident analysis shows that the structure absorbs the energy and the criticality requirements are not violated. Analyses are also conducted of the stresses on a storage rack due to maximum uplift of the refueling crane on a fuel bundle which is stuck. The evaluation of this case showed no permanent deformation of the storage rack. The high density spent fuel storage racks are seismic Category I equipment as defined in NRC Regulatory Guide 1.13. These racks are designed to withstand the effects of a maximum credible earthquake and remain functional, in accordance with NRC Regulatory Guide 1.29 and the Code of Federal Regulations, Title 10, Part 100.

The basic design criteria for the spent fuel storage rack are outlined by the NRC position paper. The NRC position paper entitled "OT Position For Review and Acceptance of Spent Fuel Storage and Handling Applications" dated April 14, 1978, as amended by the NRC letter dated January 18, 1979, offers two codes for deriving the allowable stresses. The two codes are AISC Code or the ASME Code III Subsection NF. The structural analysis herein is based on the allowable stresses as outlined in ASME Code III Subsection NF. The results of the seismic and structural analyses are interrelated as the loads of the seismic analysis are used in the structural analysis to calculate stresses. The resulting margins of safety are positive and satisfy the requirements of the ASME code. The pool floor loads resulting from the seismic and structural analyses also satisfy the requirements of the PECO specification for the spent fuel storage racks. The displacement results of the seismic analyses are used in the lift-off stability calculation and show that factor of safety against overturning is greater that the 1.5 minimum requirement of the NRC position paper. The rack seismic displacements are used in conjunction with thermal displacements to show that there is no rack-to-rack, rack-to-pool floor obstruction collision.

10.3.4.2 Spent Fuel Pool

The fuel pool together with the dryer-separator storage pool form a channel-shaped beam supported in the middle by the biological concrete shield structure and at the outer ends by the building walls.

The pool floor carries a live load in addition to the water load. A system of large steel shapes is used to support the weight of the wet concrete only. Deep beam action was checked and interactions of elements accounted for. A finite element analysis was performed to check temperature stresses in combination with other loads. Hydrodynamic effects of water were also included in the analysis.

Once the integrity of the system was ascertained, local stresses, embedments, connections, girder deflection, and discontinuities were investigated.

The pool is lined with stainless steel and is designed to preclude inadvertent loss of water from the pool.

There are no connections to the fuel storage pool which could allow the fuel pool to be drained below the pool gate between the reactor well and the fuel pool when the pool gate is in place or below 10 feet above the top of active fuel. Lines extending below this level are equipped with syphon breaker holes to prevent inadvertent pool drainage. Systems for maintaining water quality and quantity are designed so that any maloperation or failure of such systems will not cause fuel to be uncovered.

The fuel storage pool is designed to seismic Class I criteria and so that no single failure of structures or equipment will cause the inability (1) to maintain irradiated fuel submerged in water, (2) to reestablish normal fuel pool water level, or (3) to safely remove fuel. To prevent leakage, the pool is lined with stainless steel. In addition to providing a high degree of integrity, the lining is reinforced to withstand forces that might occur when the transfer cask is moved in the cask storage area.

Interconnected drainage paths are provided behind the liner. These paths are designed (1) to prevent pressure buildup behind the liner plate, (2) to prevent the uncontrolled loss of contaminated pool water to the secondary containment, and (3) to provide expedient liner leak detection and measurement.

Protection of the pool liner in the cask storage area for the normal cask lowering operation is provided by a 1-inch thick steel wearing plate. This will prevent any damage to the liner over plant life occasioned by normal fuel cask handling. Additionally, interlocks are provided to prevent the crane trolley, with a predetermined load on its main hook, from passing over the fuel pool. Strict administrative control is used for bypassing the interlocks during cask handling operations.

The reactor building crane main hook and the lifting device associated with the cask are of a single failure proof design such that a single failure will not result in dropping the load. The available makeup water sources to the spent fuel pool and associated flow rates are presented in Table 10.3.1.

The spent fuel pool cask pit area restraining structure has been analyzed to withstand cask impacts due to postulated design events. Cask placement in the center of the cask pit area is controlled in accordance with station procedures. This includes maintaining the appropriate centering tolerance as well the angular placement of the cask with respect to the trunnions and the restraining structure.

10.3.4.3 Fuel Pool Level Alarms

Low water level alarms are provided locally and in the main control room in the event of water loss. The low water level alarms are part of the fuel pool cooling system. As a backup, flow alarms are provided in the drain lines of the reactor vessel to drywell seal, drywell to concrete seal, and fuel pool gate to detect leakage.

10.3.4.4 Dry Cask Storage

Dry Cask Storage of spent nuclear fuel has been evaluated for PBAPS. This program meets the requirements of 10CFR 72 and utilizes the General License issued under 10CFR 72.

10.3.4.4.1 Dry Cask Storage Rigging and Handling

The storage cask is handled by the Reactor Building Crane in a single failure proof configuration. Other cask components such as the lid and basket hold down ring are also handled in a single failure proof configuration unless specifically evaluated otherwise in accordance with UFSAR Section 10.A.11. All cask movement in the Reactor Building will be consistent with NUREG-0612, over designated safe load paths and either with the single failure proof Reactor Building Crane or with the cask transporter with the cask at the appropriate analyzed heights. All cask movement in the Reactor Building will be on designated safe load paths to ensure that cask drop loads where applicable will not affect the safety of the

PBAPS plant. The cask transporter is not single failure proof but has been evaluated for cask drops and found to be acceptable. The cask is rigged in a single-failure-proof configuration while in the spent fuel pool by ensuring a procedurally controlled amount of water is removed from the loaded cask.

10.3.4.4.2 Dry Cask Structural Considerations

A calculation was performed to consider the acceptability of a drop of a loaded cask from a cask transporter in the Reactor Building onto the Elevation 135' floor. The calculation demonstrates the structural adequacy of the impact floor and the absence of effects on safety related equipment beneath it at a lift height less than 2.5”. Superficial damage to the floor at el. 135' would be repaired as appropriate. The lift height is procedurally controlled.

The cask will be rigged in a single failure proof configuration while rigged from the reactor building crane in the Reactor Building hatchway. The placement of the cask in the hatchway will be such that credible cask swinging in the hatchway during a seismic event will not result in cask / plant impacts. Therefore, damage to the plant is precluded.

The structural capacity of the Reactor Building floor at el. 234' has been evaluated for cask operations. These analyses assumed a coincident maximum credible earthquake. The designated cask laydown area is controlled by spent fuel procedures.

The restraint structure (without the vertical guides) in the spent fuel cask pit area of the fuel pool was modeled using finite element analysis techniques and evaluated for structural adequacy under the effects of combined loadings postulated for the structure consistent with the PBAPS UFSAR Appendix C.

Cask impacts on the restraint structure due to postulated seismic (MCE) event were evaluated for the suspended cask (pendulum effect during hoisting) and for the free-standing cask located on the wear plate (sliding and tipping) and found acceptable.

Administrative controls and procedural requirements assure that the cask is appropriately centered within the specified tolerance during the move-in/move-out and cask placement operations.

Passage of the cask transporter over the access road and haul path, with or without a cask, does not physically affect systems, structures and components (SSCs) of the PBAPS plants. The haul path and access road are well defined by roadway markings to guide the cask transporter driver. In the event the transporter fails or is inadvertently driven off the designated haul path, off-normal procedures exist to ensure that operations are halted. Cask drops along the transport route were evaluated and found acceptable.

10.3.4.4.3 Dry Cask Fuel Pool Operations

Cask insertion into the fuel pool will be controlled by procedures to ensure that the fuel pool level is maintained. Fuel pool level will be procedurally controlled by a combination of activities, including as necessary, turning off the fuel pool cooling system, lowering and raising the fuel pool level control weir gate, draining/filling the skimmer surge tanks, and controlling the filling and draining of the casks as appropriate. None of the involved activities can result in inadvertent draining of the fuel pool.

Before each cask loading campaign a plan will be prepared that specifies the fuel assemblies to be moved from the pool into the cask, and their specified assigned location in the cask fuel basket. Selection of the correct fuel assemblies from the fuel pool racks and correct placement in the cask basket will be controlled by procedural methods. Any mispositioning that could occur would be detected by confirmatory monitoring. Normal site fuel movement procedures will be used by appropriately qualified personnel.

The elevation of the fuel bundles must be increased in order to provide clearance over the lip of the open dry storage casks, which are taller than the cask for which the spent fuel pool was originally designed.

The new normal-up setpoint needed to load an ISFSI cask will be used only for fuel cask loading and unloading operations.

10.3.4.4.5 Dry Cask Storage Design Basis Events

The postulated events that could occur during cask operations are discussed in the IFSSAR and 10CFR 72.212 Report. The following is a summary of those events that could have potential impacts or interaction with PBAPS 2 and 3.

Fuel Bundle Drop

A design basis fuel bundle drop was evaluated and found to be bounded by existing accident analysis. Criticality, radiological releases and effects on the ISFSI cask and fuel pool liner were evaluated and found acceptable.

Wrong Fuel Insertion

The TN-68 IFSSAR evaluates the impact on the cask if an incorrect fuel assembly is loaded. These events are precluded due to administrative control and training of personnel involved with loading the cask. Procedural controls will ensure that only allowed fuel is selected for loading into a cask. Additionally, verifications of fuel being loaded will ensure that incorrectly loaded fuel does not go undetected. The TN-68 IFSSAR concludes that fuel with heat generation greater than allowed is not a concern to the cask as long as the cask is submerged in the fuel pool. Because there are multiple layers of fuel verification prior to placing the lid on the cask, there is no concern for incorrectly loaded fuel with a higher than allowed heat generation rate. The TN-68 IFSSAR evaluates the loading of a fuel assembly with higher than allowed enrichment and determines the impact on the criticality margin in the cask. For worst case conditions and placement into the cask, a fuel assembly with an initial enrichment of 5.0% was evaluated and determined to not cause any criticality concerns. Loading verifications prior to placing the lid on the cask would detect the incorrectly loaded assembly and remove it prior to continuing loading operations.

Cask Drop / Tip

Various scenarios involving the potential for cask drop/tip were evaluated. In no case, does the cask tip over. For the drop scenarios, the cask remains within its licensed design basis.

Natural Events

The cask and associated support equipment has been evaluated for various natural events. In all cases, the cask was shown to not tip over. Cask drops are possible when suspended on the transporter, however, these drops have been evaluated as discussed earlier. Impacts of natural events have been considered in the analysis of the cask while in the Reactor Building and have been found to not result in an uncontrolled lowering of the cask or other damage to plant equipment due to cask impacts.

Fires and Explosions

The TN-68 cask is designed to withstand various fires and explosions. The cask is not combustible and therefore poses no new significant fire or explosion threat to the plant. The transporter has been evaluated and found acceptable.

Cask Seal Leak

The worst case seal leakage has been demonstrated in the TN-68 SAR to be well below regulatory limits.

Cask Loading Operations Issues

During cask loading, various contingency actions may be required to perform in the event (for example) of the inability to get the cask adequately drained and filled with helium or the inability to meet the leak tightness requirements. Procedures exist to direct actions in these off-normal conditions. These conditions are governed by TN-68 Tech Specs to ensure that cask parameters are not exceeded. These actions may include returning the cask to the spent fuel pool for unloading. Because there are adequate controls on the cask in these off-normal conditions, there is no impact to PBAPS 2 and 3 operations.

Cask Unloading Operations

If the cask is required to be unloaded or a seal repair is required, the cask is returned to the Reactor Building. The cask transport route follows the same load path as for transport to the ISFSI. A cavity gas sample shall be obtained and analyzes and the cask depressurized to a nominal atmospheric pressure. The cask is refilled with water and the outlet line from the cask is piped below the surface of the pool with a sparger attached at the discharge end. Steam is quenched by the relatively cool fuel pool water. Helium bubbles released from the cask would rise to the surface to mix with the refueling floor atmosphere and be dissipated by the HVAC system. Particulates released from the cask would be scrubbed out by the fuel pool water and filtered by the Spent Fuel Pool Cooling and Cleanup System (SFPCCS). Except for Kr-85 and

I-129, the constituents of the gas gap from leaking rods is scrubbed out by the fuel pool water and handled by the SFPCCS. The dose due to noble gases from the unloading operation, assuming 100% failed fuel in the cask, results in a lower offsite dose than that from the refueling accident analyzed in Section 14.6.4 of the PBAPS SAR.

The heat added to the pool water is well within the cooling capacity of the SFPCCS. It is capable of receiving a full core offload directly from the reactor and still keep the pool temperature at an acceptable value. The heat from only 68 assemblies plus the latent heat stored in the cask materials is insignificant compared to that from a full core offload.

10.3.4.4.6 Dry Cask Storage Programs

As required by 10 CFR 72.212, the PBAPS radiation protection, emergency preparedness, security and training programs were updated to incorporate dry cask storage.

10.3.4.4.7 Dry Cask Operations

Helium is used during dry cask operations. The exhaust of helium into the reactor building atmosphere is not a concern to the plant since the helium is an inert gas and readily dissipates. The exhaust will be vented to the Fuel Floor area for further processing in the ventilation system.

The cask is drained of water when it is raised to the fuel pool surface water level. Evaluations and procedural controls have been developed to ensure that the cask is not raised out of the pool such that the reactor building crane or lift beam would exceed its single failure proof rating.

The casks are dried to ensure that long term corrosion of the cask is minimized. The vacuum pumps exhaust will be appropriately monitored by radiation protection personnel and filtered as necessary. The vacuum pump discharge is directed to the fuel floor area for further processing by the refuel floor ventilation system. Cask over-pressurization with helium is not a concern when using procedurally controlled standard bottles and pressures. This is due to the large volume of the cask compared to the small volume of the helium bottle.

Leak testing is performed using calibrated leak testing equipment. This equipment is appropriately controlled and poses no significant risk to the plant. Leak testing ensures that the cask is properly sealed for transport and storage outside of the reactor building.

The operations skid is designed to facilitate the evaluations required to drain, dry, inert, and test a spent fuel cask. This equipment is not safety related. Appropriate I&C measuring and test equipment will be controlled in accordance with procedures and will be within calibration frequency.

10.3.5 Safety Evaluation

The design of the spent fuel storage racks and dry storage casks provides for a subcritical effective multiplication factor (k_{eff}) for both normal and abnormal storage conditions. Under any condition the k_{eff} is equal to or less than 0.95. The spent fuel pool concrete structure, as well as each spent fuel storage rack and fixture loaded with fuel, are designed to seismic Class I criteria to withstand the maximum credible earthquake.

The spent fuel pool is adequately protected from the effects of a turbine generated missile. The probability of a turbine generated missile is small and is detailed in Section 11.2. The fuel pool is protected against low trajectory missiles by thick concrete walls between the turbine and the pool as well as the thick concrete pool walls. Once a high trajectory missile is generated, the possibility of it landing in the pool is in the range of 10^{-4}. Therefore, the combined risk to the fuel pool from a high trajectory turbine missile is insignificant.

The spent fuel pools are designed with substantial capability to withstand the effects of a tornado, including tornado-generated missiles. Discussion of this capability is provided in Paragraph J.5.2.

Additional information is provided in Topical Reports APED-5696, "Tornado Protection for the Spent Fuel Storage Pool" (General Electric, November, 1969) and "Tornado Criteria for Nuclear Power Plants" (Bechtel Corporation, July, 1969).

The spent fuel storage pools are located in the reactor buildings which serve as secondary containment for the reactors (subsection 5.3). Each reactor building is designed to control leakage from the building and provides filtration, through the standby gas treatment system, to limit radioactive discharges in the event of an accident.

Ventilation air from the spent fuel pool area is not normally filtered prior to exhaust to the atmosphere. The standby gas treatment system is described in paragraph 5.3.3.

The consequences and assumptions used in evaluating a refueling accident are presented in paragraph 14.6.4. The analysis provided in subsection 14.6.4 uses conservative assumptions, similar to those provided in Regulatory Guide 1.25, to demonstrate that releases from a postulated refueling accident result in doses which are well within 10CFR100 limits.

Provisions are made for level detection to ensure the fuel in the spent fuel storage is covered with sufficient water for radiation shielding. Leakage detection instrumentation is also provided to ensure an adequate fuel pool water level is maintained. The design of the spent fuel pool structure is such as to prevent inadvertent draining of the pool.

The radiation levels are monitored in the refueling floor exhaust duct. Both low and high radiation signals are alarmed in the control room and a high-high radiation signal isolates the duct and initiates the standby gas treatment system.

The high-density SFP storage racks utilize Boraflex as a neutron absorber material for reactivity control. Due to Boraflex degradation, PBAPS implemented an ongoing Boraflex monitoring program, to include RACKLIFE simulation of the rack degradation and blackness testing using the BADGER B-10 areal density measurement system. A SFP rack insert program has also been implemented that will replace Boraflex. The effect of plant operation at 100% rated thermal power on Boraflex degradation is accounted for by the Boraflex monitoring program until installation of the SFP rack inserts is completed. A reduction in the amount of Boraflex in the SFP racks will reduce the criticality margin such that actions are required to ensure that the Licensing Basis requirements continue to be met. To ensure the SFP storage racks can maintain criticality margin in accordance with the PBAPS Technical Specification 4.3.1.1.b requirement of 5 percent ($K_{eff} \leq 0.95$), the peak in-core fuel bundle K_{inf} is limited as follows:

1. A peak in-core fuel bundle K_{inf} limit of 1.235 has been established and applies until all of the SFP rack inserts are installed.

2. A peak in-core fuel bundle K_{inf} limit of 1.270 has been established and applies after all of the SFP rack inserts are installed.

The peak in-core K_{inf} limit for the fuel bundles used in the representative equilibrium cycle core design is 1.2095, which is bounded by the K_{inf} limits of 1.235 and 1.270. Therefore, these bundle K_{inf} limits ensure the SFP criticality margin is maintained before and after all of the SFP rack inserts are installed.

Dry cask storage casks were evaluated for various design basis events and normal conditions and found acceptable in accordance with the IFSSAR and 10CFR 72.212 Report.

10.3.6 Inspection and Testing

Dry storage casks are appropriately inspected and tested to ensure design basis assumptions are met.

The in-service inspection program for the spent fuel storage racks involves periodic assessment of neutron poison material performance.

10.3.6.1 Boraflex Inspection and Testing

This assessment may utilize jacketed Boraflex specimens contained in surveillance coupon assemblies hung on the periphery of a rack module.

A computer based Boraflex performance model and direct measurement of the B-10 areal density of representative in-service spent fuel storage rack panels may be used in conjunction with or in replacement of coupon inspection.

10.3.6.2 Neutron Absorbing Inserts Surveillance Program

The rack insert surveillance program is designed to monitor the physical properties of the insert material by performing periodic physical inspection and neutron attenuation testing to confirm the ability of the material to perform its intended function.

10.3.6.2.1 Fast Start Coupon Surveillance Program

Exelon initiated a "Fast Start" coupon surveillance program at LaSalle County Generating Station to provide early performance data on the coupon exposure to maximum temperature and gamma irradiation. The program consists of

24 coupons suspended inside of a spent fuel storage rack cell and surrounded in all adjacent cells with freshly discharged fuel. Two of the coupons will be removed approximately every six months for testing, inspection and comparison to their pre-installed condition. Initial results showed essentially no change in the coupon characteristics. Because the spent fuel pool chemistries at PBAPS are similar to LaSalle, this program provides information on initial material performance and is a basis for confidence that early insert response to the SFP environment is acceptable.

PBAPS will monitor LaSalle's program to identify any unanticipated insert material performance issues including review of their coupon test reports. Information obtained will be used to evaluate the long-term and the full rack insert surveillance programs at PBAPS and make any necessary modifications.

10.3.6.2.2 Long-Term Coupon Surveillance Program

The long-term coupon surveillance program consists of a specially designed monitoring tree to which a series of surveillance coupons are attached. The monitoring tree, placed within the PBAPS spent fuel pools, will reside there as long as the spent fuel storage racks with NETCO-SNAP-IN® rack inserts continue to be used. Periodically, as described below, coupons will be removed and sent to a qualified laboratory for testing.

Table 10.3.6.1

Long-Term Surveillance Coupons

Coupon Type	Number	Objective
General	48	(See next Table)
Bend	24	Track effects along bend radii
Galvanic (bi-metallic)	24	Trend galvanic corrosion with 304SS, Inconel 718 and Zircaloy coupons

Specific coupons will be removed from the tree on a frequency schedule in the following tables. The general coupons will be subject to pre- and post-examination according to the following:

Table 10.3.6.2

Long-Term Surveillance General Coupon Characterization

Test	Pre-Characterization	Post-Characterization	Acceptance Criteria
Visual (high resolution digital photo)	X	X	Evidence of Visual indications
Dimension	X	X	Min. thickness: 0.005 inch less than nominal thickness Length Change: Any change of +/-0.02 inch Width Change: Any change of +/- 0.02 inch Thickness Change: Any change of +0.010 inch/- 0.004 inch
Dry Weight	X	X	Any change of +/- 5%
Density	X	X	Any change of +/- 5%
Areal Density	X on select coupons	X	0.0102 $Boron^{-10}$ g/cm^2 minimum loading
Weight Loss		X	Any change of +/- 5%
Corrosion Rate		X	< 0.05 mil/yr
Microscopy		X as required	At the discretion of the test engineer
Bend Coupon Stress Relaxation		X	50% stress reduction (to maintain 100 lbf retention force)

The frequency for coupon inspection is shown in the following table.

Table 10.3.6.3

Frequency for Coupon Inspection

<table>
<tr><th>Coupon Type</th><th>First Ten Years</th><th>After 10 Years with Acceptable Performance</th></tr>
<tr><td>General</td><td>2 coupons every 2 years</td><td>2 coupons every 4 years</td></tr>
<tr><td>Bend</td><td>1 coupon every 2 years</td><td>1 coupon every 4 years</td></tr>
<tr><td>Galvanic
Couples 304
Stainless
Zircaloy
Inconel 718</td><td colspan="2">1 couple every 6 years
1 couple every 6 years
1 couple every 6 years</td></tr>
</table>

10.3.6.2.3 Full Rack Insert Surveillance Inspections

Two rack inserts will be visually inspected by camera at the frequency of the general coupon removal schedule described above to visually monitor for physical deformities such as bubbling, blistering, corrosion pitting, cracking, or flaking. Special attention will be paid to development of any edge or corner defects.

A region of high duty spent fuel storage rack cell locations will be identified and will be monitored for fuel insertion and removal events to ensure that their service bounds that of the general population of storage locations. Once every 10 years, an insert will be removed from this region and will be inspected for thickness along its length at several locations and be compared with the as-built thickness measurements of the removed insert to verify it has sustained uniform wear over its service life. After the inspection, the insert will not be reinstalled.

TABLE 10.3.1

AVAILABLE MAKEUP WATER SOURCES

Source	Route	Rate (gpm)
Torus	One RHR pump to fuel pool[1]	10,000
Refueling water storage tank and/ or condensate storage tank	One refueling water pump to reactor well header, to fuel pool cooling pumps, to bypass filter, to fuel pool	1,650
Condensate storage tank	High-pressure decontamination pump to fuel pool	25
Condensate storage tank	Fuel pool makeup from condensate transfer pump	60
Demineralized water storage	To demin. water supplies in service boxes	150
Total demineralized water available immediately		1,885
Total demineralized water available after 1 hr[2]		11,885
River water	High-pressure service water pumps via RHR cross-tie[2,3]	18,000
River water	Fire waterhose stations (2-3 in)	70
Total river water available immediately		70
Total river water available after 1 hr[3]		18,070

(1) Approximately 1 hr is required to install the removable spool before supply can be used.
(2) Can only be used if plant is shut down and RHR cooling is with RHR pumps A and/or C.
(3) Alternate to torus water using RHR pumps.

TABLE 10.3.2

RACK MODULE DATA (PER UNIT)

QTY	ARRAY	STORAGE LOCATIONS	RACK ASSY DIMENSIONS (INCHES)	DRY WEIGHT (LBS) PER RACK ASSY
1	9 x 14	126	54 x 89 x 180	10,000
2	10 x 14	280	64 x 89 x 180	11,200
1	11 x 14 Mod.	119	70 x 89 x 180	9,500
1	12 x 15	180	76 x 95 x 180	14,400
1	12 x 17	204	76 x 107 x 180	16,300
2	12 x 20	480	76 x 126 x 180	19,200
2	15 x 19	570	95 x 120 x 180	22,800
1	17 x 20	340	107 x 126 x 180	27,200
4	19 x 20	1,520	120 x 126 x 180	30,400
15 racks		3,819		

Storage locations center-to-center spacing (inches) 6.28

Storage cell liner dimension (inches) 6.07

Intermediate storage location inner dimension (inches) 6.12

10.4 TOOLS AND SERVICING EQUIPMENT

10.4.1 Introduction

All tools and servicing equipment necessary to meet the reactor general servicing requirements are supplied for efficiency and safe serviceability. The flow chart in Figure 10.4.1 defines in a general way the steps that make up a routine refueling outage. The heavy lines on the chart define the critical path in a normal outage. Deviations to this path may be encountered under abnormal circumstances. The following paragraphs describe the use of some of the major tools and servicing equipment.

10.4.2 Fuel Servicing Equipment

Two fuel preparation machines located in each fuel storage pool are used to remove and install channels to support inspection or servicing of fuel assemblies. The fuel preparation machines are also used for the placement of new fuel assemblies into the spent fuel pool. These machines are designed to be removed from the pool for servicing.

An equipment support railing is provided around the pool periphery in order to tie off miscellaneous service equipment and for personnel safety. Equipment lugs fabricated as part of the pool liner are required for fixtures that might later be desired by plant operating personnel. In addition, a curb with a plate of thick stainless steel on top is provided around the entire periphery of the refueling volume. Additional equipment may be mounted by welding to, or drilling into, the plate. The curb may be used as an additional support or tie-off area. Cable ways are recessed into the floor around the pool periphery with openings to pass cables into the pool from underneath this curbing.

The new fuel inspection stand is provided to restrain the fuel assembly in a vertical position for inspection. The inspection stand can hold two assemblies. The general purpose grapple is a small, hand actuated tool used generally with fuel. The grapple can be attached to the reactor building auxiliary hoist, the jib crane, and the auxiliary hoists on the refueling platform. The general purpose grapple is used to place new fuel in the inspection stand and transfer it to the fuel pool.

A channel handling boom, with spring loaded takeup reel, is used to assist the operator in supporting the weight after the channel is removed from the fuel assembly. The boom is located between the two fuel preparation machines. With the channel handling tool attached to the reel, the channel may be conveniently moved between fuel preparation machines.

The complete channeling procedure is as follows. Using the refuel platform and the mast grapple, a spent fuel assembly is lifted into the fuel preparation machine with the carriage lowered. After raising the assembly to its high position, the channel is unbolted from the fuel assembly using the channel bolt wrench furnished for this purpose. This wrench is used to unscrew the bolt and capture it. The channel handling tool is attached to the channel handling boom and lowered to the channel. The tool is attached to the channel triangular corner tabs by expanding two fingers on the tool. The channel is then held, and the fuel preparation machine carriage is lowered, causing the fuel bundle to slide down out of the channel. The channel is then positioned over the other fuel preparation machine, containing a new fuel assembly, and the procedure is reversed. A channel storage rack for accumulating channels is located on the wall between the fuel preparation machines. A channel check gage may be mounted on the wall adjacent to the fuel machines so the operator can check channels. The channeled fuel is stored in the pool storage racks, ready for insertion in the reactor.

10.4.3 Servicing Aids

General and local area underwater lights are provided to illuminate the internal region of the reactor vessel. Drop lights are used for intense radial illumination where needed. These lights are small enough in diameter to fit into fuel channels or control blade guide tubes. A portable underwater television camera and monitor are part of the plant optical aids. The transmitted image can be viewed on the refueling platform. This remote display assists in the inspection of the vessel internals, and general underwater surveillance in the reactor vessel and fuel storage pool. General purpose, clear plastic viewing aids that will float are used to break the water surface for better visibility.

A portable underwater vacuum cleaner is provided to assist in removing debris and miscellaneous objects from the pool floor or the reactor vessel. The pump and the filter unit are completely submersible for extended periods. Fuel pool tool accessories are also provided to meet servicing requirements.

10.4.4 Reactor Vessel Servicing Equipment

Reactor vessel servicing equipment is supplied for safe handling of the vessel head and its components, including nuts, studs, bushings, and seals.

The drywell head strongback is used for lifting the drywell head and mirror insulation. Cruciform in shape, with four equally spaced lifting points, the strongback is designed to keep the drywell head level during lifting and transport. Redundant rigging is used to connect the drywell head to the single-failure-proof strongback, resulting in a single-failure-proof lift. An exception to the single-failure-proof requirements in ANSI N14.6-1978 is that two structural features added during modifications to upgrade this device were not impact-tested. (Ref. ECR 13-00378)

The Reactor Pressure Vessel (RPV) head strongback/carousel is used for lifting the vessel head. The strongback/carousel is an integrated piece of equipment consisting of a cruciform shaped strongback, a circular monorail, and a circular storage tray.

The strongback is a box beam structure which has a hook box with three pins in the center for engagement with the reactor building crane main hoist hook. Each arm has a liftrod for engagement to the four lift lugs on the RPV head. The monorail is mounted on extensions of the strongback arms and four additional arms equally spaced between the strongback arms. The monorail circle matches the stud circle of the reactor vessel and it serves to suspend stud tensioners and nut handling device.

The head strongback carousel service the following functions:

Lifting of Vessel Head - The strongback, when suspended from the reactor building crane main hook, transports the RPV head plus the carousel with all its attachments between the reactor vessel and storage on the pedestals. The strongback and its connections to the RPV head are single-failure-proof. One exception to the single-failure-proof requirements in ANSI N14.6-1978 is that the hook and load pin material for this device was not impact-tested as specified in ANSI N14.6-1978. (Ref. ECR 13-00378)

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

The head holding pedestals are designed to support the vessel head to permit seal replacement and seal surface cleaning and inspection. The mating surface between vessel and pedestal is selected to minimize the possibility of damaging the vessel head.

A reactor servicing platform permits the operator to work at a level just above the reactor vessel flange, and permits servicing access for the full core diameter. A service platform support is provided, which rests on the vessel flange surface, and serves as both a track for the servicing platform and as a seal surface protector.

A separate seal surface protector made of aluminum is provided to protect the sealing surface of the reactor pressure vessel flange when the service platform or its track is not used.

A stud tensioner assembly is provided, and consists of four tensioners transported by the reactor building crane main hoist or the head strongback/carousel. The tensioners are controlled by a hydraulic unit with pressure gages. Each tensioner contains:

1. An integral nut wrench for rotating the nut.

2. One stud elongation gage plus one elongation rod per stud to permit initial and periodic pressure/stretch indication.

10.4.5 In-Vessel Servicing Equipment

The single or multiple instrument strongback is attached to the reactor building crane auxiliary hoist and is used to lift replacement in-core detectors from their shipping container. The instrument handling tool is attached to the in-core detector by the operators on the refueling platform. The single or multiple strongback initially supports the in-core detector(s) as they are lowered into the vessel, and the in-core detector is then decoupled from the strongback. Final in-core detector insertion is accomplished with the instrument handling tool. The instrument handling tool is used for removing and installing fixed in-core detectors, as well as for handling neutron sources and the WRNM dry tubes.

10.4.5.1 Reactor Cavity Work Platform

The Reactor Cavity Work Platform (RCWP) is a tool used to allow in vessel inspection/activities concurrent with fuel movement thereby reducing refueling critical path time. The RCWP is a stainless steel structure which consists of four (4) quadrants connected using three sets of splice plates. The RCWP is stored in four (4) specially designed sea land containers, and is brought to the refueling floor and assembled prior to use.

The RCWP has an octagonal shaped structural framework with eight radial legs which support four (4) personnel work baskets. The eight support legs rest on the reactor building elevation 234’-0” floor slab. The platform, when placed in the reactor cavity above the open reactor pressure vessel (RPV), is slightly submerged into the reactor cavity water. The bottom of the work baskets is approximate elevation 231’-0” which provides approximately 7’-0” clearance to the underside of the refueling bridge. The RCWP legs have the capability to both extend/retract and rotate in order to avoid obstructions such as the electrical pits and refuel bridge gearbox, which are present on the operating deck. The RCWP has a 30-degree refueling opening in the direction of the fuel pool to allow for refuel bridge mast and fuel bundle movement while performing in vessel activities. Electrical power and station air outlets are also provided in the RCWP work baskets.

10.4.6 Refueling Equipment

The refueling platform is used as the principal means of transporting fuel assemblies back and forth between the reactor well and the storage pool. The platform travels on rails extending along each side of the reactor well and fuel pool. The platform supports the fuel grapple and the frame-mounted and monorail auxiliary hoists. The grapple is suspended from a trolley system that can traverse the width of the platform. Platform operations are controlled from either auxiliary hoist control pendant or the fuel grapple controller consoles. The platform contains a position-indicating system that indicates the position of the fuel grapple over the core. The platform is prevented from contacting the fuel pool and reactor walls by a boundary zone interlock system.

One-half ton auxiliary hoists are mounted on both the reactor well side of the refueling platform and on the platform trolley. These hoists normally can be used with appropriate grapples to handle control rods, in-core detectors, sources, and other internals of the core. The auxiliary hoists can also serve as a means of shuffling fuel elements and other equipment within the pool and reactor.

A single operator is capable of controlling all the motions of the platform required to handle the fuel assemblies during refueling. Interlocks on both the grapple hoist and auxiliary hoists prevent lifting a fuel assembly over the core with control rod withdrawn; interlocks also prevent withdrawal of a control rod with a fuel assembly over the core attached to either the fuel grapple or auxiliary hoists. Interlocks also block travel of the refueling platform over the reactor in the startup mode. The refueling interlocks are described and evaluated in subsection 7.6, "Refueling Interlocks."

A Service Pole Caddy platform is attached on the rear side of either the Unit 2 or Unit 3 refueling platform at PBAPS. The platform provides an auxiliary work station for unlatching and latching the steam separator head bolts during refueling activities. The platform can also be utilized for other underwater servicing needs, such as jet pump beam bolt untorquing and steam line plug installation. The platform is provided with high torque service poles and a motorized hoist to handle the poles.

10.4.7 Storage Equipment

In addition to the new and spent fuel storage racks, other storage equipment is provided.

Defective fuel assemblies may be placed in special fuel cans which would be stored in the defective fuel storage rack.

10.4.8 Under-Reactor-Vessel Servicing Equipment

The necessary equipment to remove CRD's during a refueling outage is provided. An equipment handling platform with a rectangular open center is provided. This platform is rotatable to provide space under the vessel so the CRD can be lowered and removed.

A thermal sleeve installation tool (Figure 10.4.3) is used to rotate the thermal sleeve (Figure 10.4.2) within the CRD housing. Sleeve rotation permits disengagement of the guide tube. A rope and pulley integral with the tool permits complete sleeve removal.

Miscellaneous wrenches are provided to install and remove the neutron detectors. Flow through the drain tube pulls the fixed in-core detector string into the in-core guide tube thus sealing the opening in the in-core flange during in-core servicing. A drain can be opened after in-core insertion to drain any residual water. Correct seating of the in-core string is indicated when drainage ceases.

10.4.9 Equipment Storage Pit

Large radioactive components, such as the steam dryer and steam separator assembly are stored in the storage pit. The storage pit is separated from the drywell by removable concrete blocks that serve as a shield when the dryer and separator are stored and the water level is lowered. Other large items, such as the pressure vessel head and drywell head, are stored on the refueling floor.

To minimize worker exposure, a wet transfer of the dryer is normally expected. To minimize operator exposure during a dry transfer of the dryer assembly, the storage pit canal is deep enough so that the top of the dryer can be kept at least 2 ft below the operating floor level during transfer. The storage pit is deep enough below the canal that, with the reactor well drained, a minimum of 6 in of water shielding can be maintained above the separator plenum dome.

Special liner considerations account for the abrasion and high unit loadings that occur on areas where the dryer and separator assemblies are placed.

The storage pit is lined with stainless steel for leaktightness and corrosion resistance.

10.4.10 Reactor Building Crane

The reactor building crane for each unit is designed such that no credible postulated failure of any crane component will result in the dropping of the fuel cask; therefore, the consequences of this accident are precluded.

The reactor building cranes have been evaluated using the criteria of NUREG-0554 and NUREG-0612, Appendix C to establish the maximum critical load (MCL) rating at which they can be considered single-failure proof. The results of this evaluation resulted in a MCL rating of 125 tons for the main hoist reactor building cranes. Thus, for loads within this limit, a load drop is not credible.

The design of the main hoist is as follows:

A single hoist motor drives two separate shafts. The motor has two centrifugally tripped limit switches, one outboard of each hoist input pinion at each end of the motor shaft assembly. These provide an automatic safety shutdown and protection from any control or motor malfunction which might result in a runaway condition of the load. Each motor driven shaft passes through a 150 percent capacity solenoid-actuated brake. A failure of either the motor shaft, the connecting shafts, or the shaft couplings singly would not result in a load drop as the brakes would be effective in holding the load. On loss of power to the motor, both brakes engage. They can also be engaged by the operator. Additionally, there is a 90 percent capacity eddy-current brake to limit the rate of load lowering.

After the brake, each motor shaft enters its own gear reducer. If a component of one gear case (gear teeth, shafts, bearings, or structural component) should fail, the other gear reducer holds the load with its brake with a safety factor of 5.

Each gear case is fitted on its output end with a pinion meshing with the drum gear. A failure of a pinion, drum gear, pinion shaft, or pinion bearing results in the load being carried by the other similar set of parts on the other end of the drum. Again a safety factor of 5 remains in the functioning parts. In each of the main hoist gear cases, there is a mechanical load brake, with cooling of the gear case oil, to offer additional safety in load handling.

In the event of failure of the drum shaft, drum bearing, or drum bearing bracket, the drum flange drops a fraction of an inch onto machined structural seats so located that the drum is supported and the remaining pinion and gear stay in mesh to restrain the load. A safety factor of 5 still remains.

Two separate ropes are led from the drum, each being reeved through a set of block sheaves, upper and lower, and back to an equalizer bar, and are arranged for equal division of the load between the two ropes. With both ropes functioning and equalized, the safety factor of the ropes is 7 on a static basis. If one rope fails, the remaining rope supports the load with a residual safety factor of 3.5 on a static basis. The equalizer bar is fitted with double acting hydraulic cylinders and hydraulic accumulator to minimize the shock when the entire load is transferred to one rope. Therefore, load drop is precluded for a postulated single rope failure. The equalizer bar is contained within structural components so that if it breaks or if its pivot point breaks, the parts are retained within the trolley and load drop is precluded. To protect against overloading of the cables a load sensing system consisting of tension type load cells supports the load sensing sheave frame assembly. The load cells are supported by the load cell support brackets attached to the trolley frame. To protect against an unbalanced load, limit switches provide visual warning indication to the crane operator. The limit switches, attached to the trolley frame, are activated by movement in the equalizer bar assembly.

All sheaves, both upper and block sheaves, are contained in heavy structural casings which usually carry a negligible load. In the event of a sheave pin failure, the sheaves rise to the top of the block or drop to the base of the upper sheave housing and stop at those points, and load drop is precluded. The block assembly contains two 100 percent capacity hooks of "load carrying devices." This redundancy in attachment to lifting assembly and in load carrying capability are such that a single failure does not cause load drop. Additional nondestructive testing (ultrasonic and magnaflux testing for the load block swivel and the sheave shafts of the upper assembly) provides further assurance that this crane is of a quality suitable for nuclear services. Electrical circuits have been reviewed and it has been determined that no single credible electrical component failure causes the load to drop.

The auxiliary hoist is designed to satisfy the Single-Failure-Proof Guidelines of Section 5.1.6 of NUREG-0612, and thus eliminating the need to analyze the effects of drops of heavy loads per the evaluation criteria of Section 5.1 of NUREG-0612.

Protection of the pool liners in the cask storage area for the normal cask lowering operation is provided by a 1 in thick steel wearing plate. This prevents any damage to the liner over plant life occasioned by normal fuel cask handling.

The adequacy of the drywell head for a postulated drop of one of the shield plugs was performed in a load drop analysis performed in the Peach Bottom Calculation PS-0288, "Drywell Head Load Drop Analysis."

No vital equipment is located in compartments below the fuel pool floor; therefore, no loss of function of vital equipment would result from falling objects and flooding caused by a postulated event.

Strict administrative control assures that the cask is not unnecessarily lifted higher than required during maneuvering above the refueling floor and also that the cask is not brought over the reactor vessel or the fuel storage portion of the pool.

10.4.11 Heavy Loads Compliance

The licensee has a defense-in-depth program to manage the handling of heavy loads on site such that no credible load drop will endanger the public safety and health. Loads that are either not considered as 'heavy loads' (i.e., less than 1200 pounds) or have been determined to not potentially impact irradiated fuel, the reactor vessel, or safe shutdown equipment are not within the scope of the 'heavy loads' program. Any heavy loads that have not previously been evaluated will be evaluated prior to being lifted. This evaluation would include ensuring at least one of the following measures are in place for the lift:

- Mechanical stops or electrical interlocks that prevent heavy loads movement over irradiated fuel or safe shutdown equipment,
- Verification analysis that the consequences of a potential load drop are within accepted bounds, or
- Use of a single-failure-proof handling system.

Lifts are conducted in accordance with good rigging practices and in accordance with the licensee's approved procedures.

In July 1980, the NRC issued NUREG-0612, Control of Heavy Loads at Nuclear Power Plants. This NUREG was issued to resolve NRC Generic Technical Activity A-36. This generic issue involved reviewing the adequacy of NRC requirements for controlling the handling of heavy loads over or in proximity to spent fuel, the reactor core, and safe shutdown equipment. NUREG-0612 recommendations were planned to be assessed by the NRC in two phases (i.e., Phase I and Phase II). Phase I concerned itself with seven requirements that assured a defense-in-depth approach was taken in regards to handling heavy loads. Phase II of NUREG-0612 concerned itself with plant specific analyses to ensure that the potential for load drop was extremely small or if there was a load drop no significant impact to spent fuel, the reactor vessel or safe shutdown equipment would occur. The NRC issued a safety evaluation report concerning Peach Bottom compliance to NUREG-0612 Phase I on 9/21/83. Peach Bottom submitted its intent concerning compliance with Phase II. However, prior to NRC issuance of a final SER for Peach Bottom, the NRC discontinued its review of Phase II submittals. In Generic Letter 85-11, dated 6/28/85, the NRC reported to the industry that due to their reviews of Phase I activities and proposed Phase II activities, there did not warrant a need to take further action on Phase II. The Peach Bottom response to this generic letter on 2/11/86 stated that changes to Phase II actions would be considered on a case-by-case basis.

Lifts are conducted in accordance with good rigging practices and in accordance with the licensee's approved procedures.

10.4.11.1 NUREG-0612 Phase I Requirements

All heavy loads that could be brought over or in proximity to irradiated fuel, the reactor vessel or safe shutdown equipment are handled in accordance with a defense in depth philosophy. The following seven criteria ensure appropriate handling of heavy loads is in place.

1. Safe Load Paths

Safe Load Paths (SLP's) are established for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor or spent fuel pool, or to impact safe shutdown equipment required to be operable. These load paths are controlled under approved design documents. Design documents and procedures also control rigging exclusion zones and height/weight restrictions. Administrative procedures require that the cognizant supervisor review safe load paths prior to the lift. Any deviations from designated SLP's must be approved by engineering.

Concerning the Emergency Diesel Generator (EDG) Cranes, heavy loads lifts may only be performed when the EDG is inoperable or declared inoperable for purposes of heavy load lifts.

Load movements along the safe load paths are directed by a qualified signalman.

2. Load Handling Procedures

Load handling procedures are in place for the handling of heavy loads over or in proximity to reactor fuel or safe shutdown equipment. A governing administrative procedure defines the overall requirements to perform these lifting operations including the NUREG-0612 Phase I requirements. Implementing procedure(s) ensure that appropriate details of complicated lifts are defined. As appropriate, the above procedures direct the identification of required equipment, inspections and acceptance criteria required before moving the load, the steps and proper sequence to be followed in handling the load, definition and use of appropriate safe load paths and require that Phase I requirements are met for heavy load operations.

3. Crane Operator Training

For lifts performed within the scope of the heavy loads program, crane operators will be trained, qualified and conduct themselves in accordance with Chapter 2-3 of ANSI B30.2-1976, 'Overhead and Gantry Cranes'.

4. Special Lifting Devices

Special Lifting Devices used in areas where a load is carried over or in proximity to the reactor vessel, spent fuel pool, or safe shutdown equipment meet the requirements of ANSI N14.6-1978 with the following exceptions:

a. Inspections shall be performed at least once per operating cycle rather than annually.

b. Critical welds may be non-destructively examined in lieu of the routine 150% load test

c. Dry fuel storage cask trunnions are waved from the periodic load test or examination requirements.

d. The drywell strongback has two steel features that were added during modifications that did not receive the required materials testing (Charpy impact or drop weight testing). (Ref. ECR 13-00378).

e. The RPV head carousel hook and load pins did not receive the required materials testing (Charpy impact or drop weight testing) (Ref. ECR 13-00378).

The stress design factor stated in section 3.2.1.1 of ANSI N14.6-1978 is based on the combined maximum static and dynamic loads that could be imparted on the handling device based on the characteristics of the crane which will be used. Devices used for handling the spent fuel cask/lid are designed to ANSI N14.6 - 1986 which is equivalent to or exceeds the 1978 version.

5. Lifting Devices (not specifically designed)

Procedures are in place which require that all lifting devices not specifically designed (i.e., slings) that are used to lift heavy loads over or in proximity to the reactor vessel, spent fuel pool or safe shutdown equipment meet the requirements of ANSI B30.9-1971, 'Slings' or Twin-Path Extra TPXC Synthetic Round Slings constructed with K-Spec fiber meeting the requirements of ASME B30.9-2010, used in combination with engineered softeners and abrasion protection devices as required by station procedures. Additionally, a dynamic load factor of 25% of the dead load will be used in selecting the sling.

6. Cranes (Inspection, testing and maintenance)

Procedures are in place which ensure that crane inspection, testing and maintenance is performed in accordance with ANSI B30.2 (1967 version), 'Overhead and Gantry Cranes'. Additionally, if repairs of load sustaining members are made by welding, identification of materials shall be made and appropriate welding procedures will be followed.

7. Crane Design

The Reactor Bldg, Turbine Bldg, Pump Structure, and EDG Cranes meet the intent of the requirements of Chapter 2-1 of ANSI B30.2-1976, 'Overhead and Gantry Cranes' and of CMAA-70, 'Specifications for Electric Overhead Traveling Cranes'. Turbine Building Cranes are upgraded to meet single failure proof requirements of NUREG-0554 for the increased main and auxiliary hoist capacities of 115 Ton and 30 Ton respectively. Structural analyses are performed using commercially available, NRC-approved computer programs. Concrete anchor bolts are analyzed per American Concrete Institute (ACI) Code 349-01, approved by the NRC for this purpose.

10.4.11.2 NUREG-0612 Phase II Requirements

Heavy load lifts made by permanent station cranes and hoists, as well as by mobile cranes and temporary rigging, are performed in a manner to minimize the threat to irradiated fuel, the reactor vessel or safe shutdown equipment. This necessitates that the following three criteria of NUREG-0612, Phase II are met, except for alternatives which may be approved on a case-by-case basis in accordance with station procedures:

1. The lift is performed as single failure-proof equivalent (either using redundant rigging or increased safety factors) or,

2. The lifting system has electrical interlocks or mechanical stops such that loads could not be handled over or in proximity to fuel, the reactor vessel, or safe shutdown equipment or,

3. An evaluation is performed that ensures that a load drop could not cause damage to fuel, the reactor vessel, or loss of a safe shutdown function.

10.4.11.3 Safety Evaluation

Heavy load lifts are performed using a defense-in-depth program such that no credible load drop will endanger the public safety and health. The procedural controls that implement NUREG-0612 Phase I make the risk of a load drop very unlikely. In addition, single-failure-proof lifts are employed to further reduce the risk of load drop to an acceptably low level. Where single-failure-proof lifts are not used, the consequences of a postulated load drop are evaluated, and must be demonstrated to be acceptable. Resulting restrictions on load height, weight, lift configuration, and/or equipment required to be operable are procedurally controlled.

10.5 FUEL POOL COOLING AND CLEANUP SYSTEM

10.5.1 Power Generation Objective

The power generation objectives of the fuel pool cooling and cleanup system are to provide fuel pool water temperature control and to maintain fuel pool water clarity, purity, and level.

10.5.2 Power Generation Design Basis

1. The fuel pool cooling and cleanup system minimizes corrosion product buildup and controls water clarity through filtration and demineralization.

2. The fuel pool cooling and cleanup system minimizes fission product concentrations which could be released from the pool water to the reactor building environment.

3. The fuel pool cooling and cleanup system monitors fuel pool water level and maintains a water level above the fuel sufficient to provide shielding for normal building occupancy.

4. The fuel pool cooling and cleanup system limits the fuel pool water temperature during normal and refueling operations.

10.5.3 Description

The fuel pool cooling and cleanup system cools the fuel storage pool by transferring decay heat through heat exchangers to the service water system (Drawing M-363, Sheets 1 and 2). Water purity and clarity in the storage pool, reactor well, and dryer-separator storage pit are maintained by filtering and demineralizing the pool water (Drawing M-364, Sheets 1 and 2). See paragraph 10.3.4.2 for the description of the spent fuel pool. Connections also exist to use the "B" filter-demineralizer to process liquid radwaste, as shown on Drawing M-363, Sheet 1.

The system consists of three fuel pool cooling pumps, three heat exchangers, filter-demineralizer(s), two skimmer surge tanks, and associated piping, valves, and instrumentation. The three fuel pool pumps are connected in parallel, as are the three heat exchangers. The pumps and heat exchangers are located in the reactor building below the bottom of the fuel pool.

The filter-demineralizers, which collect radioactive corrosion products, are located in the radwaste building and are typically arranged so that one filter-demineralizer is aligned to each reactor unit and the third is a spare. Up to three filter-

demineralizers may be aligned to one unit to support water clarity and water chemistry improvements, as required.
The pumps circulate the pool water in a closed loop, taking suction from the skimmer surge tanks through the heat exchangers, circulating the water through the filter demineralizer, and directing the processed spent fuel cooling water through the system discharge lines located in the fuel pool and reactor well. This return flow of spent fuel cooling water is discharged downward from the discharge lines into the pool at an elevation that is above the top of the storage racks. The cooled water traverses the pool picking up heat and debris before starting a new cycle by discharging over the skimmer weirs and scuppers into the skimmer surge tanks. Makeup water for the system can be transferred from the condensate storage tank to the skimmer surge tanks. System and equipment parameters are listed in Table 10.5.1.

An evaluation of the fuel pool cooling system was performed for normal refueling of approximately 40% (320 bundles) of the core every 24 months and a full core offload just before normal refueling assuming all storage cells in the spent fuel pool are filled. The evaluations assume that the offloaded fuel has operated in the reactor at 3951 MW. For the normal refueling offload of 40% of the core, the evaluation assumes a normal complement of three fuel pool cooling trains (three fuel pool cooling pumps and three fuel pool cooling heat exchangers) in service as well as a single failure where only two fuel pool cooling trains (two fuel pool cooling pumps and two fuel pool cooling heat exchangers are in service). For the full core offload case, no fuel pool cooling trains are assumed available and fuel pool cooling is performed by the RHR system. The evaluation also considered the time for the fuel pool to boil if there is a loss of fuel pool cooling. See Table 10.5.2 for a summary of the results of these cooling system evaluations.

When flooded up, the Fuel Pool Cooling system and the RHR fuel pool assist mode can be used to remove decay heat from both the spent fuel pool and the reactor vessel by cooling the spent fuel pool. A cross-connection between the drain line from the skimmer surge tank and the RHR system allows the RHR system to take a suction from the fuel pool. This is called Fuel Pool Assist mode, when water is returned to the fuel pool and called Alternate Decay Heat Removal (ADHR) mode when water is returned to the reactor vessel through the normal shutdown cooling return line. In addition, a Split Flow mode is available when the RHR discharge flow is split between the fuel pool and the reactor vessel.

During ISFSI operation, it may be necessary to return a loaded dry storage cask to one of the Spent Fuel pools for unloading. The heat introduced to the pool by the latent heat of the cask materials and the decay heat of the 68 contained assemblies is less that the full core offload heat that the Fuel Pool Cooling and Cleanup System has been analyzed for.

Since each refueling offload is cycle specific, then the variations in the number of fuel assemblies discharged, the in-core decay time, the fuel assembly transfer rate and the power history can vary as long as analysis shows that the spent fuel pool bulk temperature will not exceed 150°F and localized boiling will not be expected to occur.

The system flow rate is larger than that required for two complete water changes per day of the fuel pool, or one change per day of the fuel pool, reactor well, and dryer-separator pit. The maximum system flow rate is twice the flow rate needed to maintain water quality.

For refueling operations, water to fill the reactor well and dryer-separator storage pit is stored in the refueling water tank. Water is transferred to the refueling area by two refueling water pumps and/or via the CST and core spray system. During drainage, water can be pumped through one of the condensate filter-demineralizer units before being returned to the storage tank.

When placing a dry fuel storage cask into the fuel pool, the water level of the pool is managed by controlling the skimmer surge tank level and the fuel pool level as needed. Procedures ensure that a new cask is inspected and cleaned as necessary prior to placement in the pool.

Fuel pool water is continuously recirculated. The circulation patterns within the reactor well and fuel pool are established by the placement of the diffusers in the reactor well and the placement of skimmers and discharge lines in the fuel pool so as to sweep particles dislodged during refueling operations away from the work area and out of the pools.

Pool water clarity and purity are maintained by a combination of filtration and ion exchange. The filter-demineralizer units are located separately in shielded cells. The filter-demineralizer maintains the Fuel Pool water quality to within the limits specified in EPRI BWR Water Chemistry Guidelines for compatibility with materials and equipment in the fuel pool that require corrosion protection. Particulate matter is removed by the filter-demineralizer unit in which finely divided, powdered ion-exchange resin and fiber material serves as the filtering medium. Alternately, a combination of powdered resin and cellulose may be used as the disposable filter medium. The filter elements are a stainless steel mesh element mounted vertically in a tube sheet and replaceable as a unit. The filter vessel is constructed of carbon steel and coated with a phenolic material. The resin is replaced when the pressure drop across the filter is excessive or when instrumentation indicates the ion exchange capacity is low. Alarms, differential pressure indicators, and flow indicators monitor the condition of the filter-demineralizers. Backwashing and precoating operations are controlled from a local panel in the radwaste building. The spent filter medium is removed from the elements by backwashing with air and condensate, then flushed to the waste sludge tank.

There are no connections to the fuel storage pool which could allow the fuel pool to be drained below the pool gate between the reactor well and the fuel pool when the pool gate is in place or below 10 feet above the top of active fuel. Fuel pool cooling and RHR discharge lines that extend below this level are equipped with syphon breaker holes to prevent inadvertent pool drainage. A level indicator, mounted at the valve rack, monitors reactor well water level during refueling. Any significant leakage through the refueling bellows assembly, drywell to reactor seal, or the fuel pool gates is annunciated on the operating floor instrument racks and in the main control room.

Instrumentation is provided for both automatic and manual operation. The surge tanks have high and low level alarms and pump trip switches. The pumps are controlled locally at the pump or from a control panel near the filter-demineralizers. Pump low suction pressure automatically turns off the pumps. A pump low discharge pressure causes alarm annunciation in the main control room and in the pump room. Also see paragraph 10.3.4.3 for spent fuel pool instrumentation.

10.5.4 Inspection and Testing

No special equipment tests are required because at least one pump, heat exchanger, and filter-demineralizer are normally in operation while fuel is stored in the pool.

Routine visual inspection of the system components, instrumentation, and trouble alarms is adequate to verify system operability. Pool level indicators and associated alarms are tested by simulating low water level to the sensors.

TABLE 10.5.1

FUEL POOL COOLING AND CLEANUP SYSTEM

Design Core Thermal Power	4,030 MWt
Total Pool, Well, and Pit Volume	111,400 cu ft
Fuel Storage Pool Volume	53,350 cu ft
System Design Flow	555 gpm
Maximum Flow	1,665 gpm
Fuel Pool Cooling Water Pumps	
Quantity	3
Type	
Horizontal, centrifugal	
Design Flow/TDH (each)	580 gpm/250 ft
Motor hp	60 hp
Fuel Pool Cooling Heat Exchangers	
Quantity	3
Heat Exchanger Capability	
One exchanger in service	= 3.75×10^6 Btu/hr
Two exchangers in service	= 7.50×10^6 Btu/hr
Three exchangers in service	=11.25×10^6 Btu/hr
Material Tube/Shell	304 SS/carbon steel
Design Code	ASME B&PV, Sec. VIII

TABLE 10.5.1 (Continued)

Fuel Pool Filter-Demineralizers

Type	Pressure precoat
Quantity	1 per unit, 1 common spare
Design Filter Area	270 sq ft
Filter Capacity	550 gpm/unit
Pressure Drop	25 psi (dirty)
Design Code	ASME & B&PV, Sec. VIII
Holding Pump Flow	27 gpm
Precoat Flow	450 gpm
Flow Control Valve Pressure Drop	100 psi (max)
	10 psi (min)

TABLE 10.5.2

SUMMARY OF COOLING SYSTEM ANALYSIS RESULTS

1) Heat Exchanger Capability

One exchanger in service	=	3.75×10^6 Btu/hr
Two exchangers in service	=	7.50×10^6 Btu/hr
Three exchangers in service	=	11.25×10^6 Btu/hr

2) Maximum Pool Heat Load to insure exit temperature is below 150°F

One exchanger in service	=	8.66×10^6 Btu/hr
Two exchangers in service	=	17.33×10^6 Btu/hr
Three exchangers in service	=	26.0×10^6 Btu/hr

3) Normal Refueling

a) Full Cooling Capability

Equipment in service:
3 FPCCS Pumps (1665 gpm total SFP flow)
3 FPCCS Heat Exchangers (2400 gpm total service water flow, 90°F service water temperature)

Start of Offload (hours after shutdown):	80
Max. SFP Temperature:	140°F
Time to Boil from Max. Temperature:	11.4 hrs
Makeup Flow Required at Boiling:	49 gpm
Max Heat Load (MBTU/hr):	23.9

b) Single Failure

Equipment in service:
2 FPCCS Pumps (1110 gpm total SFP flow)
2 FPCCS Heat Exchangers (1600 gpm total service water flow, 90°F service water temperature)

Start of Offload (hours after shutdown):	200
Max. SFP Temperature:	150°F
Time to Boil from Max. Temperature:	12.3 hrs
Makeup Flow Required at Boiling:	40 gpm
Max Heat Load (MBTU/hr):	19.5

TABLE 10.5.2 (continued)

4) Full-Core Offload, Full Cooling Capability

Equipment in service:
- 1 RHR Pump (5000 gpm total SFP flow)
- 1 RHR Heat Exchanger (4500 gpm total HPSW flow, 92°F HPSW water temperature)

Start of Offload (hours after shutdown):	150
Max. SFP Temperature:	140°F
Time to Boil from Max. Temperature:	6.0 hrs
Makeup Flow Required at Boiling:	88 gpm
Max Heat Load (MBTU/hr):	41.3

10.6 SERVICE WATER SYSTEM

10.6.1 Power Generation Objective

The power generation objective of the service water system is to supply water required for plant services.

10.6.2 Power Generation Design Basis

1. The service water system continuously supplies screened and chlorinated cooling water to the plant during normal plant operation and shutdown periods.

2. System interconnections are provided to enable the emergency service water system to serve the reactor building cooling water heat exchangers in the event of a loss of off-site power. This design feature exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross-tie valves. Therefore, little, if any, cooling would be provided to the service water system loads during a loss of off-site power.

3. The service water system supplies cooling water to the core standby cooling equipment and space coolers during normal plant operation and shutdown period only.

4. The system inhibits the release of radioactive material into the river.

10.6.3 Description

The service water system consists of three one-half capacity service water pumps in the pump structure, three horizontal fuel pool service water booster pumps in the reactor building, and associated piping, valves, and instrumentation (Drawing M-314, Sheets 1 through 9).

The three service water pumps are vertical, turbine-type pumps, connected in parallel, taking suction from the pump structure, and each delivering 14,000 gpm at a pump head of 155 ft. The pump bearings are supplied from lube water pumps. Nominal system pressure is 65 psig. The three fuel pool service water booster pumps deliver service water to the fuel pool cooling heat exchangers. These horizontal, centrifugal pumps are rated at 900 gpm at a pump head of 135 ft.

The safeguards equipment coolers and space air cooler are automatically served by the emergency service water system.

To inhibit leakage of radioactivity from potentially contaminated systems (mechanical vacuum pump and fuel pool heat exchangers), service water pressure is maintained higher than process fluid pressure. A radiation monitor on the service water effluent header from the reactor building cooling water heat exchangers detects leakage of radioactive material from these exchangers. The monitor indicates, records, and alarms in the main control room.

10.6.4 Inspection and Testing

The service water system components are proven operable by their use during normal plant operations. Portions of the system normally closed to flow can be tested to ensure their operability and the integrity of the system.

TABLE 10.6.1

SERVICE WATER SYSTEM DATA

Service Water Pumps	
Quantity	3
Type	Vertical, Turbine Type, Wet-Pit
Flow/Pump Head	14,000 gpm/155 ft
Bhp Rating	655 hp
Speed	900 rpm
Motor Type	Vertical, Induction Type
Voltage/Phase/Frequency	2,300 V/3 phase/60 Hz
Rated Horsepower	700 hp
Fuel Pool Service Water Booster Pumps	
Quantity	3
Type	Horizontal Centrifugal
Flow/Pump Head	900 gpm/135 ft
Bhp Rating	39 hp
Speed	3,600 rpm
Motor Type	Horizontal
Voltage/Phase/Frequency	460 V/3 phase/60 Hz
Rated Horsepower	40 hp

10.7 HIGH PRESSURE SERVICE WATER SYSTEM

10.7.1 Safety Objective

The safety objective of the high pressure service water system is to provide a reliable supply of cooling water for RHR under post-accident conditions.

10.7.2 Safety Design Basis

1. The high pressure service water system is designed to seismic Class I criteria to withstand the maximum credible earthquake without impairing system function.

2. The high pressure service water system is operable during flood conditions.

3. The high pressure service water system is designed with capacity and redundancy to supply cooling water to the RHRS under post-accident conditions.

4. The high pressure service water system is operable during the loss of offsite power.

10.7.3 Power Generation Objective

The power generation objective of the high pressure service water system is to supply cooling water to the RHRS for shutdown cooling and for torus cooling.

10.7.4 Power Generation Design Basis

1. The high pressure service water system supplies a reliable source of cooling water to the RHRS.

2. The high pressure service water system is designed for remote-manual initiation.

3. The high pressure service water system inhibits leakage of radioactive material from the RHRS to the environment.

4. The high pressure service water system provides an additional source of water for post-accident containment flooding by a cross tie between the high pressure service water system and the RHRS.

10.7.5 Description

Each high pressure service water system consists of four 4,500-gpm pumps installed in parallel in the pump structure (Drawing

M-315, Sheets 1 through 4). Normal water supply to the suction of the pumps is from Conowingo Pond. When the high pressure service water system is operated in conjunction with the emergency heat sink (subsection 10.24, "Emergency Heat Sink"), the suction is from the HPSW pump bay which is fed from emergency cooling tower basin. The pump discharge is manifolded and provided with a normally closed, motor-operated valve separating the four pumps into groups of two. Two parallel headers run from the pump structure to the reactor building. Each header delivers the discharge from two pumps to two RHR heat exchangers also in parallel. Under normal conditions, when the respective loop of HPSW is in operation, the service water pressure on the discharge side of the RHR heat exchanger is maintained positive with respect to the RHRS side to inhibit leakage of radioactive material into the environment. In the event of a design basis accident or transient in which additional containment cooling capacity is required, a second HPSW pump can be aligned to a second RHR heat exchanger by opening the cross-tie valve.

Under abnormal operating conditions RHRS pressure could exceed high pressure service water system pressure. An RHR heat exchanger leak under these abnormal conditions would result in radioactive RHR water migrating into the high pressure service water system and into the river. To limit the release of radioactive water to the river from this potential release path, signals from the radiation monitors in the sample system which samples the high pressure service water system upstream and downstream of the RHR heat exchangers initiate an alarm in the control room at a predetermined radiation level.

Flanged connection points are available on the high pressure service water system, downstream of the RHR heat exchangers, to allow for a temporary flow path of the RHR heat exchanger cooling water in the event that the normal flow path becomes unavailable. This alternative flow path is intended to be routed through secondary containment. Therefore, this flow path may only be used when secondary containment is not required.

An intertie is provided between units 2 and 3 high pressure service water system to provide flexibility. A cross tie to the RHRS provides the capability for primary containment flooding.

The high pressure service water system pumps are vertical multistage turbine type. The pump mounting base is of watertight construction to withstand the hydrostatic pressure at the design flood condition. The pump design data is given in Table 10.7.1.

The high pressure service water system piping and valves are designed as described in Appendix A.

10.7.6 Safety Evaluation

The high pressure service water system pumps are installed in a seismic Class I structure. The system meets seismic Class I criteria and is protected against the design flood level.

Each pump is sized to accommodate the design heat removal capacity of one RHRS heat exchanger. They have adequate head (1) to maintain the high pressure service water system cooling water at a higher pressure than the RHRS, thus inhibiting the release of radioactive material to the environment, and (2) to permit operation in conjunction with the emergency heat sink. Further, the pumps have both a normal and a standby power supply. In the event of the loss of offsite power, the pumps are supplied from the diesel generators and manually started as required.

Sufficient redundancy is provided in the number of pumps and power supplies, and in the piping arrangement, so that no single system component failure can prevent the system from supplying cooling water to accommodate the normal shutdown mode and the containment cooling mode. Therefore, core decay heat removal during the shutdown periods, or containment cooling during the post-accident condition, can be maintained.

10.7.7 Inspection and Testing

Pumps in the high pressure service water system are proven operable by their use or testing during normal station operations. Motor operated isolation valves can be tested to assure they are capable of opening and closing by operating manual switches in the control room and observing the position lights. Portions of the high pressure service water system normally closed to flow can be tested to ensure their operability and the integrity of the system.

TABLE 10.7.1

HIGH PRESSURE SERVICE WATER SYSTEM

EQUIPMENT DATA

High Pressure Service Water Pumps

Quantity	4 Per Unit
Type	Vertical, Turbine Type
Flow/Head Design Point	4,500 gpm at 700 ft
Bhp at Rating	< 975 hp
Speed	1,770 rpm
Number of Stages	6
Pump Design:	
Shut-Off Head	> 368 and < 445 psig
Material:	
Bowl/Impeller	Cast Carbon Steel or Moly Iron/Bronze or Cast Stainless Steel
Discharged Head/Column	Carbon Steel/Carbon Steel
Line Shaft	Stainless Steel
Bearings	Brass/Bronze/Rubber
Motor:	
Type	Vertical, Induction
Horsepower	1,000 hp
Voltage/Phase/Frequency	4,160 V/3 Phase/60 Hz

10.8 REACTOR BUILDING COOLING WATER SYSTEM

10.8.1 Power Generation Objective

The power generative objective of the reactor building cooling water system is to provide cooling water to auxiliary plant equipment associated with the nuclear steam supply system (NSSS).

10.8.2 Power Generation Design Basis

1. The reactor building cooling water system is designed to cool auxiliary plant equipment over the full range of reactor power operation.

2. The reactor building cooling water system is designed to inhibit the release of radioactive material to the environment.

10.8.3 Description

The reactor building cooling water system consists of two full-capacity pumps, two full-capacity heat exchangers, one head tank, one chemical feed tank, and associated piping, valves, and controls (Drawing M-316). The cooling water pumps and heat exchangers are located in the reactor building auxiliary bay. The head tank is located on the reactor building refueling floor. The system equipment data is given in Table 10.8.1.

The system is a closed loop utilizing inhibited demineralized water. The heat exchangers are designed with service (river) water on the tube side and demineralized water on the shell side. The reactor building cooling water system is designed for an operating pressure of 140 psig.

The head tank, located at the highest point in the loop, accommodates system volume changes, maintains static suction pressure on the pump, aids in detecting gross leaks in the reactor building cooling water system, and provides for adding makeup water. An automatic makeup control valve maintains water level in the tank. The automatic function is not required and may be valved out to monitor system inventory. High and low water levels are alarmed in the main control room. An inhibitor is added as necessary to the demineralized water by means of a chemical addition tank to limit corrosion.

The reactor building cooling water system supply and return headers penetrating the primary containment are each provided with a motor-operated isolation valve outside the containment. These isolation valves are manually controlled remotely from the main control room.

Electrical power for operating the reactor building cooling water system pumps during failure of offsite power is supplied from the standby power supply.

In the event of offsite power failure, the reactor building cooling water system supply to the reactor water cleanup system non-regenerative heat exchanger and pumps, instrument nitrogen compressor skids, and various sample station coolers is isolated, and the water supply is maintained to the reactor recirculation pump motor oil and mechanical seal water coolers and the reactor building equipment drain sump cooler. In addition, water is supplied to the drywell air cooling system and the drywell equipment drain sump cooler, which are normally served by the chilled water system, and to the CRD pump oil coolers and air compressor jacket and after coolers, which are normally served by the turbine building cooling water system.

The reactor building cooling water system can also supply water to the fuel pool cooling heat exchangers, via removable spool pieces, in the event of loss of normal cooling water. The control and instrumentation is designed for remote system startup from the main control room.

These design features do exist although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross tie valves. These valves were locked closed because of the lack of required structural design of the piping, and due to the adverse hydraulic effects to safety related components served by ESW. Therefore, the cooling effect of the RBCCW system to any of the components described above will be minimal.

A radiation monitor is provided at the cooling water return header to indicate, record, and alarm leakage of radioactivity.

10.8.4 Inspection and Testing

Equipment in the reactor building cooling water system is proven operable by use during normal plant operations. Motor operated isolation valves can be tested to assure they are capable of opening and closing by operating manual switches in the control room and observing the position lights. Portions of the reactor building cooling water system normally closed to flow can be tested to ensure their operability and the integrity of the system.

TABLE 10.8.1

REACTOR BUILDING COOLING WATER SYSTEM

EQUIPMENT DATA

Reactor Building Cooling Water System Pumps	2 (full-capacity)
Type	Horizontal Centrifugal
Flow and Head	1,350 gpm at 140 ft
Bhp at Rating	65 hp
Material:	
Casing/Impeller/Shaft	Cast Iron/Bronze/Stainless Steel
Motor: Size	75 hp
Voltage/Phase/Frequency	440 V/3 Phase/60 Hz
Speed	3,600 rpm
Reactor Building Cooling Water System Heat Exchangers	
Quantity	2 (full-capacity)
Type	Horizontal, Shell and Tube
Heat Transfer Duty	25,500,000 Btu/hr
Shell Design:	
Pressure/Temperature	150 psig/200°F
Material	Carbon steel
Flow Medium	Inhibited Demineralized Water
Tube design:	
Pressure/Temperature	125 psig/200°F
Material:	
Tube	Admiralty
Tube Sheet	Carbon Steel
Tube Joint	Rolled
Flow Medium	River Water

10.9 EMERGENCY SERVICE WATER SYSTEM

10.9.1 Safety Objective

The safety objective of the emergency service water system is to provide a reliable supply of cooling water to diesel generator coolers, ECCS and RCIC compartment air coolers, Core Spray Pump Motor Oil Coolers and other selected equipment during a loss of offsite power or during a loss of normal station service water due to the design flood condition or the loss of the Conowingo pond.

10.9.2 Safety Design Basis

1. The emergency service water system is designed to seismic Class I criteria.

2. The emergency service water system is operable during the design flood condition and loss of Conowingo pond.

3. The emergency service water system has sufficient capacity and redundancy so that no single active component failure can prevent the system from achieving its safety objective.

4. The emergency service water system is operable during the loss of offsite power.

10.9.3 Description

The emergency service water system is common to both Units 2 and 3. The system consists of two full-capacity pumps installed in parallel in the seismic Class I portion of the pump structure, and associated equipment coolers, valves, and controls (Drawing M-315). Normal water supply to the suction of the emergency service water system pumps is from Conowingo Pond. The pump discharge piping consists of two headers with service loops to ensure water supply to the diesel engine coolers. These two headers combine, forming a common header, to supply selected equipment coolers. Valves in the supply headers provide loop isolation. A common discharge header routes the system effluent normally to the pond. The emergency service water system pumps are vertical, single-stage, turbine type with an 8,000 gpm capacity developing a normal average system pressure of 40 psig and a normal system flow of approximately 4500 gpm. The pump mounting base is of watertight construction to withstand hydrostatic pressure at the maximum design flood condition. The pump design data is given in Table 10.9.1.

The emergency service water system is a standby system to provide adequate cooling water supply to the emergency equipment coolers and compartment air coolers during a loss of offsite power or during a loss of normal station service water due to the design flood condition or the loss of the Conowingo pond. During normal plant operating conditions, the cooling water supply to the equipment served by the emergency service water system, except the diesel generator coolers, is normally provided from the

service water system. This allows testing of safeguards equipment using service water without starting the emergency service water system pumps.

Chemical injection and corrosion monitoring systems are installed to mitigate corrosion damage to emergency service water system piping.

The emergency service water system may also be operated in conjunction with the emergency heat sink (subsection 10.24). This configuration (closed loop) is the preferred system alignment during the design flood condition and loss of Conowingo pond.

Both emergency service water pumps start after a 36 second time delay whenever 4 kV power is available (following the loss of offsite power or a diesel generator start). One of the emergency service water system pumps is manually shut off if both pumps are running and emergency service water system pressure is verified to be adequate. All system supervisory instrumentation and controls are located in the main control room.

The emergency service water system piping and valves are designed as described in Appendix A.

10.9.4 Safety Evaluation

The emergency service water system pumps are installed in a seismic Class I structure. The system meets seismic Class I criteria, and the pumps are further protected against the design flood level using watertight construction. The emergency service water system is designed with redundant pumps and piping. Each loop is powered from a separate division of both normal and standby power. Therefore, the system is both redundant and single failure proof and is operable in the event of a loss of offsite power.

10.9.5 Inspection and Testing

The cooling of equipment served by the emergency service water system, except the standby diesel generator coolers, is functionally tested using the plant service water system. Pump operation and diesel generator cooling capability is verified when operability of the diesel generators is tested. Motor operated valves can be exercised to confirm operability. Emergency service water system operability is verified by flow and heat transfer testing. Emergency service water system piping integrity is verified by visual and ultrasonic inspection and corrosion monitoring.

Emergency service water pump performance is verified in accordance with ASME Code requirements. Cooling equipment minimum flows are verified by magnetic or ultrasonic flow measurement devices.

The timer used to sequence the emergency service water pump during a LOCA is tested (with offsite power available) in accordance with surveillance test procedures. The test verifies the setting, operability, and functional performance of the relay, and provides assurance that the automatic loading sequence is being maintained and performs as required.

TABLE 10.9.1

EMERGENCY SERVICE WATER SYSTEM EQUIPMENT DATA

Emergency Service Water System Pumps*

Quantity	2 (common for Units 2 and 3)
Type	Vertical, Turbine Type
Flow/Head	8,000 gpm/96 ft
Bhp at Rating	237 hp
Speed	1,170 rpm
Number of Stages	1
Pump Design:	
Shutoff Head	132 ft
Maximum Working Pressure	200 psig
Material:	Moly Iron
Bowl/Impeller	Cast Iron/Bronze
Discharge Head/Column	Carbon Steel/Carbon Steel
Line Shaft	Stainless Steel
Bearings	Rubber
Motor Design:	
Type	Vertical Induction Type
Horsepower	250 hp
Voltage/Phase/Frequency	4,160 V/3 Phase/60 Hz

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* Emergency cooling water pump and motor are identical except for the pump column length.

10.10 TURBINE BUILDING COOLING WATER SYSTEM

10.10.1 Power Generation Objective

The power generation objective of the turbine building cooling water system is to provide cooling water to auxiliary plant equipment associated with the power conversion systems.

10.10.2 Power Generation Design Basis

The turbine building cooling water system is designed to cool non-nuclear auxiliary plant equipment over the full range of plant operation.

10.10.3 Description

The system consists of two full-capacity pumps, two full-capacity heat exchangers (system design does allow use of both heat exchangers if necessary due to high river temperatures or other limiting operating conditions), one head tank, one chemical feed tank, and associated piping, valves, and controls (Drawing M-316, Sheets 1 to 4). The cooling water pumps and heat exchangers are located on the turbine building ground floor. The system design data is given in Table 10.10.1.

The system is a closed loop utilizing inhibited demineralized water. The heat exchangers are designed with service (river) water on the tube side and demineralized water on the shell side.

The head tank, located at the highest point in the loop, accommodates system volume changes, maintains static suction pressure on the pumps, aids in detecting gross leaks in the turbine building cooling water system, and provides a means for adding makeup water. An automatic makeup control valve maintains water level in the tank. The automatic function is not required and may be valved out to monitor system inventory. High and low water levels are alarmed in the main control room. An inhibitor is added as necessary to the demineralized water by means of a chemical addition tank to limit corrosion.

In the event of offsite power failure, the turbine building cooling water system is not operated. Under loss of offsite power, the water supply to the instrument and service air compressor skids, CRD pump lube oil coolers and the thrust bearing housings is maintained from the reactor building cooling water system. This design feature still exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW cross tie valves.

Therefore, little, if any, cooling would be provided by the reactor building cooling water system during a loss of offsite power.

10.10.4 Inspection and Testing

Equipment in the turbine building cooling water system is proven operable by use during normal plant operations. Transfer valves in the system can be tested to ensure that they are capable of transferring the water supply of essential equipment from the turbine building cooling water system to the reactor building cooling water system on loss of offsite power. This design feature still exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW cross tie valves. Therefore, little, if any, cooling would be provided by the reactor building cooling water system during a loss of offsite power. System subsections normally closed to flow can be tested to ensure their operability and system integrity.

TABLE 10.10.1

TURBINE BUILDING COOLING WATER SYSTEM EQUIPMENT DATA

Turbine Building Cooling Water System Pumps

Quantity	2 (full-capacity)
Type	Horizontal, Centrifugal
Flow and Head	525 gpm at 180 ft
Bhp at Rating	34 hp
Material:	
Casting/Impeller/Shaft	Cast Iron/Bronze/Stainless Steel
Motor: Size	40 hp
Voltage/Phase/Frequency	440 V/3 Phase/60 Hz
Speed	3,600 rpm

Turbine Building Cooling Water System Heat Exchangers

Quantity	2 (full-capacity)
Type	Horizontal, Shell and Tube
Heat Transfer Duty	3,850,000 Btu/hr
Shell Design:	
Pressure/Temperature	150 psig/200°F
Material	Carbon Steel
Flow Medium	Inhibited Demineralized Water
Tube Design:	
Pressure/Temperature	125 psi/200°F

TABLE 10.10.1 (Continued)

Material:

Tube	Admiralty
Tube Sheet	Carbon Steel
Tube Joint	Rolled
Flow Medium	River Water

10.11 CHILLED WATER SYSTEM

10.11.1 Power Generation Objective

The power generation objective of the chilled water system is to provide cooling water to the auxiliary equipment inside the primary containment.

10.11.2 Power Generation Design Basis

1. The chilled water system is designed to cool the auxiliary equipment inside the primary containment over the full range of plant operation.

2. The chilled water system provides a reliable source of cooling water.

3. The chilled water system is provided with inter-ties with the reactor building cooling water system, which serves the chilled water system during a loss of offsite power. This design feature exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross tie valves. Therefore, little, if any, cooling would be provided by the chilled water system during a loss of offsite power.

10.11.3 Description

The chilled water system consists of three half-capacity, centrifugal refrigeration units, three half-capacity chilled water pumps, an expansion tank, piping, valves, instrumentation, and controls (Drawing M-327, Sheets 1 through 4). It is a closed-loop system utilizing inhibited demineralized water. The pumps circulate warm return water to the refrigeration unit chillers. The chilled water is then piped to the drywell air coolers, the recirculation pump motor coolers, and the drywell equipment sump cooler. Two parallel supply headers and return headers penetrate the primary containment. A motor operated isolation valve is located outside the containment in each line. The inter-tie with the reactor building cooling water system is made by motor operated three-way valves. An automatic transfer from system to system is made upon loss of offsite power. Chilled water system shutdown requires a manual switchover. Chillers and pumps are remotely controlled from the main control room. A standby start feature is provided for each chilled water pump. Standby equipment is provided to assure system reliability.

10.11.4 Inspection and Testing

The chilled water system is proved operable by use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

10.12 FIRE PROTECTION PROGRAM

The Fire Protection Program (FPP) is described in a document transmitted to the NRC on September 30, 1986 titled, "Fire Protection Program, Peach Bottom Atomic Power Station, Units 2 and 3", and is hereby incorporated by reference into the UFSAR.

Chapter 1 of the FPP is an introduction.

Chapter 2 provides a general description of the fire detection and suppression systems.

Chapter 3 presents an item-by-item comparison of the Peach Bottom Atomic Power Station Units 2 and 3 fire protection program with the guidelines set forth in Branch Technical Position APCSB 9.5-1, Appendix A, the requirements of Appendix R to 10CFR50, and the requirements of the Fire Protection Safety Evaluation Report.

Chapter 4 provides a tabulation of the combustible loadings in plant fire areas, describes fire barriers, and describes fire detection and suppression systems in each area. The plant is divided into 47 fire areas.

Chapter 5 provides an evaluation of the ability to safely shut the plant down in the event of a fire in any one of the plant's 47 fire areas.

Chapter 6 addresses special topics.

Chapter 7 contains the fire protection requirements which have been relocated from the Technical Specifications by Technical Specifications Change Request 90-05, which was submitted to the NRC on March 28, 1994. The relocation of these requirements was in accordance with NRC Generic Letters (GL) 86-10, "Implementation of Fire Protection Requirements," and GL 88-12, "Removal of Fire Protection Requirements from Technical Specifications."

In addition to the above, administrative procedures, system operating procedures, surveillance tests, and pre-fire strategy plans have been established to implement the Fire Protection Program.

10.13 MAIN CONTROL ROOM AIR CONDITIONING

10.13.1 Power Generation Objective

The power generation objective of the main control room air conditioning system is to provide a suitable environment for continuous personnel occupancy and to ensure the operability of control room equipment and instruments under normal and accident conditions per 12.3.4.

10.13.2 Power Generation Design Basis

1. The system is designed to provide an environment with a controlled temperature. Humidity control is available during periods of auxiliary boiler operation.

2. The system is capable of purging the main control room.

3. Redundant components are provided to ensure reliable system operation.

10.13.3 Safety Design Basis

1. The system is designed such that the control room is habitable even under the design basis accident conditions.

2. The fresh air portion of the system is designed to be operable during the loss of offsite power by using the standby power supplies.

3. The fresh air intake is filtered when main control room emergency ventilation is initiated to prevent iodine and particulate contamination of the main control room air.

10.13.4 Description

The main control room air conditioning system consists of ventilation air supply fans (normal), emergency air supply fans, air conditioning supply and return fans, filters, heating coils and cooling coils, refrigerant water chillers, chilled water pumps, dampers, duct work, instrumentation, and controls (Drawing M-384).

Outside air is drawn through a filter by a fresh air supply fan and is discharged to the inlet of the air conditioning supply fan suction, and is then discharged to duct work leading to the main control room and adjacent offices. This air is conditioned to maintain a controlled temperature environment using heating and cooling coils. Humidity is conditioned during periods of auxiliary boiler operation. Normally, control room air is recirculated by one of two return air fans. These fans take a suction from the north and south ends of the control room and discharge to the air conditioning supply fan suction with filtered outside air from the fresh air supply fans.

The control room heating coils are supplied from the auxiliary steam supply. Cooling is provided by a chilled water system consisting of two 100% chiller units, two 100% chilled water pumps, and a piping system which also supplies chilled water to the cable spreading room fan-coil supply unit and the health physics and chemistry labs fan-coil supply unit. The fresh air supply fans, both normal and emergency, are operable from the standby power supply during the loss of offsite power. The control room chiller and air conditioning supply and return fans do not run following loss of offsite power. The instrumentation and control for the main control room air conditioning system is designed for automatic operation. One fresh air supply fan, one air conditioning supply fan, and one return air fan are normally in operation. Emergency cooling and ventilation systems for the control room and other safety-related equipment rooms are installed in seismic Class I structures and are provided with 100 percent redundancy. Monitoring and adjustment of the control room emergency ventilation system air flow may be performed locally. If an operating fan fails, the loss of duct pressure is sensed and the standby fan starts automatically, the associated fan dampers open, and an alarm sounds in the control room. Fans may also be started manually.

A radiation monitoring system in the fresh air intake duct work monitors the radioactivity level in the incoming outside air. This system includes two flow switches that monitor air flow through the fresh air intake duct work. If a high activity level or loss of flow is detected, the operating normal fresh air supply fan stops, one emergency air supply fan starts, and the air conditioning supply and return air fans shut down. The air is diverted through one of the two high efficiency and charcoal filter trains automatically. The monitor also annunciates in the control room. If a high-high activity level is detected, the monitor will indicate in the control room.

The control room is capable of being purged with 100 percent outside air. A once-through flow is established using the air conditioning supply fans, with the return air fans discharging to atmosphere at the radwaste building roof.

10.13.4.1 Control Room Habitability

The primary design function of the Main Control Room (MCR) / Main Control Room Emergency Ventilation (MCREV) System is to provide a safe environment in which the operator can keep the nuclear reactor and auxiliary systems under control during normal operations and can safely shut down those systems during abnormal situations to protect the health and safety of the public and plant workers.

Technical Specifications 3.7.4 and its Bases are in place to ensure that appropriate equipment is maintained operable and inoperabilities are managed through compensatory actions and other plant actions.

A Control Room Envelope (CRE) Habitability Program is required by Technical Specifications 5.5.13. The program is established and implemented to ensure that the CRE habitability is maintained such that, with an operable MCREV system, CRE occupants can control the reactor safely under normal conditions and maintain it in a safe condition following a radiological event, hazardous chemical release as applicable, or a smoke challenge. The program shall ensure that adequate radiation protection is provided to permit access and occupancy of the CRE under design basis accident (DBA) conditions without personnel receiving radiation exposures in excess of 5 rem total effective does equivalent (TEDE) for the duration of the accident. The program includes elements required by Technical Specification 5.5.13.

As a result of Technical Specification 3.7.4 and 5.5.13 requirements, PBAPS is committed to applicable portions of NRC Reg Guide 1.197, NRC Reg Guide 1.196 as invoked by the Technical Specifications or its Bases. PBAPS is committed to NRC Reg Guide 1.78 (6/74) and NRC Reg Guide 1.95 (2/75), as applicable, for hazardous chemical assessments. The computer code HABIT is utilized for hazardous chemical assessments, which was approved in Revision 1 of Reg Guide 1.78. This is an exception to Revision 0, to which PBAPS remains committed. Additionally, Peach Bottom performs hazardous chemical assessments by probabilistic analysis in accordance with NUREG-0800, Standard Review Plan, Section 2.2.3.

10.13.5 Safety Evaluation

The fresh air portion of the main control room ventilation system permits continuous occupancy of the main control room under normal and accident conditions, including maximum credible earthquake, contaminated outside air, and loss of offsite power. The system has sufficient redundancy to maintain uninterrupted main control room ventilation for personnel occupancy and instrument operability. Evaluation as to the expected dose rates under the design basis accident conditions is included in paragraph 12.3.4.

10.13.6 Inspection and Testing

The main control room air conditioning system is proven operable by its use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

10.14 EMERGENCY VENTILATING SYSTEM

10.14.1 Safety Objective

The safety objective of the emergency ventilating systems is to maintain suitable temperatures in the plant engineered safeguards equipment rooms for equipment protection.

10.14.2 Safety Design Basis

1. The systems protect the safeguards equipment against overheating.

2. Selected systems shall be provided with redundant components for reliable operation.

3. The equipment is provided with alternate power supplies in the event of loss of offsite power.

4. The equipment is designed to seismic Class I criteria.

10.14.3 Description

The emergency ventilating systems include the following:

1. Emergency switchgear and battery rooms.

2. Standby diesel generator rooms.

3. Pump structure ventilation system (ESW/HPSW Compartment).

4. Pump rooms for the RHR, RCIC, HPCI, and core spray pumps.

The reactor building heating and ventilating system normally supplies ventilation air to the RHR, RCIC, HPCI, and core spray pump rooms (paragraph 5.3.2).

10.14.3.1 Emergency Switchgear and Battery Rooms

The system consists of a common air supply system and separate exhaust systems for emergency switchgear and battery rooms (Drawing M-399). Outdoor air is filtered, conditioned by heating coils when required, and discharged by one of the two supply fans to the emergency switchgear and battery rooms of Units 2 and 3. One of the two emergency switchgear room return air fans exhaust air to atmosphere at the radwaste building roof or back to the suction of the supply fan as controlled by an air-operated damper. One of the two battery room exhaust fans discharges exhaust air from the battery rooms to atmosphere at the radwaste building roof. Loss of duct pressure automatically starts standby fans and sounds an alarm in the main control room.

The equipment is installed in a seismic Class I structure adjacent to the main control room. The ventilation system is normally in operation and continues to operate during accident conditions including the loss of offsite power. All system controls are from a local panel. Redundant fans are provided for reliable system operation. A seismically supported, safety grade, pneumatic supply has been provided to maintain the dampers open in accident conditions.

10.14.3.2 Standby Diesel Generator Rooms

Each standby diesel generator room is provided with ventilation air supply fans and an exhaust relief damper (Drawing M-385). Combustion air for the diesel engine is taken from the room. The ventilation systems are supplied with power from the diesels during the loss of offsite power.

10.14.3.3 ESW/HPSW Compartments

The ESW/HPSW compartment housing the high pressure service water pumps, emergency service water pumps, fire pumps, and service water screen wash pumps is provided with a ventilation supply and exhaust system in each of the two seismic Class I compartments. The ventilation system is supplied with standby power during the loss of offsite power. Redundant ventilation equipment is furnished in each compartment for uninterrupted service. The pump structure ventilation system for each HPSW subsystem is single failure proof.

10.14.4 Safety Evaluation

The emergency equipment rooms are provided with cooling and ventilating systems with sufficient redundancy to ensure proper operation of equipment during normal and accident conditions. In addition, equipment is designed and installed in accordance with seismic Class I criteria and is supplied with normal and standby power.

10.14.5 Inspection and Testing

The emergency ventilating systems are proved operable by use during normal plant operation. The effectiveness of the energy removal from the local environments can be evaluated by measuring the compartment air temperatures where the equipment is located. Portions of the systems normally closed to flow can be tested to ensure operability and integrity of these systems.

The instantaneous auxiliary relays used to sequence the diesel generator room vent supply fans and the residual heat removal compartment fan coolers during a LOCA (with offsite power available) will be tested in accordance with surveillance test procedures. The test will verify the settings, operability, and functional performance of the relays, and will provide assurance that the automatic loading sequence is being maintained and will perform as required.

10.15 PLANT HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

10.15.1 Power Generation Objective

The power generation objective of the plant heating, ventilating, and air conditioning systems is to control the plant air temperatures and the flow of airborne radioactive contaminants to ensure the operability of plant equipment and the accessibility and habitability of plant buildings.

10.15.2 Power Generation Design Basis

The plant heating, ventilating, and air conditioning systems:

1. Provide appropriate temperature control for personnel comfort and equipment performance.

2. Provide sufficient filtered fresh air supply for personnel.

3. Provide air movement patterns from areas of lesser to areas of progressively greater contamination potential prior to final exhaust.

4. Minimize the possibility of plant exhaust air recirculation into the plant air intake.

10.15.3 Description

10.15.3.1 General

The plant heating, ventilating, and air conditioning systems provide heated or cooled air to main areas of the plant. Supply air temperature is controlled by heating coils and cooling coils. Generally, airflow is routed from areas of lesser to areas of progressively greater contamination potential prior to final exhaust. Also, the ventilation system has sufficient design capacity to protect equipment from excessive temperatures.

The exhaust ventilation air from the turbine building and radwaste building is discharged to atmosphere from the ventilation stack above the reactor building roof. Exhaust from areas where radioactive particulate may be present, such as equipment rooms, is not recirculated but is exhausted through high-efficiency filters to atmosphere. Clean exhaust air from other plant areas is not filtered prior to being released to atmosphere.
The reactor building heating and ventilating system is described in paragraph 5.3.2. The main control room air conditioning system is described in subsection 10.13, and the emergency heating and ventilating systems are described in subsection 10.14.

10.15.3.2 Turbine Building

The ventilation system supplies filtered and tempered outdoor air to the operating floor, main condenser area, and equipment compartments (Drawing M-387). The main condenser area is maintained at a slight negative pressure to reduce exfiltration of potential radioactive contaminants to the adjacent areas. Ventilation air to the operating floor is recirculated or exhausted as required to maintain space temperature. The exhaust air from the operating floor and the main condenser area is discharged to the atmosphere through the ventilation stack located at the top of the reactor building. Air from potentially contaminated equipment compartments is exhausted through high-efficiency filters prior to release to the atmosphere at the ventilation stack. Supplementary cooling in the main condenser area and condensate pump room is provided by fan-coil units using service water for cooling. Additionally, unit heaters are provided in various areas for equipment freeze protection.

10.15.3.3 Radwaste Building

The ventilation system for the radwaste building maintains a supply of filtered and tempered fresh air to all areas of the radwaste building (Drawing M-389). Generally, air is distributed from areas of lesser to areas of progressively higher contamination.

Two exhaust systems are used: normal and equipment compartment exhaust. The normal exhaust is unfiltered and is discharged to atmosphere at the reactor building roof through the ventilation stack. The equipment compartment exhaust air is filtered prior to release to atmosphere from the ventilation stack. Air vented from tanks containing radioactive liquids is exhausted through high-efficiency filters prior to joining the equipment compartment exhaust duct work.

10.15.3.4 Miscellaneous Rooms and Buildings

The cable spreading room, located beneath the main control room, is provided with its own supply and exhaust fans, filters, heating and cooling coils, duct work, instrumentation, and controls. Redundancy in the number of fans provides continued operation of the system. These fans shut down on a loss of offsite power.

The computer room, located in the cable spreading room area, is provided with self-contained air conditioning units, filters, and controls to maintain constant temperature and humidity in the room. These units operate from the standby power supply during a loss of offsite power.

The administration building, chemical laboratory rooms, shop and warehouse building, water treatment building, and other structures in the plant are provided with separate conventional heating, ventilating, and/or air conditioning system.

10.15.4 Inspection and Testing

The plant heating, ventilating, and air conditioning systems are proved operable by their use during normal plant operation. Portions of the systems normally closed to flow can be tested to ensure operability and integrity of the systems.

10.16 MAKEUP WATER TREATMENT SYSTEM

10.16.1 Power Generation Objective

The power generation objective of the plant makeup water treatment system is to provide a supply of water suitable as makeup for the plant and reactor systems and other water requirements.

10.16.2 Power Generation Design Basis

The makeup water treatment system is designed to provide reactor quality water for pre-operational tests, startup, and normal power operation.

10.16.3 Description

The makeup water treatment system is common to Units 2 and 3 (Drawings M-317 and M-319).

The makeup water treatment system receives river water from the service water system. The system consists of a raw water treatment system, a clarified water storage tank, a makeup demineralizer system, a demineralized water tank, and associated pumps, piping, and instrumentation.

The raw water treatment system consists of skid mounted equipment that is vendor supplied and operated. This equipment produces up to 400 gpm of clarified and filtered water with a nominal flow of 200 gpm for use in the makeup demineralizer system, domestic water, and other uses. This water is pumped to a 200,000 gallon clarified water storage tank. The clarified and filtered water is continuously monitored by vendor supplied turbidity and pH measuring devices which initiate an alarm on a vendor panel.

The makeup water demineralizer system consists of three feed pumps taking suction on the clarified water storage tank and discharging to vendor supplied ultra pure water equipment. The discharge from the ultra pure water equipment goes to a 50,000-gal demineralized water storage tank. The discharge to the storage tank is monitored for quality by conductivity measuring devices which initiate an alarm on a local panel. Also, silica content is continuously monitored and recorded. The quality of water discharged to the storage tank is controlled to maintain water within the limits specified in EPRI BWR Water Chemistry Guidelines.

The piping, tanks, and associated equipment of the demineralized water treatment system are of corrosion-resistant metals which prevent contamination of the makeup water with foreign material.

10.16.4 Inspection and Testing

The makeup water treatment system is an operational system in daily use and as such does not require testing to ensure operability. High demineralizer effluent conductivity automatically initiates an alarm. Grab samples are tested in the laboratory to check demineralizer performance and to ascertain stored water quality.

10.17 INSTRUMENT AIR, SERVICE AIR, AND INSTRUMENT NITROGEN SYSTEMS

10.17.1 Safety Objective

The safety objective of the instrument air, service air, and instrument nitrogen systems is to provide a safety grade, pneumatic supply to support short-term and long-term operations of safety equipment.

10.17.2 Safety Design Basis

1. The containment atmospheric control system containment purge and vent isolation valves are each provided with a backup, safety grade, pneumatic (nitrogen) supply to the valves' inflatable seals.

2. The containment isolation and flow control valves in the CAD vent lines are each provided with a separate, backup, safety grade, pneumatic (nitrogen) supply. The control valves in the CADS supply are provided with a safety grade supply of nitrogen from the CADS nitrogen supply.

3. The ADS valves are provided with a separate short-term, safety grade, pneumatic supply and also a long-term, backup, safety grade, pneumatic supply of nitrogen. To fulfill the requirements of Appendix R to 10CFR, Part 50 manual actions may be performed to connect a back-up safety grade pnuematic nitrogen supply to enable remote operation of safety relief valves. See FPP Table A-4 for actions required to credit this pneumatic supply.

4. A separate short-term, backup, safety grade, pneumatic supply is provided to each of the MSIVs.

5. The suppression chamber-to-secondary containment vacuum breaker air-operated valves are each provided with a backup, safety grade, pneumatic supply.

6. The emergency switchgear and battery room dampers are provided with a backup, safety grade, pneumatic supply.

10.17.3 Power Generation Objective

The power generation objective of the instrument air and service air systems is to supply suitable quality air at adequate pressure for power plant operation.

10.17.4 Power Generation Design Basis

1. The instrument air system supplies clean, dry, oil-free air, nominally at 100 psig, to station instrumentation and controls.

2. The service air system supplies clean air, nominally at 100 psig, for station services.

3. Standby onsite power is provided to the backup air compressors, following a loss of offsite power, to replenish compressed air storage as required. This design feature exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross tie valves. Therefore, little, if any, cooling would be provided to the backup air compressors during a loss of offsite power.

4. Service air use is restricted during emergency conditions so that the instrument air supply shall not be impaired.

5. Two separate systems are provided for each unit for the condensate filter demineralizer backwash operations.

6. Instrument nitrogen/instrument air is provided to the MSIV's for maintaining the valves open when operating the steam cycle.

7. A separate air supply system is provided to selected radwaste equipment.

10.17.5 Description

The instrument air and service air systems (Drawing M-320) consist of four air compressors per unit operating in parallel to supply common discharge headers via individual air receiver tanks, piping, valves, and instrumentation. The instrument and service air systems of Units 2 and 3 can be crosstied.

Two of the three larger compressors (650 SCFM) normally supply all compressed air requirements for one reactor unit during normal operation. The three larger compressors are fed from non-1E power sources. During emergency conditions when neither station nor offsite power are available, the smaller (419 SCFM) compressor, which is fed by a Class 1E power source, is designed to provide desired operational flexibility. This design feature exists although the heat sink, emergency service water (ESW), for the

reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross tie valves. Therefore, little, if any, cooling would be provided to the air compressors during a loss of offsite power.
The instrument air compressors normally operate (load and unload) within a pressure range of approximately 10 psi. The service air compressor, which can feed either of the instrument air headers and the service air header, operates over approximately a 15 psi range so that it will not assume control from the instrument air compressors. In the unlikely event that header pressure decays to 97 psig, an air operated valve in the supply to the service air header will close, thus utilizing the instrument and service air compressors for instrument air only. The duty status of all three compressors can be changed to allow for maintenance and equalization of wear. During a loss of station or offsite power, only the 419 SCFM compressor (backup compressor), is fed by diesel backed power. This design feature exists although the heat sink, emergency service water (ESW), for the reactor building closed cooling water (RBCCW) system has been eliminated as a result of locking closed the ESW-RBCCW cross tie valves. Therefore, little, if any, cooling would be provided to the air compressors during a loss of offsite power. During a LOCA event the affected unit's backup compressor will trip if running or will be prevented from starting for 60 seconds. Identical backup compressors are provided for each unit, and manual crossties are provided so that either or both backup compressors can be utilized to supply either unit. A single backup compressor is sufficient to supply operational flexibility for one unit during shutdown following a LOOP and/or LOCA.

Each of the four compressors is of the 2-stage oil-free rotary screw design. These compressors are water cooled and are complete packaged units, incorporating an inter-cooler, after-cooler, oil cooler, bleed-off cooler, and all controls and instrumentation in a single sound attenuating enclosure. "Compressor trouble" alarms actuated by any compressor trip functions are provided both in the control room and locally on the compressors.

The lead compressors are rated at 691 ACFM at 125 psig maximum and utilize a 150 HP motor with a 1.15 service factor. The backup compressors are rated at 456 ACFM at 125 psig maximum and utilize a 100 HP motor with a 1.15 service factor. All compressor motors are capable of starting and accelerating at 75% of nominal voltage.

The prefilters of the air dryer are the coalescing type and are designed to remove effluent to 0.0013 ppmw. The dual tower instrument air dryer package is rated at 900 scfm, is of the heatless design and utilizes activated alumina desiccant for absorption of moisture. The dryer is designed for a discharge dew point of -40°F. Each dryer incorporates a moisture sensing control which measures the actual moisture load present on the desiccant during each cycle. It then limits the number of regeneration (purge) cycles to only those required to remove moisture to maintain the required outlet dew point. The after filters are designed to remove particulate to 0.9 micron absolute. Also incorporated in the dryer skid package are a flow meter and a dew point analyzer. The flow meter is provided with flow recording and totalizing capabilities to enable continuous monitoring of plant air usage. The dew point meter gives a continuous readout of moisture level. There are local alarms on each dryer skid to indicate high differential pressure across the prefilters, high moisture content in the outlet air, and dryer control malfunctions. There is one common alarm window per unit, located on C212L in the control room, to indicate an alarm condition exists on either of the two dryer skids for that unit. The discharge from the dryer package than passes to the plant instrument air headers.

Breathing air stations are provided with air from the service air system headers.

Since the air is supplied by non-lubricated compressors, the instrument air system is supplied with clean, dry, oil-free air for use by instrumentation and controls. This system supplies air to the main steam isolation valves external to containment. The main steam isolation valves are provided with accumulators for reliable operation without compressor operation.

The control rod hydraulic control system air requirement is for scram reset purposes only, and its demand is met by the CRDS storage capacity. Other pneumatic-operated devices are also designed for the fail-safe mode, and do not require a continuous air supply under abnormal conditions.

The Condensate Filter Demineralizer backwash operation employs the use of two separate air backwash systems. The primary system is a high pressure air surge system which uses a non-lubricated, two stage, water cooled compressor rated at 200 scfm at 200 psig. Each unit has two separate receiver tanks (150 ft^3 each) which are cross-tied to allow either compressor to charge both units. In addition each unit is provided with a backup low pressure air scrub backwash system using low pressure centrifugal blowers rated at 1400 scfm.

The containment atmospheric control system purge and vent valves are supplied with separate safety grade pneumatic supplies to the inflatable seals to maintain their leaktight condition. The source of this pneumatic supply is from the Safety Grade

Instrument Gas (SGIG) system. The SGIG supplies pressurized nitrogen gas from the CAD tank as a backup to normal instrument air. The safety grade pneumatic supply is isolated from the nonsafety grade portion of the air supply by spring-loaded, soft-seat, check valves designed for zero leakage. The purge and vent valves alarm upon opening or on loss of seal pressure.

The suppression chamber-to-secondary containment vacuum breaker air-operated valves are each supplied with separate, safety grade, pneumatic supplies. There are two suppression chamber-to-secondary containment vacuum breaker lines on each unit. Each line is provided with a normally closed, fail open, air-operated butterfly valve. Each of these valves is provided with a safety grade pneumatic supply in order to maintain valve closure. One valve on each unit is equipped with an inflatable seal which is also supplied by the safety grade pneumatic supply. These valves alarm upon opening or, for the valves equipped with the inflatable seal, on loss of seal pressure. The source of this pneumatic supply is from the Safety Grade Instrument Gas (SGIG) system. The SGIG supplies pressurized nitrogen gas from the CAD tank as a backup to normal instrument air. The safety grade pneumatic supply is isolated from the nonsafety grade portion of the air supply by spring-loaded, soft-seat, check valves designed for zero leakage.

The safety grade supply to the CADS valves is described in paragraph 5.2.3.9 of subsection 5.2.

A separate air supply system is provided to selected radwaste equipment; the system contains two air compressors, associated controls, a receiver, and separate piping to connect the air supply to the equipment. This system eliminates the potential of service air system contamination in other areas of the plant due to backflow from radwaste equipment.

The ADS accumulators, which provide the short-term, backup, safety grade supply, and their long-term, safety grade, pneumatic supply are described in paragraph 4.4.5 of subsection 4.4.

An MSIV accumulator is located close to each isolation valve to provide pneumatic pressure for valve closing in the event of failure of the normal, non-safety grade, air supply system. The accumulator volumes are designed for inboard and outboard isolation valves when the normal pneumatic supply to the accumulator has failed. The supply line to the accumulator is large enough to make up pressure to the accumulator at a rate faster than the rate the valve operation bleeds pressure from the accumulator during valve opening and closing. The air supply lines are provided with check valves to assure the integrity of the accumulator air supplies.

In order to eliminate the introduction of compressed air into the containment and to minimize the need for venting and discharge of the primary containment gases to the environment, an instrument nitrogen system is provided for pneumatic service to ensure the oxygen concentration is maintained less than 5 percent inside the drywell (Drawing M-333, Sheets 1 and 2).

Essentially, this system takes suction from the containment nitrogen atmosphere and discharge to a receiver which will be the source of supply for the required pneumatic services inside the drywell. In this manner, no air will be added to the containment atmosphere, but rather the containment nitrogen atmosphere will be recycled, with any losses of nitrogen made up by the normal inerting system.

The instrument nitrogen system lines are seismic Class I from the containment penetrations to the second isolation valve, and have automatic isolation valves which function as part of the primary containment and reactor vessel isolation control system when required.

Pneumatically operated devices located within the primary containment are normally operated by the instrument nitrogen system. A cross connection is provided between the instrument air system and the instrument nitrogen system to service the components in the primary containment should the instrument nitrogen system be inoperable. Additionally, vital components, such as the main steam isolation valves and main steam relief valves, are provided with accumulators for reliable operation without compressor operation.

The emergency switchgear and battery room dampers are supplied with safety grade pneumatic supplies to maintain the dampers open. The source of the pneumatic supply is nitrogen cylinders. The safety grade pneumatic supply is isolated from the non-safety grade potion of the air supply by spring-loaded, soft seat, check valves. The safety grade supply to the E.S.G.B.R. dampers is described in paragraph 10.14.3.1.

10.17.6 Safety Evaluation

The safety grade, pneumatic supplies to the essential valves of the CADS are provided so that the system can supply post-LOCA nitrogen addition to the containment and can facilitate controlled venting of containment. The safety evaluation for the CADS is contained in paragraph 5.2.3.9.

The safety grade, pneumatic supply to the containment purge and vent valves is provided to maintain pressure in the inflatable valve seats to assure leaktight conditions. The safety evaluation is contained in paragraphs 5.2.3.7 and 5.2.4.

The safety grade, pneumatic supply to each of the suppression chamber-to-secondary containment vacuum breaker butterfly valve is provided to maintain valve closure. It also provides the pneumatic supply to the inflatable seal utilized in one of the valves on each unit. The safety evaluation is contained in paragraphs 5.2.3.6 and 5.2.4.

Each ADS valve is provided with a short-term, backup, safety grade, pneumatic supply by means of its associated accumulator and check valve to provide sufficient capacity to cycle the valve open five times at atmosphere pressure, twice at 70% of containment design pressure, or once at containment design pressure, all within a 4-hour period.

A long-term, backup, safety grade, pneumatic supply has been provided to the ADS valve accumulators inside the primary containment to assure ADS valve operability for a period of 100 days following an accident.

A split ring header is installed inside the containment with three ADS valves connected to one section of the split header and the remaining two ADS valves connected to the other section of the split header. The safety grade, pneumatic pressure is a series of nitrogen cylinders located within the reactor building with a connection provided outside the reactor building for the installation of additional bottles, as required. Also, a long-term, backup, safety grade pneumatic nitrogen supply has been provided to SRVs RV2(3)-02-071E, H&J. This pneumatic supply is provided to enable remote operation of the above valves for a period of 72 hours following a Design Basis fire in Fire Areas 6S (Unit 2) and 13S (Unit 3) which has been postulated to render the ADS valves available for only short-term operation. The source of the pneumatic nitrogen supply is the Safety Grade Instrument Gas (SGIG) system. The SGIG system is tied into the 6,000 gallon liquid nitrogen tank which supplies the Containment Atmospheric Dilution (CAD) system. The CAD tank is located outside of Fire Areas 6S (Unit 2) and 13S (Unit 3).

Spare primary containment penetrations, two for each unit, have been modified to provide a permanent means of connection to each section of the safety grade, pneumatic supply headers within each drywell. Containment isolation has been provided for the instrument gas supply lines into containment by the use of check valves and other automatic valves outside the primary containment. The outer, automatic valves are manually controlled from the control room and automatically close on low differential pressure between pneumatic supply pressure and containment pressure or if gas flow becomes excessively high.

The MSIV accumulators are provided to supply a safety grade, backup, pneumatic supply to close the MSIV's by pneumatic pressure following the loss of normal non-safety grade pneumatic supply. The safety function of the accumulators is assured by a safety grade check valve which isolates the accumulators and allows them to perform their safety function.

The safety grade, pneumatic supply to the emergency switchgear and battery room dampers is provided to assure continued operation of the ventilation system.

10.17.7 Inspection and Testing

The instrument air and service air systems are proved operable by their use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

The post-LOCA CADS is functionally tested in accordance with plant procedures. The atmospheric analyzing system is functionally tested in accordance with the Technical Requirements Manual. Inspection and testing of the ADS is discussed in paragraph 4.4.8.

10.18 DOMESTIC AND SANITARY WATER SYSTEM

10.18.1 Power Generation Objective

The power generation objective of the domestic and sanitary water system is to provide the potable water supplies and sewage treatment necessary for normal plant operations and shutdown periods.

10.18.2 Power Generation Design Basis

1. Domestic water is chlorinated.

2. Sanitary system water (sewage) is treated prior to release.

10.18.3 Description

Domestic water is supplied from the clarified water system, discussed in subsection 10.16, "Makeup Water Treatment System." The domestic water system consists of a 5,000-gal domestic water storage tank, two domestic water pumps, a domestic water hydropneumatic tank, hypo-chlorinator, and distribution piping (Drawing M-317). Clarified and filtered water is chlorinated and stored in the domestic water storage tank, then pumped to the hydropneumatic tank, where it is pressurized for system distribution. Water heating units are provided for domestic showers.

An onsite sewage treatment plant is provided to treat the normal sewage prior to release. The facility has the capacity to handle Units 2 and 3 and to handle the variable loading at the plant due to population fluctuations between outage and non-outage periods. The sewage treatment system is designed to provide an effluent that meets the regulations of the Commonwealth of Pennsylvania.

10.18.4 Inspection and Testing

The domestic and sanitary water system is proved operable by its use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

10.19 PLANT EQUIPMENT AND FLOOR DRAINAGE SYSTEM

10.19.1 Power Generation Objective

The power generation objective of the plant equipment and floor drainage system is to collect and remove waste liquids from their points of origin to a suitable disposable area.

10.19.2 Power Generation Design Basis

1. Liquid waste drains are classified in accordance with radioactive contamination potentials and conductivity levels and chemical content.

2. Potentially radioactive liquid wastes are collected separately from the non-radioactive wastes, in a controlled and safe manner.

10.19.3 Description

The plant equipment and floor drainage system handles both radioactive and potentially radioactive wastes. Radioactive wastes are collected in the building sumps and transferred to the radwaste building for treatment, sampling, and analysis prior to disposal or reuse in the plant. Non-radioactive wastes are pumped or drained by gravity into the sewer system, storm drain system, or intake bay, and released.

10.19.3.1 Radioactive Equipment Drainage System

1. Reactor Building Drains

   Reactor containment systems' equipment wastes are collected in two separate systems. The drywell equipment drain sump system collects equipment drains located in the primary containment. The reactor building equipment drain sump system handles drainage from equipment drains located in the secondary containment. Equipment drains are collected in closed piping and discharged to the equipment drain sump. Pumps transfer these wastes to the radwaste system. Containment is provided in transferring waste from the sumps to the radwaste system by maintaining a minimum water level in the sump, which seals the pump suction lines. To prevent blowout of water seals, the drywell equipment drain discharge line penetrating the primary containment has two isolation valves which close upon a high drywell pressure signal.

2. Turbine Building

   The turbine building radioactive equipment drainage system is collected in sumps located below the basement level. Sump pumps transfer the liquid to the radwaste system.

3. Radwaste Building

   The radwaste building is provided with an equipment drain sump. Sump pumps transfer the liquid to the radwaste system. Radioactive drainage within the radwaste onsite storage facility is discussed in section 9.3.3.2.

4. Recombiner Building

   The recombiner building is provided with an equipment drain sump. Sump pumps transfer the liquid to the radwaste system.

10.19.3.2 Floor Drainage System

In general, floor drains from the primary containment, reactor building, turbine building, recombiner building, and radwaste building are collected in sumps located in the basement or lowest level of the building. Sump pumps transfer the waste from the sumps to the radwaste system.

10.19.3.3 Non-Radioactive Drainage System

Roof drains from the reactor buildings, turbine building, radwaste building, and other buildings, and some floor drains in the turbine building service areas are collected and typically discharged by gravity to the storm drain system. Floor and equipment drains associated with the Unit 2 and Unit 3 critical pump portions of the Circulating Water Pump Structure are collected in a common sump and pumped to the intake bay. Rainwater from the roof drain is normally routed directly to the intake bay. Refer to UFSAR Section 12.2.10 for details regarding how this drainage system provides protection of critical equipment during external flood conditions.

10.19.3.4 Miscellaneous Drainage System

Non-radioactive chemical liquid wastes are collected, neutralized, and routed to the settling basin prior to release to the pond. Oil drains and oil-contaminated liquid drains are collected in a separate oil collection tank for offsite disposal.

10.19.3.5 Torus Dewatering Facilities

A 1.2 million-gal capacity storage tank and associated valving and piping is provided for dewatering the torus to support containment suppression chamber inspections and/or modifications. The tank provides temporary storage for the entire volume of the torus.

The Torus De-Watering System (TDWS) is only connected to the torus for dewatering/polishing in plant modes 4 and 5. Removable spool pieces with isolation valves are utilized to allow the TDWS pump suction to be connected to the torus. The spool piece assemblies (with closed isolation valves) are fully qualified to allow the torus to maintain a reliable source of water for ECCS operation while operations with the potential to drain the vessel are in progress.

Torus water transfer is via the torus dewatering pumps (Units 2 and 3) and sludge pump (Unit 3 only). The torus water may be sent to either the Condensate Storage Tank or the Torus Dewatering Tank (TDT). Transfer is generally routed through a condensate filter demineralizer to improve water quality prior to storage in the TDT. Additionally, the TDWS may be used to filter and polish the torus water by operating the system in closed loop from the torus through a condensate filter demineralizer, and back to the torus.

10.19.4 Inspection and Testing

The plant equipment and floor drainage system is proved operable by use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

10.20 PROCESS SAMPLING SYSTEM

10.20.1 Power Generation Objective

The power generation objective of the process sampling system is to monitor the operation of equipment and systems, and to provide information for making operational decisions.

10.20.2 Power Generation Design Basis

1. The process sampling system is designed to obtain representative samples which can be used in the radiochemical laboratory.

2. The process sampling system minimizes contamination and radiation effects at the sampling stations.

3. The process sampling system is designed to reduce decay and sample line plateout.

10.20.3 Description

Samples are taken at locations throughout the plant from the process and auxiliary systems (Table 10.20.1). Sample points are grouped as much as possible at normally accessible locations, and drains are provided at these locations to limit the risk of contamination. Lines are sized to ensure purging and sufficient velocities to obtain representative samples. The samples are analyzed and the resulting information is used to evaluate the condition of the plant.

10.20.4 Inspection and Testing

The process sampling system is proved operable by its use during normal plant operation. Grab samples are taken to verify the proper operation of the continuous samplers. Portions of the system normally closed to flow can be tested to ensure the operability and integrity of the system.

TABLE 10.20.1

PROCESS SAMPLING SYSTEM

Description	Locations	Purpose
	Nuclear Steam Supply System	
Reactor water	Recirculation pump discharge	Reactor water quality, crack
arrest verification		
Main steam	Main steam line	Carryover, moisture
RHRS	RHR HX outlet	HX leakage
	Cleanup Demineralizer	
Filter-demineralizer	Influent header	Reactor water quality
Filter-demineralizer	Powdex unit effluent	Filter condition
Filter-demineralizer	Precoat recycle line	Element leakage
Regenerative HX	Return to reactor	HX leakage
Non-regenerative HX	Cooling water outlet pipe	HX leakage
	Condensate System	
Condensate	Hotwell trays	Tube leakage
Condensate	Condensate pump discharge	Tube leakage, water quality
Condensate demineralizer	Influent header	Condensate quality
Condensate demineralizer	Powdex unit effluent	Filter condition
Condensate demineralizer	Effluent header	Treated condensate quality
Consensate demineralizer	Precoat recycle line	Element leakage
	Feedwater Systems	
Heater drains	Heater No. 3 outlet	Water quality
Feedwater	Heater No. 5 outlet	Water quality
Feedwater	Reactor inlet	Water quality
	Closed Cooling Water Systems	
Turbine building cooling water	Pump discharge	Inhibitor concentration
Reactor building cooling	Pump discharge	Inhibitor concentration
	Circulating and Service Water Systems	
Service water	Pump discharge header	Determine background
Circulating water	Condenser outlet	Chlorine residual
Circulating water	Discharge canal	Activity release

TABLE 10.20.1 (Continued)

Description	Locations	Purpose
	Circulating and Service Water Systems	
Service water	Pump discharge header	Determine background
Circulating water	Condenser outlet	Chlorine residual
Circulating water	Discharge canal	Activity release
	Liquid Radwaste System	
Laundry drain tank	Pump discharge	Process data
Laundry drain filter	Filter effluent	Water quality
Floor drain collector tank	Pump discharge	Process data
Floor drain filter	Filter effluent	Process data
Floor drain demineralizer	Demineralizer effluent	Process data
Floor drain sample tank	Pump discharge	Discharge suitability
Waste collector tank	Pump discharge	Process data
Waste surge tank	Pump discharge	Process data
Waste collector filter	Filter effluent	Process data
Waste demineralizer	Demineralizer effluent	Process data
Waste sample tank	Pump discharge	Discharge suitability
R/W fuel pool F/D precoat	Precoat recycle line	Element testing
Fuel pool HX	HX outlet	Fuel pool quality, HX leakage
Fuel pool filter demineralizer	Powdex unit effluent	Filter/demineralizer condition
Chemical waste tank	Pump discharge	Process data
Condensate phase separator decant	Pump discharge	Process data
Cleanup phase separator decant	Pump discharge	Process data
Centrifuge liquid effluent	Liquid discharge pipe	Process data
	Makeup Water Treatment Systems	
Raw water inlet	GE M52 skid inlet	Process data
Filtered water outlet	GE M52 outlet	Process data
Domestic water	Pump discharge	Chlorine residual
Carbon filter	Filter effluent	Process data

TABLE 10.20.1 (Continued)

Description	Locations	Purpose
	Makeup Water Treatment Systems (Continued)	
Cation unit	Effluent	Process data
Anion unit	Effluent	Process data
Mixed bed unit	Effluent	Water quality
Dilute acid	Header	Process data
Dilute caustic	Header	Process data
Neutralizer tank	Outlet pipe	Process data
Demineralized water storage tank	Pump discharge	Water quality
Condensate transfer system	Pump discharge	Water quality
Refueling water transfer system	Pump discharge	Water quality
	Plant Off-Gas Systems	
Air ejector discharge	Header	Activity; H_2, 0_2, and air in-leakage
Off-gas stack sample particulate	Main stack	Noble gas monitoring and and iodine samples to determine release rates
Recombiner area monitoring	Fan discharge from individual equipment rooms, hydrogen analyzers, instrument racks, equipment sumps, and cooling water surge tank. Identification of specific source of leakage is obtainable.	Activity
Building ventilation exhaust particulate	Building ventilation stack	Noble gas monitoring and and iodine samples to determine release rates
Control room, radwaste, recombiner ventilation	Fan discharge	Activity

10.21 COMMUNICATIONS SYSTEMS

10.21.1 Power Generation Objective

The power generation objective of internal and external communications is to establish a combined system of loudspeakers and telephones to provide convenient, effective operational communications between various plant buildings and locations.

10.21.2 Power Generation Design Basis

1. Voice communication to points outside the station is provided by a dial telephone system.

2. Voice communication between various plant buildings and locations is provided.

10.21.3 Description

The following means of communication are provided in the plant:

1. A dial phone system with a self-contained power supply is provided for communicating with points outside the station.

2. An intraplant communication system consisting of handsets and loudspeakers is provided for paging and communications in all appropriate areas. The intraplant system employs equipment that operates from the AC instrument bus. Loudspeakers powered by individual amplifiers are located throughout the station, with muting facilities provided where required. Paging plus two-party line channels are provided for simultaneous operation.

3. A separate intraplant telephone system allows uninterrupted private communication for maintenance and general use between the main control room, reactor refueling area, and other selected plant areas. The system is designed to ensure that no interference in vital communication is caused by other plant communication systems.

4. An evacuation alarm system is located in strategic points throughout the plant to warn personnel of emergency conditions. Additional speakers are located, especially in high noise areas, to provide plant evacuation signal.

5. A distributed antenna system was installed throughout the plant to provide the capability of using low power walkie talkies as a supplementary means of communicating within the plant. Because these walkie talkies are low power, they will not interfere with plant instrumentation.

6. A dedicated communications system, using the distributed antenna system is installed to allow plant operators to communicate between the main control room and the Unit 2 and Unit 3 Alternative Control Stations. This system is used for coordinating testing of the Alternative Control Stations and in an Emergency, for a Safe Shutdown from the Alternative Control Stations. See the Fire Protection Program (FPP) for details.

10.21.4 Inspection and Testing

The communication systems are proved operable by use during normal plant operation. Loss of offsite power operation can be tested to ensure operability and integrity of the systems.

10.22 STATION LIGHTING SYSTEM

10.22.1 Power Generation Objective

The power generation objective of the station lighting system is to provide adequate normal and emergency indoor station lighting. Power is supplied from a normal AC source, standby AC system, and from the station battery system.

10.22.2 Power Generation Design Basis

1. Lighting intensities approximate levels recommended by the Illuminating Engineering Society.

2. Mercury vapor fixtures and mercury switches are not used inside the primary containment or directly above the reactor on the refueling floor.

3. The main control room has a fluorescent lighted, glare-free, luminous ceiling to reduce glare and shadows at the control boards.

4. Emergency lighting is provided in the control room, diesel generator rooms, emergency switchgear area, and other points where lighting may be required under abnormal conditions.

10.22.3 Description

The station lighting system is supplied from the station auxiliary power system described in Section 8.0, "Electrical Power Systems." Normal power is supplied from the unit auxiliary or the startup transformers. The power supply for lighting areas required during shutdown or abnormal conditions is automatically transferred to the standby diesel generator system if the normal power supply is lost.

The lighting distribution system has separate, dry-type lighting transformers and circuit breaker type panel boards.

A separate emergency DC lighting system, energized from the station batteries, is provided for safe exit lighting if all AC power sources are lost.

Separate 8-hour, battery-powered lighting is provided to support safe shutdown operations remote from the control room (Reference Table A-4 of the PBAPS Fire Protection Program). Task lighting is provided at the sites of the operations. The routes used to access and egress the sites are also illuminated. See Fire Protection Program (FPP) for details.

10.22.4 Inspection and Testing

The station lighting system is proven operable during normal plant operation. Loss of offsite power operation can be tested to ensure operability and integrity of the system.

10.23 PLANT AUXILIARY BOILERS

10.23.1 Power Generation Objective

The power generation objective of the plant auxiliary boiler system is to supply necessary steam for plant uses.

10.23.2 Power Generation Design Basis

1. The plant auxiliary steam system operates independently from the nuclear steam system. Wherever the two systems have interfaces, a positive means of separation is provided.

2. The auxiliary steam system is designed to provide operational flexibility to accommodate the seasonal steam demand.

10.23.3 Description

The plant auxiliary boilers are common to both Units 2 and 3. The auxiliary steam system consists of two 40,000-lb/hr, oil-fired, water-tube package boilers and associated equipment and instrumentation (Drawing M-324, Sheets 1, 1A, 2, 2A, 3, 3A, and 4). The boilers have a design and maximum allowable working pressure of 275 psig. The boilers are designed, fabricated, tested, and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section I, and the rules and regulations of the Commonwealth of Pennsylvania.

Process steam (200 psig system) and plant heating steam (50 psig system) are distributed from the boiler steam outlet header.

Except for cold startup of a boiler or a startup subsequent to a safety trip, the boiler control system is designed for unattended operation.

The 200 psig process steam header provides the following process steam during the plant startup until the nuclear steam pressure is adequate:

1. Condensate deaeration in the hotwell during startup.

2. Turbine shaft seal steam during startup.

The condensate from this process is not returned to the deaerator but is drained to the main condenser.

10.23.4 Inspection and Testing

The auxiliary steam system is proven operable by its use during normal plant operation. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

10.24 EMERGENCY HEAT SINK

10.24.1 Power Generation Objective

The power generation objective of the emergency heat sink is to provide an onsite heat removal capability so that the reactors of Units 2 and 3 can be shut down in the event of the unavailability of the normal heat sink.

10.24.2 Power Generation Design Basis

1. The emergency heat sink has a sufficient capacity for removing the sensible and decay heat from the reactors' primary systems and auxiliary systems so that the reactors can be shut down in the event of the unavailability of the normal heat sink.

2. The emergency heat sink has the heat removal capacity to supply a source of cooling water to the emergency service water system and the high pressure service water system when required.

3. The emergency heat sink provides sufficient water storage capacity to permit emergency cooling tower operation until a makeup water supply can be established.

4. The emergency heat sink can operate during a loss of offsite power and can withstand a seismic event.

10.24.3 Description

The emergency heat sink facility consists of a fireproof, multicell, mechanical, induced-draft cooling tower, constructed as a seismic Class I structure, with an integral onsite 3.55 million-gal water storage reservoir (Drawing C-2). The facility operates in conjunction with the high pressure service water pumps (subsection 10.7), the emergency service water pumps (subsection 10.9) at the pump structure, and the emergency service water booster pumps (Drawing M-330). The equipment, valves, and piping in the emergency heat sink system are designed in accordance with seismic Class I criteria. Power requirements are supplied from the standby power supply. Equipment data is shown in Table 10.24.1.

The high pressure service water pumps take suction from the pump bays to supply water to the RHR heat exchangers. Sufficient head is available to pump the return water directly to the emergency cooling tower. Water supplied from the onsite reservoir flows by gravity to the pump structure in two full-capacity lines, this flow being regulated by two motor operated flow control valves in series in each line. The emergency service water pumps, also located in the pump structure, take suction from the pump bays and supply water to standby diesel generator coolers and the CSCS's pump room air coolers. The return water from the various coolers is boosted in pressure by one of two full-capacity emergency service water booster pumps and delivered to the emergency cooling tower. After an extended period of time, the fuel pool cooling system may be served by the emergency service water system by adding cross connections.

Sluice gates in the pump structure isolate the high pressure service water and emergency service water pump bays from Conowingo Pond. These gates are manually closed prior to utilizing the onsite reservoir.

The cooling tower is a mechanical, induced-draft type consisting of three cells each capable of handling the heat transfer duty of one RHR heat exchanger (one HPSW pump) plus the plant auxiliary cooling requirement (one ESW pump). The tower heat transfer duty is based on the heat duty occurring when the RHRS operating mode is switched from the containment (torus) cooling mode to the shutdown cooling mode at the time the reactor water temperature reaches 300°F.

The emergency heat sink system supplies cooling water to two high pressure service water pumps and one emergency service water pump continuously until all the nuclear fuel can be shipped offsite. Makeup water is supplied from an offsite source.

The installed capacity of 3.55 million gal of water stored in the emergency cooling reservoir is adequate for 1 week of operation without makeup. Makeup of water to the system will be initiated as expeditiously as possible after shutdown of the reactors and will be continued for an indefinite period as required.

After a two-reactor shutdown, assuming the turbine condensers are not available as heat sinks, it is estimated that continued operation of the RHRS in the shutdown cooling mode can cool the reactors to 212°F in approximately 12 hr and to 125°F in about 3 weeks. Based on controlled cooling tower operation at the rated flow condition, the total water consumed at the end of 7 days is approximately 2.9×10^6 gal and a makeup rate of 250 gpm will be required after the first week. The turbine-condensers, if available, will be used as heat sinks for the removal of reactor heat as long as effective. The minimum Conowingo Pond level required for effective operation of the main condenser circulating water pumps is approximately 93.8 feet (C.D.). Note: Water level in the pump bays will be lower due to level differential across the traveling screens.

The offsite makeup water supply to the plant will be made by truck trailers, or temporary hose lines, and portable pumping equipment will be available and used to withdraw water from waterholes in the Susquehanna River or Rock Run Creek. Water transportation into the plant will be initiated as soon as practicable after the loss of the dam accident. The 250 gpm makeup rate required 1 week after reactor shutdown represents about three 5,000 gal water trucks per hour.

The feasibility of transporting a large quantity of water was demonstrated during the 1965 drought period in York, Pennsylvania, when several million gallons were delivered by truck daily to the potable water system of that city. Fuel oil is also delivered (two or three trucks per hour) to several generating stations on the licensee’s system.

10.24.4 Inspection and Testing

To assure that the emergency heat sink will function properly, the tower and reservoir are inspected for integrity and reservoir level. The high pressure service water, emergency service water, and emergency cooling water pumps are tested in conjunction with their systems' testing. Portions of the system normally closed to flow can be tested to ensure operability and integrity of the system.

Flow measurement devices are provided in the emergency cooling water system to facilitate testing of the emergency cooling water pump and the emergency service water booster pumps in accordance with AMSE Code requirements.

The timer used to sequence the emergency cooling water pump during a LOCA will be tested in accordance with surveillance test procedures. The test will verify the setting, operability, and functional performance of the relay, and will provide assurance that the automatic loading sequence will be maintained and will perform as required.

TABLE 10.24.1

EMERGENCY HEAT SINK EQUIPMENT DATA

Design Performance and Type

Type	Induced Draft/ Counter Flow
Design Wet Bulb Temperature	78.0°F
Number of Towers/Number of Cells per Tower	1 / 3
Total Heat Load	357 x 10^6 Btu/hr
Water Side	
High Pressure Flow	
Hot Water Flow	9,000 gpm
Hot Water Temperature	160°F
Cold Water Temperature	90°F
Evaporation Loss at Rated Flow	7%
Low Pressure Flow	
Hot Water Flow	8,000 gpm
Hot Water Temperature	100°F
Cold Water Temperature	90°F
Evaporation Loss at Rated Flow	1%
Total Water Concentration/Cell	3.69 gpm/ft^2
Water Load on Tower Base Area	187 gal/ft^2*
Hot Water Overload Capability	50% (Approx.)
Cold Water Temperature at Overload Flow	96°F *
Drift Water Loss at Rated Flow	<0.05%
Retention Time through Tower	7.0 sec
Air Flow	
Stack Height	20.0 ft
Air Flow	8.01 x 10^6 lb/hr
Draft Loss Inches	0.633 in H_20
Total Fan Power Demand, Bhp at Motor Coupling	185.0/cell

* Both systems at 50 percent overload.

TABLE 10.24.1 (Continued)

Mechanical Equipment (per Cell)

Fans	
Number	1
RPM	116.7 rpm
Blade Material	Reinforced
Fiberglass Epoxy	

Tower and Cell Structure

Tower Height	57 ft 4 in
Air Intake Height	10 ft 6 in
Cell Dimension	48.0 ft x 48.0 ft
Stack Height	20.0 ft

Emergency Cooling Water Pumps	For specifications see Table 10.9.1

Emergency Service Water Booster Pumps

Quantity	2 (common to both units)
Pump Design	
Type	Horizontal split
Flow/Head	8,000 gpm/100 feet
Bhp at Rating	230
Speed	1,170 rpm
Number of Stages	1
Material	
Bowl	Bronze
Shaft	AISI 303
Shaft Sleeve	AISI 440c
Wear Ring	Bronze
Impeller/Liner	ASTM B143 Bronze
Motor Design	
Type	Horizontal Induction Type
Horsepower	250 hp
Voltage/Phase/Frequency	4,000 V/3 Phase/ 60 Hz