9 AUXILIARY SYSTEMS

Not all subsystems of the Auxiliary Systems are required to support permanent plant shutdown or defueled operations. The status of these subsystems is listed in a table in each section. Design Basis, Licensing Basis, and operational information contained in this chapter has been updated to reflect the current status. Although the subsystems removed or partially removed from service no longer support operation, they may still contain fluids, gases, or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration.

9.1 FUEL STORAGE AND HANDLING

Structures / Systems / Components	Status
New Fuel Storage	Partially Removed from Service
Spent Fuel Storage	Available
Independent Spent Fuel Pool Cooling System (ISFPCS)	Available
Fuel Pool Make Up System (FPMUS)	Available
Fuel Handling System	Partially Removed from Service
Independent Spent Fuel Storage Installation (ISFSI)	Available
Fuel Loading Equipment for UMAX ISFSI	Available

A separate fuel-handling building (FHB) is provided for each reactor unit. Plant General Arrangement Drawings (Controlled Drawings 40000 through 40010) show the locations of the fuel storage facilities in the station complex.

See Appendix 9A for San Onofre Units 2 and 3 alignment with NUREG-1738, “Technical Study of Spent Fuel Pool Accident Risk at Decommissioning Plants.”

9.1.1 NEW FUEL STORAGE

San Onofre Units 2 and 3 have permanently ceased operation and removed all fuel from both units’ reactor vessels. Even though this system is titled “New Fuel Storage,” no new fuel is stored at SONGS in the permanently defueled condition. However, this system is only partially removed from service to allow for activities during the decommissioning process not related to new fuel storage. New fuel storage racks and equipment classifications are listed in Controlled Document 90034, “Q-List.”

Non-fuel items stored in the new fuel storage racks may include fuel inserts, dummy fuel assemblies, and items with approximate dimensions of, and weighing less than, a fuel assembly, such as underwater trash cans, four-finger CEA carriers, and spent fuel cell blocking devices.

The New Fuel Area (FHB Room 408) is the location of the primary loop of the Independent Spent Fuel Pool Cooling System (ISFPCS) (See Section 9.1.3).

9.1.2 SPENT FUEL STORAGE

9.1.2.1 Design Bases

The spent fuel storage racks and spent fuel pool provide for storage of spent fuel assemblies in appropriate regions of the spent fuel pool, while maintaining a coolable geometry, preventing criticality, and protecting the fuel assemblies from excess mechanical or thermal loadings. Westinghouse 14 x 14 fuel assemblies with a maximum enrichment of 4.0 wt% U235 from San Onofre Unit 1 and Combustion Engineering 16 x 16 type fuel assemblies with a maximum enrichment of 4.8 wt% U235 from San Onofre Units 2 and 3 may be stored in either Unit 2 or Unit 3 spent fuel racks. The design characteristics of the Spent Fuel Racks are shown in Table 9.1-1A.

Fuel storage is divided into two regions within each pool. Region I (312 locations) uses a water gap between storage cells and can be used to store high reactivity (i.e., high initial enrichment, low burnup) assemblies. Region II (1230 locations) consists of high density fuel assembly spacing (no water gap between cells).

Placement of fuel in Regions I and II is determined by burnup calculations and is controlled administratively. Soluble boron is credited and the following storage patterns and guide tube (GT) inserts are used as needed:

(1) Unrestricted storage, minimum discharge burnup and cooling time requirements versus initial enrichment,

(2) Peripheral storage, minimum discharge burnup and cooling time requirements versus initial enrichment,

(3) 2x2 storage patterns, minimum discharge burnup and cooling time requirements versus initial enrichment,

(4) 3-out-of-4 storage patterns, minimum discharge burnup and cooling time requirements versus initial enrichment,

(5) 3x3 storage patterns, minimum discharge burnup and cooling time requirements versus initial enrichment,

(6) Credit for inserted Control Element Assemblies (CEAs),

(7) Credit for cooling time (Pu-241 decay), and,

(8) Credit for borated stainless steel GT inserts.

Table 9.1-1A
DESIGN CHARACTERISTICS OF SPENT FUEL RACKS

Region	Fuel Rod Array (No. Of Arrays)	Centerline Spacing (In.)	Enrichment (Wt % U235)	K_{eff}
Region I	12 X 13	10.40	Credit For: • Burnup, • Cooling Time, • Storage Patterns, • Erbia, and • Inserted CEAs • (Note 1)	k-eff < 1.00, no boron k-eff ≤ 0.95, with boron
Region II	14 X 15 13 X 15	8.85	Credit For: • Burnup, • Cooling Time, • Storage Patterns, • Inserted CEAs, and • GT Inserts • (Note 2)	k-eff < 1.00, no boron k-eff ≤ 0.95, with boron

NOTES:
(1) C-E (16 X 16) TYPE WITH FRESH FUEL ENRICHMENT 2.47 W% U235.
(2) (A) C-E (16 X 16) TYPE WITH FRESH FUEL ENRICHMENT 1.23 W%
(B) W (14 X 14) WITH FRESH FUEL ENRICHMENT 4.00 W% U235 if:
(1) burnup greater than 26,300 MWD/T and cooling time greater than 20 years
(2) burnup greater than 27,100 MWD/T and cooling time greater than 15 years
(3) burnup greater than 28,200 MWD/T and cooling time greater than 10 years

When three GT inserts are placed in a fuel assembly, the orientation shall be as shown in Licensee Controlled Specifications (LCS). Either three or five GT inserts may be placed in a fuel assembly. The GT inserts are made from borated stainless steel, type 304 B7, grade A in accordance with ASTM specification A 887 and A 484. The possibility of accidentally withdrawing a GT insert is minimized because special tooling is required to remove it, and it will be completely contained within the guide tubes of the designated assemblies. Potential misloading of the GT inserts is minimized due to the design of the installation equipment, procedural controls, and the double verification requirement that will be in place to ensure the GT inserts are installed properly.

The possibility of accidentally withdrawing a CEA is minimized because specialized tooling is required for withdrawing a CEA from a fuel assembly. It is physically possible for the spent fuel handling tool to bind on a CEA after ungrappling from a fuel assembly and raising the tool. However, existing SONGS procedures require that the operator validate “tool weight only” on the spent fuel handling machine's load cell read out after ungrappling from a fuel assembly and raising the hoist slightly, and to report this information to the engineer directing fuel movement.

When checkerboard or 3-out-of-4 storage patterns are used in Region II, the empty storage locations must be blocked to prevent the inadvertent placement of a fuel assembly. A cell blocking device shall be used which contains no fuel material (U or Pu) and whose materials of construction are compatible with the spent fuel pool environment. Acceptable devices for blocking cells in the Region II racks include dummy fuel assemblies, devices containing no fissile material and having approximately the same dimensions as a San Onofre Units 2 and 3 fuel assembly (e.g., underwater trash cans, four finger CEA carriers, surveillance capsule holders, empty rod storage baskets and empty fuel assembly cages or facsimile) and plugs which block the top of the spent fuel pool cell.

Requirements for unrestricted storage in Region I and II and additional storage patterns are addressed in applicable LCS.

A reconstitution station is permitted in Region II and is a checkerboard pattern (Figure 9.1-9d). In a checkerboard pattern, vacant spaces surrounding the assembly will be blocked to prevent inadvertent assembly insertion.

No physical barrier is necessary between the two regions. The racks meet the requirements of:

(1) The NRC "OT position for Review and Acceptance of Spent Fuel Storage and Handling Applications," dated April 14, 1978, and modified January 18, 1979, and,

(2) WCAP-14416-NP-A as amended by the SER in NRC to SCE letter dated September 27, 2007.

Criticality of fuel assemblies in the spent fuel storage racks is prevented by the design of the racks (the water gap in Region I) which limits fuel assembly interaction, and by fuel storage patterns based on discharge burnup, cooling time, erbia in fresh assemblies, inserted CEAs, and GT inserts (borated stainless steel rods).

The presence of a minimum of 2000 ppm boron in the pool water will decrease reactivity by approximately 20% Δk. Postulated accidents involving misplacement and damage to fuel assemblies may cause a reactivity increase. In all cases K_{eff} would remain less than or equal to 0.95 due to the dissolved boron.

The licensing basis of the spent fuel pool is in compliance with 10 CFR 50.68.

(1) San Onofre plant procedures prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible (unborated water).

    Movement and storage is limited to analyzed conditions using approved methodology. Based on the physical design at SONGS described in Section 9.1.5, fuel is handled and stored in three areas in the fuel storage building:

    1) New fuel elevator pool

    2) Storage rack pool

    3) Cask pool

The pools are physically separated by walls with gates to allow fuel transfer using the spent fuel handling machine between them. The new fuel storage room is located in a separate room. A single rail connects the new fuel storage room to the up-ender and new fuel elevator pool via the new fuel crane but it is no longer used to handle fuel.

The restrictions on handling and storage for each area are as follows:

1) New fuel elevator pool:

Movement: One fuel assembly to be moved at one time with spent fuel handling machine

Storage: One fuel assembly may be in the pool at a time.
Storage rack pool:

Movement: One fuel assembly to be moved at one time with spent fuel handling machine

Storage: Assemblies may be stored in spent fuel storage racks in accordance with applicable Technical Specifications and LCS.

2) Cask pool:

Movement: One fuel assembly with the spent fuel handling machine or approved cask with the cask crane to be moved at one time. Fuel loading into the cask is per approved cask loading procedure.

Storage: One Fuel assembly or approved cask configurations.

SONGS may move assemblies simultaneously in each of the three areas as restricted above since motions are limited to separate and distinct physical locations by crane and pool designs.

(2) Credit is taken for soluble boron. Therefore, the k-effective of the Region I and Region II spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity does not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective remains below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

Per 10 CFR 50.68(c), when a spent fuel storage cask approved under 10 CFR 72 is in the spent fuel pool, criticality considerations and requirements in 10 CFR 50.68 do not apply. Specific criticality requirements provided in Part 72 Certificate of Compliance 72-1029 (NUHOMS) or 72-1040 (HI-STORM UMAX) are applicable.

(3) The quantity of Special Nuclear Material (SNM), other than nuclear fuel stored onsite, is less than the quantity necessary for a critical mass.

(4) Radiation monitors are provided in storage and associated handling areas when fuel is present to detect excessive radiation levels and to initiate appropriate safety actions.

The single area radiation monitor for direct gamma radiation in each of the Units 2 and 3 fuel handling buildings functions to: immediately alert personnel entering or working in the area of increasing or abnormally high radiation levels which, if unnoticed, could result in inadvertent overexposure; inform the Control Room / Command Center operator of the abnormal radiation increase in the area; and, comply with the requirements of 10 CFR 50, Appendix A, General Design Criteria 63, for monitoring fuel and waste storage and handling areas.

This single area radiation monitor in each fuel handling area is of a non-saturating design so it can register full scale if exposed to radiation levels up to 100 times full-scale indication. The monitor consists of a gamma-sensitive radiation detector transmitting to an alarm-readout unit in the Control Room / Command Center. Indicating alarm units (both audible and visual) are also mounted near the detector location to alert personnel in the area. This monitor views the cask lay down area, the cask hatch area, and a portion of the spent fuel pool. It is located approximately 30 feet from the nearest corner and approximately 90 feet from the farthest corner of the spent fuel pool. The alarm setpoint is fully adjustable throughout the entire range of the rate meter. The setpoint is set high enough to avoid spurious alarms yet set low enough to provide an early warning detection of any significant increase in radiation such as from a fuel handling accident. The nominal setpoint is 2.5 mr/hr; however, this may be increased to avoid spurious alarms if the background increases such as when spent fuel is moved. In addition to a high-level alarm, the detector is provided with an instrument failure alarm to alert the loss of monitoring capability. The radiation level is trended on CDAS.

Shielding is provided for protection during all phases of spent fuel transfer and storage. Operations requiring the shielding of personnel include spent fuel storage and spent fuel shipping cask loading prior to transportation. All spent fuel operations are performed in borated water.

Travel stops in the spent fuel handling machine restricts withdrawal of the spent fuel assemblies. Combined with the travel stops, administrative controls in effect during fuel movement provide the means of maintaining water cover greater than 8 ft-5 in. over a raised fuel assembly's active portion. For a fuel assembly raised with the spent fuel handling machine, 8 ft-5 in. of water cover over the active portion of the fuel assembly equates to approximately 27 ft-2 in. of water over the top of the stored fuel assemblies or a water level of 60 ft-2 in. plant elevation. The shielding afforded by the 8 ft-5 in. of water cover, in addition to that of the handling tool, will ensure that the radiation level at the water's surface above a raised fuel assembly will be less than 8 mrem/hr.

A minimum depth of 23 feet of water over the stored spent fuel assemblies, the water surrounding the stored spent fuel assemblies, and the concrete walls of the fuel transfer pool and spent fuel storage pool, limit the maximum continuous radiation dose levels in working areas to less than 8 mrem/hr.

The spent fuel storage racks are designed to provide protection against damage to the fuel and to prevent fuel assemblies from being inserted into other than the prescribed locations. Structural deformations of the racks are limited and edge-to-edge spacing is maintained to preclude the possibility of criticality. The spent fuel storage racks are designed to prevent significant lateral movement of the racks when loaded with any combination of fuel assemblies under anticipated loading conditions, including the design basis earthquake. Lateral movement is restricted to maintain safe geometry margins.

Design of the spent fuel storage facility ensures adequate convective cooling for the removal of decay heat, even in the event a fuel assembly is dropped and lies horizontally across the top of the racks.

The spent fuel is protected against the design wind loadings and tornado-generated missiles for the design tornado conditions specified in Chapter 3.

Spent fuel storage racks and equipment classification are listed in Controlled Document 90034, "Q-List."

The spent fuel storage racks are fabricated of stainless steel and contain Boraflex. Boraflex was initially installed as a neutron absorbing material, but is no longer credited in the safety analysis due to its degradation.

The walls and floor of the spent fuel pool have a stainless steel liner to ensure the watertight integrity of the spent fuel pool.

The spent fuel pool is interconnected with the fuel transfer pool and the spent fuel cask loading pit (refer to Figure 9.1-3) by connecting canals. These canals allow underwater transfer of spent fuel assemblies between each area. These canals can be sealed by movable gates to enable draining of adjacent areas without affecting the water level in the spent fuel pool.

A cask pool cover is used to provide additional working space, typically during fuel inspection and reconstitution. The load restrictions involving the use of the cask pool cover have been analyzed in accordance with the guidance of NUREG 0612. These load restrictions prevent the postulated load drops from resulting in perforation of the cover and unacceptable leakage from the pool. These load restrictions also prevent loads from rolling into the spent fuel pool.

The cask pool cover consists of four segments, which will be bolted together with installation beams (strong-backs) to create one complete assembly prior to its placement over the cask pool. The cover assembly will be lifted by the Cask Handling Crane, then lowered over the cask pool until it rests on the cask pool curbs. Once in place, the strong-backs would normally be removed, and the confining nature of the cask pool walls would hold the cover in place.

The spent fuel storage facility was designed consistent with the following.

Document	Description
ASME Section III	Nuclear Power Plant Components 1986 Edition up to and including A-86 Addenda
ASME Section III	Code Data Reports and Code Symbol Stamping are not required
ASME Section IX	Welding and Brazing Qualifications
ASME Section V	Nondestructive Examination
AISC	American Institute of Steel Construction Specification, Eighth Edition
ANSI/ANS 8.17-84	Criticality Safety Criteria for the handling, Storage, and Transportation of LWR fuel Outside Reactors
ANSI N8.1-83	Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors
USNRC Position Paper, April 14, 1978, Revised January 18, 1979	OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications
ANSI N16.9-75	Validation of Calculational Methods for Nuclear Criticality Safety
ANSI N18.2-73	Nuclear Safety Criteria for Stationary Pressurized Water Reactors
ANSI N45.2.2-72	Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants (During the Construction Phase)
ANSI N210-76	Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations
USNRC RG 1.13 Rev. 1, Dec 1975	Spent Fuel Storage Facility Design Basis
USNRC RG 1.124 Rev 1, Jan 1978	Service Limits and Loading Combinations for Class I Linear-Type Component Supports
USNRC RG 3.4 Rev 2, April 1986	Nuclear Criticality Safety in Operations with Fissionable Materials at Fuels and Materials Facilities
USNRC SRP 3.8.4 Rev 1, July 1981	Other Category I Structures, Appendix D, Technical Position on Spent Fuel Racks

Spent fuel may also be stored in the Independent Spent Fuel Storage Installation (ISFSI). See Section 9.1.6 for the location and description of this storage facility.

9.1.2.2 Facilities Description

The spent fuel storage facility is part of the fuel handling building, a Seismic Category I structure. Spent fuel assemblies are stored under water in spent fuel storage racks in the spent fuel pool. For storage of the initial core of new fuel the spent fuel pool was dry.

Two types/sizes of spent fuel storage racks are used (Region I and Region II). The two Region I racks each contain 156 storage locations each spaced 10.40 in. on center in a 12 x 13 array. Each storage location consists of Type 304LN stainless steel square cell 8.64 inches in inside dimension, with 0.110 in. thick walls. The spent fuel assembly is located within the stainless steel cell.

The six Region II storage racks are similar to Region I except that four of the Region II racks contain 210 storage locations in a 14 x 15 array. The remaining two Region II racks contain 195 storage locations in a 13 x 15 array. All locations are spaced 8.85 in. on center. Type 304LN stainless steel is used for the square cells and the principal structural members.

The Region I storage rack modules are composed of individual storage cells made of stainless steel. These racks contain a neutron absorbing material, Boraflex, which is held in place along the outer cell walls by a 0.20 in. thick wrapper. The neutron absorber rack design includes a Boraflex verification view-hole in the cell or wrapper wall so that the presence of Boraflex material may be visually confirmed at any time and acts as a vent hole for off gassing. However, the Boraflex is degrading and is no longer credited in the safety analysis. The cells within a module are interconnected by grid assemblies to form an integral structure (Figure 9.1-2a). Each rack module is provided with leveling pads which contact the spent fuel pool floor or pool floor plates and are remotely adjustable from above, through the cells, at installation. The modules are neither anchored to the floor nor braced to the pool walls. They also are not connected to each other. Also, the pool floor plates are not attached to the pool floor.

The Region II storage rack modules consist of stainless steel cells assembled in a checkerboard pattern by welding the individual cells together at the cell corners (Figure 9.1-2a). Each cell is of the same basic design as described for Region I including the presence of Boraflex. However, the Boraflex is degrading and is no longer credited in the safety analysis. The cells are welded to a base support assembly and to one another to form an integral structure without use of grids as used in Region I racks. Around the periphery of each rack assembly, stiffener plates, which are located adjacent to the base plate, are welded against all cells and cover plates. This design is also provided with leveling pads which contact the spent fuel pool floor or pool floor plates (same as Region I's) and are remotely adjustable from above, through the cells, at installation. The modules are neither anchored to the floor nor braced to the pool walls or each other. The fuel rack assembly consists of two major sections which are the base support assembly and the cell assembly.

Region II high density spent fuel storage rack cells are also used to perform spent fuel reconstitution. Figure 9.1-9d shows the storage pattern restrictions for a typical reconstitution station. A small work platform is installed over the spent fuel pool to access fuel assemblies in their storage cells. The reconstitution work station is arranged to permit the spent fuel handling machine to position a spent fuel assembly adjacent to the work platform for removal of the upper-end-fitting (UEF) to gain access to the individual fuel rods for replacement and inspection purposes. Rack spacers (up to 24 in. in size) may be used to raise the spent fuel assembly in the storage cell so that the UEF flow plate is aligned approximately with the top of the racks and the tops of the fuel rods can be seen with the TV camera.

The spacer length is selected to assure that the fuel rods do not extend above the spent fuel racks. Special tooling is used to remove the UEF, remove and replace defective fuel rods, and install and torque the UEF. Figure 9.1-9f displays the dimensions and location of a spent fuel assembly in the reconstitution work station.

Figure 9.1-4 shows the relative positions of the spent fuel rack modules in the spent fuel pool. Figures 9.1-5 and 9.1-6 show the details of the spent fuel rack modules.

The minimum edge-to-edge separation between fuel assemblies is maintained under all anticipated service conditions, including conditions arising during and after seismic events. Failures of systems or structures not designed to Seismic Category I standards located in the vicinity of the spent fuel storage racks were considered in ensuring that the minimum edge-to-edge separation was maintained.

The Units 2 and 3 spent fuel storage facilities may be used for storage of spent fuel from San Onofre Unit 1.

The Unit 1 fuel assembly can be stored without the use of any spacers or adapters in any of the spent fuel rack locations. The weight of the Unit 1 fuel assembly is less and its center of gravity is located at a lower elevation than that of a Unit 2 or 3 fuel assembly. These effects result in lower rack stresses imposed by Unit 1 fuel than the stresses from Unit 2 or Unit 3 fuel.

Figure 9.1-9c shows the general arrangement of a fuel assembly in the spent fuel rack.

In order to maintain pool clarity during fuel transfer operations, vacuum and filter pumps may be placed on top of the spent fuel storage racks. Fuel assemblies are relocated as necessary prior to placing vacuum and filter pumps on the spent fuel storage racks. The vacuum and filter pumps have a support platform with structural support legs that are inserted into fuel cells to prevent sliding or tipping over. The total weight of each vacuum and filter pump is less than 2000 pounds.

9.1.2.3 Safety Evaluation

San Onofre has been approved for soluble boron credit. The criticality acceptance criteria specified in 10 CFR 50.68(b)(4) are:

(1) The k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and

(2) The k-effective must remain below 1.0 (subcritical), at a 95 percent probability, 95 percent confidence level, if flooded with unborated water.

The following are the conditions that are assumed in meeting this design basis:

A. The fuel assembly is modeled without control rods or non-contained burnable poison and is assumed to be at its most reactive point in life. For the Region I racks, a CE 16x16 fuel assembly with equivalent "fresh enrichment" of 2.47 wt% U235 was modeled. For the Region II racks, a CE 16 x 16 fuel assembly with equivalent "fresh fuel" enrichment of 1.23 wt% U235 was modeled.

   The CE 16 x 16 fuel assembly is more reactive than the W 14 x 14 fuel from San Onofre Unit 1 as stored in San Onofre Units 2 or 3 pools.

   The assembly is conservatively modeled with water replacing the assembly grid volume with no U-234 or U-236 in the fuel pellet.

B. The storage cell nominal geometry is shown on Figure 9.1-2a for Region I and II.

C. The moderator is pure (1 gm/cm^3) water at the temperature and density within the design limits of the pool which yields the largest reactivity. No dissolved boron is included in the water.

D. The calculation is infinite in lateral extent.

E. Mechanical uncertainties and biases due to mechanical tolerances during construction are treated by either using "worst case" conditions or by performing sensitivity studies and obtaining appropriate values. The items included in the analysis are:

   - Stainless steel thickness
   - Cell inner diameter
   - Center-to-center spacing
   - Asymmetric assembly positioning
   - Enrichment

F. Credit is taken for the neutron absorption in the full length SS storage cell wall and SS Boraflex wrapper.

G. No credit is taken for the Boraflex in the Region I and Region II racks.

H. The most adverse delta-k from a pool temperature range from 68 deg F to 160 deg F is included. This delta-k bounds the reactivity change for temperature change from 68 deg F to 50 deg F.

The calculation methods and computer codes employed in the criticality analysis of the various fuel and fuel handling configurations, including the spent fuel racks, are as follows:

Regions I and II

A. CELLDAN calculates the atoms/barn-cm of U^{235}, U^{238}, and Oxygen in the UO_2 fuel. CELLDAN also calculates the atoms/barn-cm of Hydrogen, Oxygen, B^{10}, and B^{11} in the water. Finally, CELLDAN calculates the Dancoff factor, and U^{235} and Oxygen scattering cross-sections per U^{238} atom for NITAWL-II.

B. NITAWL-II generates a binary cross-section library for KENO V.a. The library contains 27 group cross-sections data for every nuclide in the KENO V.a problem. Using the U^{238} number density, Dancoff factor, and U^{235}/Oxygen scattering cross-sections per U^{238} atom from CELLDAN, NITAWL-II uses the Nordheim Method to do resonance shielding of the U^{238} cross-section.

C. KENO V.a is the nuclear industry standard program for criticality analyses. KENO V.a is a three-dimensional, multi-group, Monte Carlo program.

D. CASMO-3 is a multi-group two-dimensional transport theory program for calculations on BWR and PWR fuel assemblies. It is extensively used by utilities in the U.S. In these analyses, CASMO-3 is used for two purposes. First, CASMO-3 is used to evaluate the reactivity variations (Δk) due to enrichment uncertainty, the rack manufacturing tolerances, and pool temperature variations. Second, CASMO-3 is used to generate the initial enrichment versus discharge burnup criteria for Region I and Region II storage.

The bias and 95/95 uncertainty in the bias for CELLDAN, NITAWL-II, KENO V.a, and the 27 group cross-section library are 0.00814 and 0.00172, respectively. The bias and uncertainty were determined by analyses of 16 B&W critical experiments.

Reactivity Equivalencing and Cooling Time

Spent fuel storage, in the Region I and Region II spent fuel storage racks, is achievable by means of the concept of reactivity equivalencing. The concept of reactivity equivalencing is predicated upon the reactivity decrease associated with fuel depletion. A series of reactivity calculations are performed to generate a set of enrichment-fuel assembly discharge burnup ordered pairs which yield the equivalent K_{eff} when the fuel is stored in the Region II racks.

Licensee Controlled Specifications 4.0.100, Figure II-1 shows the constant K_{eff} contour generated for the San Onofre Unit 2 or 3 Region II racks when storing CE 16 x 16 fuel in the interior cells. Note in Licensee Controlled Specifications 4.0.100, Figure II-1, the endpoint at 0 GWD/T where the enrichment is 1.23 wt% and at 5.0 wt% where the burnup is 53.76 GWD/T (0 years cooling), 47.77 GWD/T (5 years cooling), 44.75 GWd/T (10 years cooling), 43.00 GWD/T (15 years cooling), and 41.86 GWD/T (20 years cooling). The interpretation of the endpoint data is as follows: the reactivity of the Region II racks containing fuel at 53.76 GWD/T (0 years cooling), 47.77 GWD/T (5 years cooling), 44.75 GWd/T (10 years cooling), 43.00 GWD/T (15 years cooling), and 41.86 GWD/T (20 years cooling) burnup which had an initial enrichment of 5.0 wt% is equivalent to the reactivity of the Region II racks containing fresh fuel having an initial enrichment of 1.23 wt%. The decrease in equivalent burnup with cooling time is due to the decay of Pu-241. Storage requirements for San Onofre Unit 1 UO2 fuel assemblies initially enriched to 4.0 wt% are shown in Table 9.1-1A.

The data points on the reactivity equivalence curve were generated with a transport theory computer code, CASMO-3. CASMO-3 is a depletable, two-dimensional, multigroup, discrete ordinates, transport theory code.

A study was done to examine fuel reactivity as a function of time following discharge from the reactor. Fission product decay was accounted for using CINDER. CINDER is a point-depletion computer code used to determine fission product activities. The fission products were permitted to decay for 30 years after discharge. The fuel reactivity was found to reach a maximum at approximately 100 hours after discharge. At this point in time, the major fission product poison Xe^{135}, has nearly completely decayed away. Furthermore, the fuel reactivity was found to decrease continuously from 100 hours to 30 years following discharge. Therefore, the most reactive point in time for a fuel assembly after discharge from the reactor can be conservatively approximated by removing the Xe^{135}.

In the Region I and II calculation method, the CASMO-3 code has been validated by comparisons with experiments where isotopic fuel composition has been examined following discharge from a reactor.

Credit for Soluble Boron

SONGS has been approved for soluble boron credit. Therefore, the Region I and II racks have a non-accident k-eff less than 1.0 including all uncertainties at a 95/95 probability/confidence level assuming no soluble boron. The minimum soluble boron concentration that results in k-eff less than or equal to 0.95 under accident conditions, including all uncertainties is:

(1)	370	ppm	(reduce k-eff from 1.0 to < 0.95)
(2)	730	ppm	(fuel miss-loading accident, maintain k-eff < 0.95)
(3)	396	ppm	(equivalencing and burnup uncertainties)
(4)	50	ppm	(boron measurement uncertainty)
(5)	154	ppm	(future contingencies)
	1,700	ppm	Total

The spent fuel pool boron concentration is maintained at or above 2,000 ppm. A boron dilution analysis has been performed which shows that it is not credible to dilute from 2000 ppm to 1700 ppm.

As a further conservatism, San Onofre Units 2 and 3 calculated discharge assembly burnups will be reduced 6.6% before comparison with the storage pattern burnup acceptance criteria in Licensee Controlled Specifications 4.0.100, Figure I-1 and Figure II-1 and other criteria in Licensee Controlled Specification 4.0.100. San Onofre Unit 1 calculated discharge assembly burnups will be reduced 10.0%.

The fuel-handling building is a Seismic Category I, reinforced concrete, shear wall structure with a wall thickness that provides the necessary radiation shielding and protection for the spent fuel storage facility against design wind loadings and tornado-generated missiles for design tornado conditions as specified in Chapter 3.

The Independent Spent Fuel Pool Cooling System (ISFPCS) is designed to remove the decay heat produced in the fuel and to permit storage of spent fuel assemblies in the fuel pool as of June 30, 2014 (see Table 9.1-1B) until it is placed in dry cask ISFSI storage (see Section 9.1.6) and then ultimately shipped offsite. The ability of the fuel pool cooling system to ensure continuous cooling (except during testing) is discussed in Section 9.1.3.

The Spent Fuel Pool Makeup System (FPMUS) maintains the spent fuel storage pool water inventory to ensure spent fuel pool safety functions are met. The FPMUS is fully discussed in Section 9.1.5.

Temperature gradients for the fuel pool are established giving full consideration to the short-and long-term temperature effects. Even under the adverse conditions of a prolonged outage of the ISFPCS (an extremely unlikely event based on its design) the maximum temperature of the spent fuel pool water will not exceed 212ºF (see Section 9.1.3.3). The reinforced concrete temperature differences and gradients are determined based on an inside face temperature of 230ºF (water temperature of 212ºF and gamma heating of 18ºF). For the liner plate, the temperature of 216ºF was used. This lower temperature is used because the effect of gamma heating on the liner plate is minimal due to the liner plate thickness and the cooling effect of the surrounding pool water. Structural design of the pool accounts for these gradients by using a cracked-section, inelastic analysis.

This analysis indicates that the spent fuel pool walls have sufficient structural capability to accommodate this highly unlikely thermal loading. A stainless steel liner is installed along the interior surface of the spent fuel pool to ensure the leak tight integrity of the pool, even in the presence of minor inherent concrete cracking of the spent fuel pool walls.

The fuel handling system provides for the safe handling of fuel assemblies, CEAs, and spent fuel shipping casks under foreseeable conditions. Design and construction of this system includes interlocks, travel and load-limiting devices, and other protective measures to minimize the possibility of mishandling or equipment malfunction that could damage safety-related equipment or fuel assemblies and cause fission product release. The specific provisions designed to avoid accidental dropping of heavy objects on the spent fuel assemblies are discussed in Section 9.1.4.

The spent fuel storage racks are constructed entirely of stainless steel and contain a Boraflex panel. The Boraflex used in the spent fuel rack construction was manufactured by Brand Industrial Services, Inc. Typical Boraflex material has a density of about 1.7 gm/cm^3 and consists of the following:

B - 38.0 wt%	SI - 20.5 wt%	O - 18.5 wt%
C - 20.7 wt%	H - 2.3 wt%.	

The Boraflex panels in the Region I and II racks are degrading. SONGS has been tracking the silica in the spent fuel pools which has been on the increase since the installation of the Boraflex racks. Increased silica is an indication of the degradation of the Boraflex. Since the Boraflex is degrading, Boraflex is not credited in the safety analysis described above.

After reactor shutdown, dose rates in working areas above elevation 45 feet are less than 2.5 mrem/hr, except as noted below. In accessible areas below 45 feet, dose rates are less than 15 mrem/hr. Areas above elevation 63 feet 6 inches near the spent fuel pool experience approximately 8 mrem/hr while a spent fuel assembly is in transit and/or as a result of unusually high spent fuel pool liquid source terms. In order not to exceed the integrated doses specified in 10 CFR 20, the radiation levels are closely monitored during fuel handling operations to establish the allowable exposure times.

The minimum water depths and concrete walls, as discussed in Section 9.1.2.1, provide shielding for stored spent fuel assemblies. The maximum continuous radiation dose level from fuel assemblies in working areas is less than 8 mrem/hr.

As discussed in Section 9.4.3.1.2.3, the fuel handling building and spent fuel area normal ventilation system exhausts to the two plant vent stacks. This system normally operates continuously.

Units 2 and 3 have separate spent fuel storage facilities. Therefore, there are no safety implications related to sharing.

The cask loading area of the spent fuel storage pool is designed to withstand the impact loading of a dropped fuel cask. Any leakage caused by localized damage shall be within the limits of the FPMUS (discussed in Section 9.1.4), and shall be confined to the leak chase system.

Except for two SFP exhaust registers located adjacent to the SFP gates which have been blocked off, all exhaust registers in the pool perimeter are provided with seismic wave protection buoyancy dampers to minimize fuel pool water spillage. All exhaust ductwork serving the pool registers is sloped such that pool water spillage is collected through the contaminated drain system.

Any spillage of the fuel pool water due to splashing or other causes drains to the miscellaneous liquid waste system via the FHB floor drains and FHB sump, precluding flooding of vital equipment.

Control of liquid leakage from the spent fuel pool is maintained by a system of leak chases which are placed behind the spent fuel pool liner plates. The leak chases are connected to drain lines that terminate in the leak detection compartment which drains to the FHB sump. The FHB sump high level alarm would inform the Control Room / Command Center personnel of potential spent fuel pool liner leakage. Observance of leakage from a specific drain line will allow identification of the general location of the leak in the pool liner.

The vacuum and filter pump support platform is restrained to the spent fuel storage racks via support legs that are inserted into the fuel cells. This ensures that the vacuum and filter pump assemblies will not slide or tip over during a design basis earthquake. The effect of the vacuum and filter pumps on the underlying spent fuel storage racks is minimal as a vacuum/filter pump with support platform weighs less than a fuel assembly and represents only a small percentage of the total weight of a partially loaded spent fuel rack.

In the event that the vacuum filter and pump separates from its support platform spent fuel stored inside the spent fuel storage racks will not be damaged since the top of the fuel is approximately one foot below the top of the racks. In addition, the non-fuel upper end fitting of the fuel assembly will prevent and large fragments from damaging the fuel rods.

9.1.3 INDEPENDENT SPENT FUEL POOL COOLING SYSTEM

San Onofre Unit 2 and Unit 3 has permanently ceased operation and removed all nuclear fuel from both units' reactor vessels. The irradiated fuel is stored in the spent fuel pool (SFP) and in the Independent Spent Fuel Storage Installation (ISFSI) until it is shipped offsite. In this configuration, the SFP and its systems are dedicated principally to spent fuel storage.

9.1.3.1 Design Bases

Units 2 and 3 have separate and independent fuel pool cooling systems. Each system is designed to provide continuous cooling for spent fuel assemblies stored in the fuel pool. There is sufficient margin in the heatup rate such that occasional outages for testing and maintenance activities can be accommodated with minimal effect on pool temperature.

The ISFPCS is a Quality Class III-AQ, Seismic Category III system as approved by Amendment No. 233 to Facility Operating License NPF-10 and Amendment No.226 to Facility Operating License NPF-15 for San Onofre Units 2 and 3 respectively. These Amendments provide exceptions for SONGS commitments to NRC Regulatory Guides 1.13, 1.29 and 1.76 (Reference 5).

Table 9.1-1B lists the maximum decay heat load for each unit's SFP. The heat load values reflect the irradiated fuel inventories at the time of permanent cessation of power operation. There were 1318 irradiated fuel assemblies in Unit 2 SFP and 1350 irradiated fuel assemblies in Unit 3 SFP after plant shutdown.

Table 9.1-2A lists the principal parameters of the ISFPCS components. For seismic classification of system components and piping refer to Controlled Document 90034, "Q-List." ISFPCS design features include the following:

- The primary/secondary plate heat exchanger is designed to remove spent fuel pool heat load of 3.0 MBTU/hr.
- The primary loop is designed for a minimum flow rate of 500 gallons per minute.
- Each 200 ton chiller unit has the capability of removing 2.4 MBTU/hr, for a total of 4.8 MBTU/hr heat removal capacity.
- The secondary loop is designed for a minimum flow rate of 700 gallons per minute. The surge tank maintains system volume during thermal expansion and ensures that the secondary system remains at a higher pressure than the primary loop.
- One air compressor provides pressure to the ion exchanger column air operated valves.
- A purification loop provided to maintain pool water purity (chemistry), when needed.
- The ISFPCS relies on the essential bus via the off-site-powered 12kV Ring Bus System and a manually-initiated on-site backup diesel generator.

The maximum decay heat load as of June 30, 2016 was 2.360 MBTU/hr. The heat load values include a contingency Dry Storage Canister (DSC) offload of 0.127 MBTU/hr (37.2 kW). This heat load is bounded by the design basis heat load of 3.00 MBTU/hr that can be transferred by the ISFPCS to the atmosphere. This is based on a conservative air temperature of 120ºF (Reference 8).

9.1.3.2 System Description

The fuel pool cooling system is shown on the following controlled drawings.

40122D	40122E
40122DSO3	40122ESO3

The ISFPCS consists of two loops, a primary cooling loop, and a secondary cooling loop. There is also a purification loop attached to the primary loop that can be placed in service as necessary. The ISFPCS is controlled manually from local control panels. Command Center / Control Room CDAS alarms for high fuel pool temperature, high and low liquid level in the fuel pool, and high radiation (described in Section 9.1.2) in the fuel pool area, are provided to alert the operator to abnormal circumstances. A local alarm for low liquid level in the fuel pool is also provided.

The ISFPCS is a Quality Class III-AQ, Seismic Category III system as approved by Amendment No. 233 to Facility Operating License NPF-10 and Amendment No. 226 to Facility Operating License NPF-15 for San Onofre Units 2 and 3 respectively. These Amendments provide exceptions for SONGS commitments to NRC Regulatory Guides 1.13, 1.29 and 1.76 (Reference 5).

The ISFPCS primary loop consists of two 100% capacity pumps (one in standby) and one 100% capacity heat exchanger. The ISFPCS primary loop pumps are connected to a common suction header and a common return header. The primary loop also consists of appropriate piping, valves, and instrumentation. Portions of the piping, including that within the spent fuel pool, the primary loop return line, and distribution sparger at elevation 17 feet (adjacent and beneath spent fuel racks) are Seismic Category I piping (repurposed original piping).

After ISFPCS startup, the primary cooling pump will maintain the required NPSH and the priming pump can be secured. (The priming pump is used to fill the pump suction line prior to system startup.) Spent fuel pool water is circulated by the primary loop cooling pumps through the primary loop heat exchanger where it is cooled. The heat is rejected to the ISFPCS secondary loop. Differential pressure is monitored at the heat exchanger to ensure that the secondary side system operates at a higher pressure than the primary side system to control any cross contamination in case of plate failure (see Section 9.1.2.3 for boron concentration requirements). Prior to entering the primary loop heat exchanger, a portion of the SFP water can be diverted, filtered, and processed through a set of ion exchange columns containing a mixed bed of resin in order to maintain water chemistry requirements.

The ISFPCS purification loop consists of two ion exchangers (IX), one resin trap, appropriate piping, valves, and instrumentation. The ISFPCS purification flow is drawn off the primary loop pump common discharge prior to the primary loop heat exchanger. Resin will be placed in the ion exchanger as necessary to improve water chemistry or clarity. It is possible to operate the primary loop system with either or both ion exchangers bypassed. Local sample points are provided to permit analysis of ion exchanger efficiencies.

Temporary installation of submersible purification equipment can be placed on the upper shelf of the cask handling pool. The installation, operation, and removal of this equipment are administratively controlled. This purification equipment typically consists of filters and an ion exchanger. The purification equipment is Quality Class III and Seismic Category III.

The ISFPCS secondary loop consists of two 100% capacity pumps and two 200 ton chillers per unit. The second pump acts as a built-in spare for redundancy. Maximum secondary loop operating temperature is 108°F (Reference 8) and secondary chilled water temperature is maintained by adjustment of the primary loop flow through the primary/secondary heat exchanger and chiller outlet temperature setpoints. The secondary loop also consists of one surge tank, piping, valves, and instrumentation. The chiller inlet and outlet manifolds are designed for cross connecting the Unit 2 and Unit 3 secondary cooling loops if desired. This allows using 3 of the 4 chillers to remove the total heat load for both units and provides redundancy/operating margin in the event that one chiller is taken out of service.

One air compressor per unit is installed to provide motive force for the priming pump, the IX column air operated valves and pressurize the secondary loop surge tank bladder.

The Independent Spent Fuel Pool Cooling System is powered by the essential electrical system and a back-up diesel generator (see Chapter 8).

Command Center Data Acquisition System (CDAS) displays in the Control Room / Command Center provide alarms for high fuel pool temperature, and high and low liquid level in the fuel pool. The separate Spent Fuel Pool Cooling Human-Machine-Interface (HMI) display panels provide primary pump status, primary flow alarm, secondary pump status and chiller unit status in the Control Room / Command Center, Fuel Handling Building 63ft (New Fuel Room 408) and in the Secondary Pump Station (outdoors on East Road).

Instrumentation provided in the ISFPCS includes:

A. Temperature

   Instrumentation is provided to measure the temperature of the water, and to provide a local and remote indication for primary and secondary loop temperatures.

   CDAS pool temperature alarms, HMI panel indications and administrative controls are relied upon to protect the ion exchanger resin from high temperature.

B. Pressure

   Instrumentation is provided to give local and remote indication of the pressure in the primary and secondary loop.

C. Flow

   Instrumentation is provided to measure primary, ion exchanger, and secondary loop flows.

D. SFP Level

Instrumentation is provided in the ISFPCS suction piping to measure SFP level to approximately six feet from the surface. SFP level can be read locally and in the Control Room/Command Center.

Additional instrumentation taps off of the FPMUS (see Section 9.1.4 for FPMUS description) discharge piping to correlate SFP level down to 23 feet above the top of the spent fuel assemblies. This local SFP level indication is located on FHB elevation 17 ft. in Room 107 which is adjacent to the SFP Makeup control panel.

Table 9.1-2A lists the principal parameters of the ISFPCS components. For seismic classification of system components and piping see Controlled Document 90034, "Q-List."

9.1.3.3 Safety Evaluation

San Onofre Unit 2 and Unit 3 has permanently ceased operation and removed all nuclear fuel from both units' reactor vessels. The irradiated fuel will be stored in the spent fuel pool (SFP) and in the Independent Spent Fuel Storage Installation (ISFSI) until it is shipped offsite. In this configuration, the SFP and its systems are dedicated principally to spent fuel storage.

The NUREG-0800 Branch Technical Position (BTP) ASB 9-2, "Residual Decay Energy for Light Water Reactors for Long Term Cooling," is utilized to compute the heat dissipation requirements in the pool. An uncertainty factor of 10% is used to conservatively bound the decay heat.

Reference 5 provides approved exceptions for SONGS commitments to NRC Regulatory Guides 1.13, 1.29, and 1.76 and allowed the Independent Spent Fuel Pool Cooling System to be Seismic Category III and permits exceptions for the protection of the secondary cooling side, support systems, and power supply from tornado missiles.

Table 9.1-1B provides maximum decay heat load for each unit's SFP. The heat load values reflect the irradiated fuel inventories at the time of permanent cessation of power operation. There are 1318 irradiated fuel assemblies in Unit 2 SFP and 1350 irradiated fuel assemblies in Unit 3 SFP. The heat load values include a contingency Dry Storage Canister (DSC) offload of 0.127 MBTU/hr (37.2 kW).

Table 9.1-1B
SFP Heat Loads

Date	SFP Decay Heat Load + one DSC offload (max 37.2 kW / 0.127MBTU/hr)	
	Unit 2 SFP (BTU/hr)	Unit 3 SFP (BTU/hr)
6/30/2013	3.859E+06	3.879E+06
12/31/2013	3.260E+06	3.254E+06
6/30/2014	2.912E+06	2.895E+06

12/31/2014	2.686E+06	2.663E+06
6/30/2015	2.538E+06	2.512E+06
12/31/2015	2.434E+06	2.407E+06
6/30/2016	2.360E+06	2.332E+06
12/31/2016	2.304E+06	2.276E+06
12/31/2021	2.014E+06	1.988E+06
12/31/2026	1.801E+06	1.778E+06
12/31/2031	1.612E+06	1.591E+06
12/31/2036	1.445E+06	1.426E+06
12/31/2043	1.241E+06	1.226E+06

The maximum decay heat load as of June 30, 2016 was 2.360 MBTU/hr which is within the capacity of a single chiller unit. This spent fuel heat load is bounded by the design basis heat load of 3.0 MBTU/hr that can be transferred by the ISFPCS to two secondary chiller units (2.4 MBTU/hr design capacity per unit). This is based on a conservative maximum sustained outside air temperature of 120°F and maximum sustained humidity of 100% (Reference 8).

The secondary chillers and the outdoor atmosphere provides ultimate heat sink for rejecting spent fuel assembly decay heat from the spent fuel pool cooling system (Section 9.2.2 Ultimate Heat Sink).

Inadvertent draining of the SFP, including siphoning, below approximately 23 feet above the stored fuel is prevented by design features (e.g., siphon breaker) and Administrative Controls. Leakage from the fuel pool cooling system is detected by a drop in SFP level. The spent fuel pools are equipped with local, remote, and CDAS level indications. Control Room / Command Center CDAS indication has level trending and High / Low level CDAS alarms. Makeup to the spent fuel storage pool is via the Spent Fuel Pool Makeup Pumps from the Spent Fuel Pool Makeup Tank (see Section 9.1.4). The FHB sump with adequate capacity is provided to collect system leakage. A high level alarm is provided to annunciate in the Control Room / Command Center CDAS when a high sump level is reached.

In the event of a seismic event the temporary submersible purification equipment could potentially fall from the upper shelf and down to the floor of the cask handling pool. As discussed Section 9.1.5.3, a postulated drop of the cask in the cask handling pool will not cause perforation or spalling of the concrete slab which forms the floor of the pool, therefore, a drop of purification equipment would not cause perforation or spalling either.

The temporary submersible ion exchanger has the ability to perform sluice operations. If sluicing is required, the sluice pump would remain outside the cask handling pool while the ion exchanger would remain on the upper shelf of the cask handling pool. In order to prevent the inadvertent drain down of the SFP it is required to close the gate to the Cask Handling Pool during sluicing operations.

NRC Safety Evaluation Report (Reference 5) identifies the spent fuel pool system safety functions as:

- Maintaining spent fuel clad integrity with water inventory above the top of stored fuel assemblies.
- Maintaining spent fuel assembly radiation shielding / isotope absorption with 23 feet of water above the fuel assemblies.

The SER identified that the safety importance of decay and residual heat removal is related to the magnitude of the decay heat produced by the stored fuel. In the event of a sustained loss of forced cooling, that over 7 days would be necessary for the decay heat to increase the SFP coolant temperature from nominal conditions to 212°F. The Chapter 15 SFP boiling event bounds the consequences of an extended loss of SFP forced cooling during decommissioning, so a boiling SFP does not immediately challenge safety limits, provided that coolant inventory is maintained.

The ISFPCS does not have a credited safety function based on:

1) The normal SFP coolant inventory that provides the capacity to withstand long periods of leakage or evaporation related to design basis accidents or events without substantial degradation of the key fuel cooling and shielding safety functions (Reference 5).
2) The ample time would be available to correct loss of forced cooling events (Reference 5).

Table 9.1-2A

PRINCIPAL PARAMETERS OF THE ISFPCS

Component Description	Parameter
Primary Loop Spent Fuel Pool Cooling Pump	
Quantity	2
Design flow (minimum)	500 gal/min
Design head	150 feet
Secondary Loop Cooling Pump	
Quantity	2
Design flow (minimum)	700 gal/min
Design head	175 feet
Spent Fuel Pool Heat Exchanger	
Quantity	1
Primary side flowrate (minimum)	500 gal/min
Secondary side flowrate (minimum)	700 gal/min
Total design heat load	3 MBTU/h
Spent Fuel Pool Ion Exchanger	
Quantity	2
Design flowrate (per Ion Exchanger Column)	150 gal/min
Secondary Loop Chiller	
Quantity	2
Max evaporator flow	883 gal/min
Total heat load per unit	2.4 MBTU/h

The failure of portions of the ISFPCS piping which are not designed to Seismic Category I standards that are located entirely within the Fuel Handling Building Operating Deck Elevation 63 ft. will result in a minimal loss of normal spent fuel pool level (Elevation 60 ft.). Loss of level is limited by the anti-siphon break in the pump discharge piping at elevation 58’-11” in Unit 2 and 59’-0” in Unit 3. A primary loop piping break will not preclude maintaining spent fuel storage safety functions of water inventory and radiation shielding (minimum 23 ft. above the top of spent fuel assemblies; see Section 9.1.2.1).

In the event of a loss of all normal cooling capability of the SFP cooling system, at least 79 hours would elapse before the pool temperature would rise from 132ºF (high temperature alarm setpoint) to 212ºF. This allows time in which to effect repairs and restore cooling.

ISFPCS active component failures are addressed by use of the redundant component(s) and cross-tie to opposite secondary cooling loop. Passive component failures are address by timely repair, the large pool water inventory, and the diverse makeup methods. Common-mode failures are addressed by either the on-site backup diesel generator or use of a diverse makeup method.

Those diverse spent fuel pool makeup capabilities are discussed in Section 9.1.4, and Appendix 9A, and related to the SONGS commitments related to Unit 2 License Condition 2.C.(26) and Unit 3 License Condition 2.C.(27).

9.1.3.4 Inspection and Testing Requirements

Each component was inspected and cleaned prior to installation into the system. Demineralized water was then used to flush the entire system. The system was tested initially with regard to flow paths, flow capacity, and mechanical operability. Instruments were calibrated, alarms were verified to be functional, and setpoints were verified during testing.

The ISFPCS is routinely running. Pumps are rotated on a regular period. Daily operator rounds verify that critical system parameters are meeting requirements.

9.1.4 SPENT FUEL POOL MAKEUP SYSTEM

9.1.4.1 Design Bases

Units 2 and 3 have separate spent fuel pool makeup systems (FPMUS) designed to Seismic Category I and Quality Class III-AQ as approved by Amendment No. 233 to Facility Operating License NPF-10 and Amendment No. 226 to Facility Operating License NPF-15 for San Onofre Units 2 and 3 respectively. These Amendments provide exceptions for SONGS commitments to NRC Regulatory Guides 1.13, 1.29 and 1.76 (Reference 5).

The manually-operated FPMUS provides low-flow and high-flow capability for makeup to the SFP. In addition to the normal function of makeup for evaporation and leakage losses, the NRC Safety Evaluation Report (Reference 5) identifies the spent fuel pool system safety functions as:

- Maintaining spent fuel clad integrity with water inventory above the top of stored fuel assemblies.
- Maintaining spent fuel assembly radiation shielding / isotope absorption with 23 feet of water above the fuel assemblies.

Spent Fuel Pool Makeup Tanks have on-site hose-fed manual replenishment from non-seismic non-safety-related tanks and one seismically-qualified non-safety-related tank.

9.1.4.2 System Description

Spent fuel pool makeup inventory for the low-flow makeup pumps and the high-flow pump is from the dedicated Spent Fuel Pool Makeup Tank, designed as Seismic Category I with a 300,000 gallon nominal capacity. Formerly titled Primary Plant Makeup Storage Tanks, T055 and T056 are located in vaults at Elevation 9 ft. within the Seismic Category I Auxiliary Radwaste Building.

Table 9.1-2B, Principal Parameters of the FPMUS, lists the design capacities of the major system components.

Each unit-specific FPMUS is powered from the essential 480V Bus which is supplied from the off-site powered 12kV Ring Bus System (see Chapter 8). The essential bus is supported by a backup diesel generator.

The makeup pumps are controlled at a local panel in Penetration Building Elevation 17 ft. In addition to the normal makeup path from Tanks T055 and T056, alternate makeup sources are available. These sources can be manually aligned locally in the Penetration Building (adjacent to FHB Room 107).

Table 9.1-2B

PRINCIPAL PARAMETERS OF THE FPMUS

Component Description	Parameter
Spent Fuel Pool Low Flow Rate Makeup Pump	(P-1018, P-1019)
Quantity per Unit	2
Design flow	45 gal/min
Design head	198 feet
Spent Fuel Pool High Flow Rate Makeup Pump	(P-015)
Quantity per Unit	1
Design flow	500 gal/min
Design head	300 feet
Spent Fuel Pool Makeup Tank	(T055, T056)
Quantity per Unit	1
Total Volume	300,000 gal

On-site demineralized water supplies are available to manually replenish the Spent Fuel Pool Makeup Tanks (T055, T056). The four on-site demineralized water storage tanks (DWST) and an associate supply header are credited with the following remaining non-safety functions:

- Manual replenishment of Spent Fuel Pool Makeup Tanks (T055, T056)
- Contingency water source for a Mitigating Strategies event (See Appendix 9A)

The on-site demineralized water storage tanks are available for manual replenishment of the Spent Fuel Pool Makeup Tanks. The nominal capacities are shown in Table 9.1-2C.

Table 9.1-2C
FPMUS REPLENSHMENT TANKS

Demineralized Water Storage Tank[a]	Nominal Capacity, Gallons
T-266	535,000
T-267	535,000
T-268	535,000
T-351	150,000

[a] Controlled Document 90034, "Q-List," controls the quality and seismic designations.

The three large capacity DWSTs are located on the elevated bluff (south of Unit 3) allowing gravity-fed replenishment. The supply header has hose connections to allow use of a portable-engine-driven pump.

The seismically-qualified DWST, located in the North Industrial Area (Elevation 20 ft.), has a seismically-qualified diesel-driven trailer-mounted fire pump to provide the required motive force for replenishment. Dedicated suction and discharge hoses are stored on-site to reach either SFP Makeup Tanks (T055, T056).

9.1.4.3 Safety Evaluation

Spent fuel Pool inventory in the SFP and connected pools is sufficient to maintain the coolant inventory more than three feet above the stored fuel for over one month with no forced cooling and no make-up water addition as described in the March 11, 2016 NRC Safety Evaluation Report (SER -- Reference 5) That SER credits the FPMUS to manually maintain the pool inventory to ensure the following spent fuel pool safety functions:

- Spent fuel clad integrity with water inventory above the top of stored fuel assemblies.
- Spent fuel assembly radiation shielding / isotope absorption with 23 feet of water above the fuel assemblies.

The maximum SFP decay heat load in Table 9.1-1B allows sufficient time in which to align makeup water to the pool, effect repairs and restore pool cooling. Reference 5 concludes that in the event of a creditable liner leak that 70 hours is available before the affected spent fuel pool level would drop to 10 ft above top of fuel assemblies.

The seismically-qualified FPMUS along with multiple and diverse alternate make-up paths provide reasonable assurance that adequate make-up would be provided well before a substantial loss of SFP coolant inventory that could challenge the spent fuel pool safety functions (Reference 5).

Spent Fuel Pool Makeup pumps are powered from the essential 480V Bus which is powered from off-site 220kV sources and an on-site diesel generator providing manual backup power (see Chapter 8).

FPMUS active component failures are addressed by use of the redundant component(s), gravity feed, or diverse pumps. Passive component failures are address by timely repair, the large pool water inventory, and the diverse makeup methods. Common-mode failures are addressed by either the on-site backup diesel generator or use of an on-site diverse makeup methods and storage tank(s).

Those diverse spent fuel pool makeup capabilities are discussed in Appendix 9A and are related to the SONGS commitments related to Unit 2 License Condition 2.C.(26) and Unit 3 License Condition 2.C.(27).

The quality assurance measures applied to the design provide reasonable assurance that procedures to recover spent fuel pool level with make-up capability will be both available and effective (Reference 5).

9.1.4.4 Inspection and Testing Requirements

Each component is inspected and cleaned prior to installation into the system. The system is operated and tested initially with regard to flow paths, both low flow and high flow capacity, and mechanical operability. Instruments are calibrated.

Data are taken periodically during normal plant operation to confirm normal makeup capabilities, Routine inspections verify pump alignment, material condition, and electrical power to the makeup pump motor controls.

The High Flow and Low Flow Spent Fuel Makeup pumps are momentarily started on a quarterly basis to verify motor and pump operation.

The spent fuel pool makeup operation to replace evaporative losses actively demonstrates the pool refill capability of the High Flow Make Pumps.

9.1.5 FUEL HANDLING SYSTEM

Fuel handling equipment is located both in the Containment Building and in the Fuel Handling Building. The fuel handling equipment in the Containment Building has been removed from service. The fuel handing related equipment in the Fuel Handling Building remains in service.

9.1.5.1 Design Bases

9.1.5.1.1 System

The fuel handling system is designed for handling and storage of fuel assemblies, control element assemblies (CEAs), and Guide Tube (GT) inserts. As appropriate, the fuel handling equipment includes interlocks, travel limiting features, and other protective devices to minimize the possibility of mishandling or equipment malfunction that could result in inadvertent damage to a fuel assembly and potential fission product release. GT inserts are borated stainless steel rods which may be placed in the guide tubes of fuel assemblies to reduce the required burnup for storage.

The fuel pool water provides the coolant medium during spent fuel transfer. The spent fuel pool is provided with a spent fuel pool cooling and cleanup system, which is discussed in detail in Section 9.1.3.

All spent fuel transfer and storage operations are designed to be conducted underwater to ensure adequate shielding during fuel handling operations and to permit visual control of the operation at all times.

The general arrangement of the fuel handling system is shown in Figure 9.1-3.

9.1.5.1.2 Fuel, CEA, and GT Insert Handling Equipment

The principal design criteria for the spent fuel handling machine are:

A. For non-seismic operating conditions, the bridges, trolleys, hoist units, hoisting cable, grapples, and hooks conform to the requirements of Crane Manufacturing Association of America Specification No. 70. All other components meet the requirements of the Manual of Steel Construction, American Institute of Steel Construction.

B. For seismic design, the combined dead loads, live loads, and seismic loads do not cause any portion of the equipment to disengage from its mountings or fail in a manner that would result in its falling into the spent fuel pool. The dead weight, live, and design basis earthquake (DBE) seismic loadings are combined in calculating material stress.

C. C. Grapples and mechanical latches that carry fuel assemblies, CEAs, or GT inserts are mechanically interlocked against inadvertent opening.

D. Equipment is provided with locking devices, appropriate foreign materials controls, or restraints to prevent parts, fasteners, or limit switch actuators from becoming loose. In those cases where a loosened part or fastener can drop into, or is not separated by a barrier from, or whose rotary motion may propel it into the water of the spent fuel pool, these parts and fasteners are lock-wired or otherwise positively secured.

E. The spent fuel handling tool length provides the mechanism which precludes raising fuel above the minimum safe water cover depth. With the hoist at the upper limit, the grappled fuel assembly is suspended below the minimum safe water cover depth at all times and will not cause damage or distortion to the fuel or the spent fuel handling machine when engaged at full operating hoist speed.

F. The fuel hoist is provided with load measuring devices and interlocks to interrupt hoisting if the load increases above the overload setpoint and interrupt lowering if the load decreases below the underload setpoint.

G. In the event of loss of power, the brakes are actuated and the load is held in position.

H. Interlocks are provided to ensure the readiness of system components, to simplify the performance of sequential operations, and to limit travel and loads so that design conditions are not exceeded. In no case are they utilized to prevent inadvertent criticality or reduce the minimum water coverage for personnel protection. No single interlock failure will result in a condition that allows equipment malfunction, damage to the fuel, or reduces shielding water coverage. Where these results are considered possible, redundant switches, mechanical restraints, and physical barriers are employed, as well as hoist motor electrical overload protection. These features ensure loading capability to values below those that would result in damage to the fuel.

9.1.5.1.3 Cask Handling Crane

The principal design criteria for the cask handling crane are as follows:

A. For non-seismic operating conditions, the bridge, trolley, hoist units, hoisting cable, and hook conform to the requirements of The Crane Manufacturing Association of America Specification No. 70, which also refers to the applicable portions of the Manual of Steel Construction, American Institute of Steel Construction. All the components of the crane shall conform to the following codes: ASTM, AISC, AGMA, IEEE, NEMA, NEC, NFPA, ANSI, and OSHA.

B. Positive means such as restraining lugs are provided on the crane to prevent bridge, trolley, or any other part from becoming dislodged and falling on structures situated below the crane in the event of a DBE.

C. A basic stress criteria for structural steel is that the allowable flexural stress is the least of 0.9 times yield strength or 0.9 times the stress obtained from the ultimate capacity calculated with due regard to the elastic stability of the member.

D. In the event of loss of power, the equipment, and its load will remain in a safe condition.

E. The Unit 2&3 Cask Handling Crane is single-failure-proof in accordance with Ederer's X-SAM Licensing Topical Report, EDR-1.

F. The Unit 2 Cask Handling Crane bridge structural members are qualified by cold proof testing to operate with material temperatures at or above 61.4°F. The Unit 3 Cask Handling Crane bridge structural members are qualified to by cold proof testing to operate with material temperatures at or above 63.1°F.

9.1.5.2 System Description

9.1.5.2.1 System

The fuel handling system is an integrated system of equipment, tools, and procedures for handling and storing spent fuel assemblies. The system provides for handling and storage of fuel assemblies to shipping of spent fuel. The equipment is designed to handle the spent fuel underwater until it is placed in a cask for shipment from the site. Underwater transfer of spent fuel provides a transparent radiation shield as well as a cooling medium for the removal of decay heat. Boric acid is added to the water in the quantity required to ensure subcritical conditions during fuel handling and storage.

Major components of the system are the spent fuel handling machine and the cask handling crane. CEAs are moved from one fuel assembly to another by utilizing the Spent Fuel Handling machine with the five finger CEA handling tool. GT inserts are moved into and out of fuel assemblies with the GT insert handling tool. The spent fuel handling machine moves fuel between the fuel storage racks in the spent fuel pool and the spent fuel shipping cask.

Major tools and servicing equipment required for handling fuel and fuel inserts are listed in Table 9.1-4.

Major components of the fuel handling system, are shown in Figure 9.1-3 and are described below. The seismic category, quality class, design codes, and standards used for design, manufacture, testing, maintenance, and operation of these principal components are listed in Controlled Document 90034, “Q-List.”

Where possible in the design of this equipment, mechanical stops and positive locks were provided to prevent damage to, or dropping of, the fuel assemblies.

The following identifies and defines the function of the interlocks contained in the fuel handling equipment. In no case has a method been provided to directly inform the operator that an interlock is inoperative; however, in most cases a redundant device is provided to perform the same function as the interlock or to present information to the operator to deduce that an interlock has malfunctioned.

Table 9.1-4

MAJOR TOOLS AND SERVICING EQUIPMENT REQUIRED FOR HANDLING FUEL AND FUEL INSERTS

	Description
1.	Source Handling Tool
2.	CEA Transfer Basket (Four Finger CEA Carriers)
3.	CEA Handling Tool (Four Finger)
4.	Cask Handling Crane
5.	Spent Fuel Handling Machine (Fig 9.1-21)
6.	New Fuel Elevator (Fig 9.1-22)
7.	Spent Fuel Handling Tool (Units 2 & 3) (Fig 9.1-23)
8.	New Fuel Handling Tool (Fig 9.1-23)
9.	CEA Handling Tool
10.	Spent Fuel Handling Tool (Unit 1)
11.	Five Finger CEA Handling Tool
12.	TRI-NUC Pump Canisters
13.	Dummy Fuel Assembly
14.	GT Insert Handling Tool

9.1.5.2.1.1 Spent Fuel Handling Machine

The following identifies and describes the functions of the interlocks that are part of the spent fuel handling machine:

A. Spent Fuel Handling Machine Hoist Interlock

   Interrupts hoisting if the load increases above the overload setpoint. Since the tool is manually controlled by the operator, failure of the tool to move or reduction in tool speed as a result of an overload can be sensed by the operator if the interlock becomes operative.

B. Spent Fuel Handling Machine Hoist Interlock

   Interrupts hoisting if the load decreases to cable slack.

   Since the tool is manually controlled, a slack cable condition can be visually determined by the operator and hoisting can be terminated.

C. Spent Fuel Handling Machine Translation Interlock

Provides speed restriction on bridge and trolley translation unless the load is in the full up position, at which time fast speed is allowed.

If this interlock fails, the mandatory slow speed restriction is removed. However, since the translation speed controls are infinitely variable, the operator can run at slow speed when the interlock malfunction is recognized.

D. Spent Fuel Handling Machine Translation Interlock

Protects, by means of zone switches, against running the load into walls or the gate of the storage area.

No backup or additional circuitry is provided for this interlock. However, the operator can directly observe the tool and the attached load so that translation can be terminated if an interlock fails to operate.

E. The Spent Fuel Handling Tool Length

Provides the mechanism which precludes raising fuel above the minimum safe water cover depth. With the hoist at the upper limit, the grappled fuel assembly is suspended below the minimum safe water cover depth at all times and will not cause damage or distortion to the fuel or to the spent fuel handling machine when engaged at full operating hoist speed.

9.1.5.2.1.2 New Fuel Elevator[1]

The following identifies and describes the functions of the interlocks that are part of the new fuel elevator:

A. New Fuel Elevator Hoist Interlock

Stops the elevator motor should the cable become slack.

If this interlock fails, the operator can stop the elevator motion from the spent fuel handling machine console.

[1] Even though this subsection is titled "New Fuel Elevator," no new fuel is stored at San Onofre Units 2 and 3 in the permanently defueled condition. However, this system is only partially removed from service to allow for activities during the decommissioning process not related to new fuel storage.

B. New Fuel Elevator Hoist Interlock

Prevents raising of the elevator with a fuel assembly in the elevator box. This interlock is a backup for the administrative control, which precludes the placement of a spent fuel assembly in the new fuel elevator.

The fuel handling machines do not fall within the definition of an overhead or gantry crane as described in OSHA subpart N, Materials Handling and Storage, or 29 CFR 910, Section 1910.179. However, considerable importance has been attached to meeting the standard as well as operator, equipment, and facility safety. In those cases where the fuel handling machine does not conform to the OSHA regulations, additional features to protect the safety of the operator and facility have been installed and are a part of appropriate operational procedures.

9.1.5.2.2 Components

9.1.5.2.2.1 Fuel Transfer Tube and Valve

A fuel transfer tube extends through the containment wall and connects the refueling pool to the transfer pool.

The 36-inch diameter transfer tube is contained in a 42-inch diameter penetration that is sealed to the containment. The transfer tube and penetration sleeves are sealed to each other by welding rings and bellows-type expansion joints.

The 36 inch transfer tube valve is attached to the spent fuel pool end of the transfer tube. The valve is closed and the manual operator for the valve has been removed. The transfer tube is also sealed by means of a blind flange located inside the containment.

9.1.5.2.2.2 Fuel, CEA, and GT Insert Handling Equipment

Two fuel handling tools, as shown on Figure 9.1-23 are used to move Units 2 and 3 fuel assemblies in the spent fuel pool area. Long tools are provided for underwater handling of Units 2 and 3 fuel in the spent fuel pool. The tools are operated manually. Irradiated CEAs are handled underwater by long CEA handling tools. GT inserts are handled by the GT insert handling tool.

9.1.5.2.2.3 Spent Fuel Handling Machine

The spent fuel handling machine, as shown on Figure 9.1-21, is a traveling bridge and trolley that rides on rails over the spent fuel pool, fuel transfer pool, and cask loading pit. Motors on the bridge and trolley position the machine over the spent fuel assembly storage racks, the new fuel elevator, and the fuel shipping cask. Access to the new fuel elevator is blocked by ISFPCS piping. End stops on the spent fuel handling machine bridge rail prevent the machine from impacting plant structures and equipment.

The spent fuel handling machine hoist supports the handling tool for grappling fuel assemblies. This tool is operated manually from the operator's platform on the trolley. Once a fuel assembly is grappled, a cable and hoist winch raise the fuel assembly. The spent fuel handling machine can transfer a spent fuel assembly from one spent fuel cell to another or from the spent fuel racks to the fuel shipping cask loading area.

The controls for the spent fuel handling machine are mounted on a console located on the spent fuel handling machine trolley.

The coordinate locations of the bridge, hoist, and trolley are indicated in inches by digital indicators on the control panel. In addition, visual indication of bridge and trolley position is provided by index markers located on the bridge and trolley festooned cable tracks. The index markers are color-coded to differentiate between Region I and Region II storage cells.

During withdrawal or insertion of a fuel assembly, the load on the hoist cable is monitored to ensure that movement is not being restricted. Set-points are such that damage to the assembly is prevented.

Positive locking is provided between the grappling tool and the fuel assembly to prevent inadvertent uncoupling. The drives for both the bridge and the trolley provide close control for accurate positioning, and brakes are provided to maintain the position once achieved. In addition, interlocks are installed so that movement of the spent fuel handling machine is not possible when the hoist is withdrawing or inserting an assembly.

Hand-wheels are provided for bridge, trolley, and winch motions in the event of a power loss.

9.1.5.2.2.4 New Fuel Elevator

A fuel elevator, as shown on Figure 9.1-22, is used to lower non-fuel items, such as blocking devices, from the operating level at the top of the fuel transfer pool to the bottom of the pool where it is grappled by the spent fuel handling tool. The fuel elevator can also be used to remove non-fuel items from the spent fuel pool. The elevator is powered by a cable winch, and non-fuel items are contained in a simple support structure whose wheels are captured in two rails. Non-fuel items are loaded into and removed from the elevator by means of the new fuel crane monorail and the new fuel handling tool. Access to the new fuel elevator has been blocked by ISFPCS piping.

9.1.5.2.2.5 Irradiated Fuel Inspection

Cladding breaches have historically been the primary cause for classifying a fuel as damaged. When required, fuel assemblies may be examined for cladding defects. The presence of damaged fuel in fuel assemblies, including lead fuel, lead use, and test assemblies, is determined by inspections. Inspections may utilize various techniques, including review of Reactor Coolant System (RCS) activity records, canister sipping, ultrasonic testing, visual inspection, and Eddy current testing. Inspections are performed in the spent fuel pool.

A sipping system associated with in-pool operations may be used to detect leaking fuel assemblies. With canister sipping a fuel assembly is placed inside a sealed canister. A vacuum is drawn to force the gaseous radioactive fission products out of the failed fuel rod and into the canister water where they may be sampled.

Ultrasonic testing of a fuel assembly identifies the individual fuel rod that is damaged by detecting liquid water in a failed fuel rod. The water is introduced into the failed fuel rod via a cladding defect or breach. The advantages of ultrasonic testing are that the fuel assembly does not have to be dismantled, individual failed fuel rods can be detected, and whole rows of fuel rods can be examined simultaneously. This method will locate the axial location of breach site on a failed fuel rod.

Visual inspection of a fuel assembly may also be used to assess the degree of damage in more detail. If the damage is located inside the fuel assembly, the assembly may be disassembled to inspect single fuel rods.

To disassemble a fuel assembly requires that the fuel assembly be placed on a pedestal in the spent fuel rack in order to raise the top of the fuel assembly above the top of the spent fuel racks for access and visibility. Upon removal of the fuel assembly upper end fitting, the tops of all fuel rods in the assembly become accessible for inspection and replacement, if needed.

Individual fuel rods are removed by pulling vertically until the fuel rod is completely withdrawn from the fuel assembly. The withdrawn fuel rod may be passed through Eddy current coils. Eddy current techniques allow the axial location of a fuel cladding defect to be determined. The technique is very sensitive and can also be used to detect non-penetrating cracks and an estimate of through-wall wear.

Fuel rods exhibiting non-penetrating cracks or cladding wear may be rotated such that the area of worn cladding is no longer adjacent to the cause of the wear. Fuel rods exhibiting through-wall wear may be swapped out for intact fuel rods from a different fuel assembly, or they may be replaced with a filler rod. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used as part of a fuel reconstitution effort. The use of replacement rods is addressed in Reference 4. After the desired fuel rods have been inspected and replaced, the fuel assembly is reassembled.

9.1.5.2.2.6 Cask Handling Crane

The cask handling crane is a 125-ton capacity bridge crane.

The cask handling crane, including all supports, is designed as Seismic Category I systems and equipment. The cask handling crane transfers the spent fuel cask between the shipping-receiving area, the cask decontamination pit, and cask loading pit. The heaviest load to be handled by the cask handling crane is a loaded spent fuel cask with a maximum weight of 125 tons.

The Unit 2&3 Cask Handling Crane is single-failure-proof in accordance with Ederer X-SAM Licensing Topical Report, EDR-1.

9.1.5.2.2.7 Spent Fuel Pool Water Seals

The spent fuel storage pool has two water seals that separate the spent fuel storage area and the (1) spent fuel cask handling pool and, (2) fuel transfer/upender pool. Each spent fuel storage pool water seal consists of a bulkhead gate with two independent pressurized bladders which provide redundant seals between the bulkhead gate and the spent fuel pool walls. These pressurized seals are constructed of heavy radiation resistant reinforced fabric. Normal seal operating pressure is 20 psig.

9.1.5.2.2.8 Pneumatic Seal Pressurization

The pressurization source for the spent fuel pool pneumatic seals is supplied by redundant gas cylinders.

9.1.5.2.3 System Operation

9.1.5.2.3.1 Spent Fuel Transfer

The spent fuel handling machine transfers the spent fuel assemblies from the storage racks to the spent fuel shipping or transfer cask. The cask loading area is connected to the pool by a canal and a sliding gate sized to allow passage of a spent fuel assembly suspended from the spent fuel handling machine. The spent fuel cask arrives in a specially built transporter at the loading area that is serviced by an overhead cask handling crane. The main hoist of the crane lifts the cask to the operating floor and transfers the cask to the wash-down / lay-down area.

After the cask is serviced and washed, it is transferred over the operating floor to the cask loading pit. Positioning the cask into the cask loading pit is a two-step hoisting operation governed by administrative controls as well as by crane interlocks. The first hoisting step sets the cask on an intermediate ledge of the pit to interrupt the single lift over the full depth of the pool. The second hoisting step lowers the cask to the bottom of the cask loading pit. These steps are designated as positions B and C on Figure 9.1-25 and positions B and C on Figure 9.1-26.

The spent fuel assemblies are then transferred underwater and are loaded into the cask, using the spent fuel handling machine. Removal of the now loaded cask is accomplished by a reversal of the two-step hoisting operation described above. In this manner, the potential for a cask drop in excess of 30 feet is avoided.

The loaded cask is lifted to the wash-down area of the operating floor where radioactive materials and residual coolants are removed. After the wash-down is complete and the area is drained, the spent fuel cask is loaded into the transporter, and is ready for shipment.

With the sliding gate secured, a submersible pump is required to drain the spent fuel cask loading pit. The pump takes suction from the pit and discharges the fluid to the spent fuel pool.

9.1.5.2.3.2 Placement and Orientation of Fuel Assemblies and GT Inserts

9.1.5.2.3.2.1 Placement and Orientation of Fuel Assemblies

The fuel enrichment within a fuel assembly is identified by a coded serial number marked on the assembly's upper end fitting. This serial number is used as a means of positive identification for each assembly in the plant. A Certified Fuel Handler has the oversight and responsibility for fuel movement and to ensure that the assemblies are moved to the correct locations.

Prior to movement of fuel data sheets are prepared. These data sheets detail the order in which fuel assemblies are moved. The data sheets are verified as correct by a minimum of two independent reviewers.

9.1.5.2.3.2.2 Placement and Orientation of GT Inserts

Either three or five GT inserts may be placed in a fuel assembly. When three GT insets are placed in a fuel assembly, the orientation shall be as shown in Licensee Controlled Specifications 4.0.100, Figure II-23. To preclude inadvertent removal of a GT insert, the top of the GT inserts shall be below the top of the fuel assembly in which they are inserted.

9.1.5.2.3.3 NUREG-0612 Heavy Load Handling System

Table 9.1-5 identifies cranes and hoists which handle heavy loads in the vicinity of irradiated fuel. The cranes and hoists listed in this table are subject to administrative controls that satisfy guidelines for heavy load handling established in NUREG-0612 (Ref. 1).

Table 9.1-5
NUREG-0612 HEAVY LOAD HANDLING SYSTEMS

Handling System	Design Capacity (tons)	Location
Cask Handling Crane	125/10	Fuel Handling Bldg.
New Fuel Handling Crane	5	Fuel Handling Bldg.

These guidelines consist of the following criteria from Section 5.1.1 of NUREG-0612:

1. Definition of safe load paths
2. Development of load handling procedures
3. Periodic inspection and testing of cranes
4. Qualifications, training and specified conduct of operators
5. Special lifting devices should satisfy the guidelines of ANSI N14.6
6. Lifting devices that are not specially designed should be installed and used in accordance with the guidelines of ANSI B30.9
7. Design of cranes to ANSI B30.2 or CMAA-70

Other station cranes and hoists have been evaluated as exempt from NUREG-0612 guidelines.

9.1.5.3 Safety Evaluation

9.1.5.3.1 Cask Handling Crane

The cask handling crane is a Seismic Category I component as described in Controlled Document 90034, "Q-List," and Section 9.1.5.2.2.6. The cask handling crane, including all supports, are analyzed for the operating basis and design basis earthquakes to ensure complete stability under loaded and unloaded conditions. Where analytical means do not give positive assurance that the crane or any part of it will not fall off the rails, the stability of the crane components is ensured by a system of restraining devices that remain effective during crane operating motion. The cask handling crane is restrained by upkick lugs which engage the trolley and the bridge trucks to their rails. The cask handling crane was upgraded to single-failure-proof criteria.

Failure of any part of the cask handling cranes, or any other crane capable of carrying major loads, does not cause any damage to spent fuel or safety-related equipment. Positive protection against dropping the spent fuel cask into the spent fuel storage pool is provided by the basic layout of the spent fuel storage pool, fuel transfer system, and fuel handling arrangement which make it impossible to pass the cask over the spent fuel storage racks. The cask is assigned to a separate laydown area, designated as the cask loading pit, in the spent fuel pool. The cask is physically isolated from movement over the spent fuel storage area or new fuel storage racks because the cask handling crane does not extend across these areas. The fuel handling building layout is designed to prevent damage to essential equipment or release of radioactivity as a result of a fuel handling cask drop.

Cask drops were analyzed using the guidelines of NUREG-0612, Control of Heavy Loads at Nuclear Power Plants, July 1980. The analysis considered the approach and orientation of the cask with respect to the pool, maximum impact loads from a rigid cask dropping on exposed structural members, and the restricted travel path of the cask. The cask cannot fall into the spent fuel pool by basic layout and credit is not taken for energy absorbing devices.

Design features that prevent damaging spent fuel and essential equipment are:

A. During cask handling operations, the spent fuel cask cannot travel over the spent fuel pool where spent fuel is stored due to physical limitations in crane travel (refer to Figure 9.1-24). There are no conceivable cask drops, including a tilted cask that hits the edge of the spent fuel pool that could result in dropping a cask directly into the spent fuel pool.

B. Exposure to cask drop exists only in the spent fuel cask storage pool which is adjacent to the spent fuel pool. A 4-foot thick reinforced concrete wall separates the spent fuel pool from the spent fuel cask storage pool. This concrete wall ensures that a cask dropped into the spent fuel cask storage pool will not damage the spent fuel racks in the spent fuel pool. In addition, a postulated drop of the cask in the cask handling pool will not cause perforation or spalling of the concrete slab which forms the floor of the pool.

C. The east-west direction of cask approach and regress into the spent fuel cask storage pool ensures that a dropped or tilted cask will not directly impact the 4-foot-thick separation wall. Refer to Figures 9.1-24, 9.1-25, and 9.1-26. The prescribed east-west direction of travel for the crane is dictated by critical path limit switches provided in the cask handling crane. Operation of the crane with travel path restricted by critical path limit switches is enforced by administrative control.

D. During handling operations, the cask travels over the spent fuel pool makeup spray piping. The operating floor is designed to withstand a cask drop of 6 inches. This provides a protective barrier for the spent fuel pool heat exchanger and cooling pumps which are located at the lower elevations below the operating floor of the fuel handling building.

E. The Unit 2&3 Cask Handling Crane is single-failure-proof in accordance with NUREG-0554, NUREG-0612, Appendix C, and the X-SAM Licensing Topical Report, EDR-1.

An analysis of the consequences of dropping a spent fuel assembly during handling operations is given in Chapter 15. An analysis of the consequences of a loaded transfer cask falling from the upper shelf of the cask pool is given in Chapter 15. As shown, there is no undue exposure to the general public or personnel. Chapter 15 provides a summary of a spent fuel pool gate drop analysis that credits the administrative controls to preclude damage to the fuel stored in the racks. Chapter 15 describes the evaluation of the radiological consequences of the drop of a fuel assembly during handling. The analysis conservatively assumes that both the dropped assembly and the impacted assembly (two assemblies worth of fuel) are damaged.

9.1.5.3.2 Fuel Handling

A failure mode and effects analysis of the fuel handling equipment is not required. The results of the analysis provided in Chapter 15 demonstrate that applicable dose limits are not exceeded as a result of the design basis fuel handling accident. No component or subsystems of the fuel handling equipment are required to either prevent or mitigate the consequences of the postulated fuel handling accident.

The presence of approximately 2000 ppm boron in the pool water will decrease reactivity by about 20% Δk. For all postulated accidents involving misloading and damage to fuel assemblies, should there be a reactivity increase, K_{eff} would be less than or equal to 0.95 due to the dissolved boron and thus meets the acceptance criteria of no criticality.

Operability of the fuel handling equipment, including the bridge and trolley, the lifting mechanisms and the associated instrumentation and controls, is assured through the implementation of preoperational tests. In addition to the interlocks described in Section 9.1.5.2.1, the equipment has the following special features:

A. The major components of the fuel handling system are electrically interlocked with each other to assist the operator in properly conducting the fuel handling operation. Failure of any of these interlocks in the event of operator error will not result in damage to more than one fuel assembly. The radiological consequences associated with the activity release from an entire assembly are discussed in Chapter 15.

B. Miscellaneous special design features that facilitate handling operations include: backup hand operation of the spent fuel handling machine bridge, trolley, and hoist in the event of power failure.

C. Travel stops in the spent fuel handling machine restrict withdrawal of the spent fuel assemblies. The spent fuel handling tool length provides for minimum water cover. This provides for a minimum water cover of 8 ft-5 in. feet over the active portion of the fuel assembly limiting the radiation level to approximately 8 mrem/hr or less at the surface of the water.

D. The structural design of the fuel storage racks incorporate provisions to withstand uplift forces as defined below:

Spent Fuel Storage Racks	6,000 lb
New Fuel Storage Racks	3,000 lb

These uplift forces are governed by crane-installed load cells and represent the maximum pull that the spent fuel handling machine can exert on the racks through a fuel assembly stuck within a storage cell. Sustained or repeated application of the uplift forces will not compromise the structural integrity of the racks or their anchorage and will not result in an increase of the Keff associated with the racks.

E. The new and spent fuel storage area is not exposed to overhead handling of the spent fuel cask. In those areas, the only objects that travel overhead are the fuel assemblies, spent fuel pool gate and spent fuel pool test equipment. A fuel assembly drop due to failure of the spent fuel handling machine is a remote occurrence that would result in a limited fall. The spent fuel storage racks are designed so that impact from accidental dropping or side swinging of a fuel assembly will not damage the stored assemblies.

F. The potential drop of the spent fuel pool gate or test equipment skid is discussed in Chapter 15.

G. High and low pressure protection is provided to assure continuous gate seal pressurization. High pressure protection is provided by a relief valve (QCIII, SCII/I). Local audible alarm and pressure indicator are provided to indicate less than normal operating pressure. Check valves (QCIII, SCII/I) prevent the rapid loss of the gate seal if its primary pressurization system fails. Upon loss of the primary pressurization system the backup pressurization system is automatically placed in service.

Administrative controls and physical limitations imposed on fuel handling operations to preclude the possibility of a fuel handling accident are discussed previously in this subsection (9.1.5).

9.1.5.4 Testing and Inspection Requirements of Refueling Equipment

During manufacture at the vendor's plant, various in-process inspections and checks are required, including certification of materials and heat treating, and liquid-penetrant or magnetic-particle inspection of critical welds. Following completion of manufacture, compliance with design and specification requirements is determined by assembling and testing the equipment in the vendor's shop. Utilizing a dummy fuel assembly having the same weight, center of gravity, exterior size and end geometry as an actual assembly, all equipment is run through several complete operational cycles. In addition, the equipment is checked for its ability to perform under the maximum limits of load, fuel mislocation, and misalignment. All traversing mechanisms are tested for speed and positioning accuracy. All hoisting equipment is tested for vertical functions and controls, rotation, and load misalignment.

Hoisting equipment is also tested to 125% of specified hoist capacity. Setpoints are determined and adjusted and the adjustment limits are verified. Equipment interlock function and backup systems operations are checked. Those functions having manual operation capability are exercised manually. During these tests, the various operating parameters such as motor speed, voltage and current, hydraulic system pressures, and load measuring accuracy and setpoints are recorded. At the completion of these tests the equipment is checked for cleanliness and the locking of fasteners by lock-wire or other means is verified.

Equipment installation and testing at the plant site is controlled by approved installation procedures and pre-operational test procedures designed to verify conformance with specification. Each component is inspected and cleaned prior to installation into the system. Recommended maintenance, including any necessary adjustments and calibrations, is performed approximately every two years or when in use. Periodic in-service tests also include checks of all control circuits including interlocks and alarm functions.

9.1.5.5 Instrumentation Requirements

The refueling system instrumentation and controls are described in paragraph 9.1.5.2. Analysis provided in Chapter 15 demonstrates that applicable dose limits are not exceeded as a result of the design basis fuel handling accident. No credit is taken for instrumentation or interlocks on components of the fuel handling equipment to either prevent or mitigate the consequences of the postulated accident. Thus, safety related interlocks are not provided.

9.1.6 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI)

The ISFSI is a fenced, protected area located within the Unit 1 north Industrial Area, dedicated to the storage of dry spent fuel from Units 1, 2, and 3. The ISFSI was initially sized to empty the Unit 1 Spent Fuel Pool and to create enough room in the Unit 2 and 3 Spent Fuel Pools to permit operation through the end of San Onofre Units 2 and 3 licensed plant life.

The final ISFSI configuration will consist of multiple rows of NUHOMS Advanced Horizontal Storage Modules (AHSM) and an additional pad containing Holtec UMAX MSE storage systems. See the respective Dry Fuel Storage FSARs for more detailed information.

The ISFSI is protected by a security fence and features described in the SONGS Physical Security Plan. Lightning protection is provided for the modules and the security light towers. Except for periods of facility expansion (adding additional modules), routine inspections, and during actual fuel loading operations, the ISFSI will be empty of vehicles, extraneous equipment, and personnel. Transient combustibles are controlled by administrative procedure.

9.1.7 FUEL LOADING EQUIPMENT FOR UMAX ISFSI

9.1.7.1 Design Basis

The system, structures, and components that support transferring fuel from the spent fuel pool to the UMAX ISFSI are Quality Class IV and Seismic Category III except for lifting and handling devices which are Quality Class II and Seismic Category I.

9.1.7.2 System Description

9.1.7.2.1 Forced Helium Dehydration (FHD) System

The FHD system is a skid mounted equipment package used to de-moisturize a Multi-Purpose Canister (MPC) with a closed loop helium circulation system.

The FHD is used to remove the remaining moisture in an MPC cavity that could not be removed through the MPC drain line using the multi-purpose pump. The MPC internals are de-moisturized by evaporation of water. Injection of hot and dry helium promoted de-moisturization in two ways: First, high gas temperatures heat any remaining water in the MPC, thereby raising its vapor pressure; Second, a continuous supply of dry helium sustains a large driving force (vapor pressure differential between moisture and bulk gas). A high vapor pressure differential ensures that moisture in less accessible areas of MPC internals transitions to vapor and is readily removed by the circulating helium. A chiller is then used to lower the circulating helium temperature to approximately 5°F to freeze out any remaining water vapor circulating through the MPC.

The FHD system incorporates necessary hardware to cover the four modular functions: (i) condensing module, (ii) demoisturizer module, (iii) helium circulator module and (iv) pre-heater module. For this purpose, four discrete hardware components are utilized. An air-cooled condenser, a refrigerated fluid cooled chiller-exchanger, a rotary lobe circulating blower, and an electrical process heater are included in the FHD System. Helium is supplied via bottles staged outside the Fuel Handling Building.

9.1.7.2.2 Welding System

The Automated Welding System performs field welding operations for the MPC closure in accordance with the applicable sections of the ASME B&PV Code. The welding operations performed include the MPC lid to MPC shell weld, closure ring to MPC shell weld, and closure ring to MPC lid weld. In addition to the Automated Welding System, manual welding equipment is used to perform the MPC port cover plate welding.

9.1.7.2.3 Fuel Handling Components

The Fuel Handling Components that support fuel transfer to the UMAX ISFSI include the HI-TRAC Variable Weight (VW) transfer cask seismic restraint, lifting yoke, and yoke extensions. Additional fuel handling related equipment is contained in section 9.1.5.

The HI-TRAC VW seismic restraint system encircles the top and bottom of the HI-TRACK VW transfer cask and secures the transfer cask to seismic restraint supports on the cask wash down area walls. The seismic restraint system prevents tip-over of the HI-TRAC.

The Lifting Yokes and Lifting Yoke Extensions are used to handle the loaded and empty HI-TRAC VW cask. They may also be used to lift a loaded MPC or MPC Lid with additional rigging.

9.1.7.2.4 Spent Fuel Pool Purification System

The spent fuel pool purification system maintains pool clarity during fuel transfer operations. The system consists of vacuum and filter pumps that are bolted at their baseplates to a support platform. Hoses can be attached to the vacuum and filter pumps to perform localized cleaning in the spent fuel pool. The support platform contains legs that are inserted into the fuel cells of the spent fuel storage racks to prevent the equipment from sliding or tipping over.

9.1.7.2.5 Pumps and Water Storage Systems

Various pumps are used to support fuel loading operations. These include a skid mounted multi-purpose pump, a submersible pump for use in the spent fuel pool, a pump as a part of the hydrostatic test skid, a pump that can be lowered into the MPC through the port holes in the lid, and a pump used to move water to and from the water storage container (water bladder) and the HI-TRAC water jacket.

Water bladders are flexible water storage systems that are used to store demineralized water in the penetration area outside of the spent fuel pool rooms. The water bladders keep the clean demineralized water separate from the spent fuel pool water.

9.1.7.2.6 Cask Work Platforms

The cask work platforms allow access to the top of the HI-TRAC and MPC for sealing and drying activities. The cask work platforms are positioned in the cask washdown areas. Each cask work platform has a removable portion on the side of the platform closest to the cask hatch. Removing this portion of the platform allows for the HI-TRAC to be moved into the center of the cask work platform.

9.1.7.3 <u>Safety Evaluation</u>

All the SSCs below are administratively controlled through site procedures to ensure adequate seismic restraint requirements are met to preclude interaction with safety-related components.

9.1.7.3.1 FHD System

The FHD system has no safety functions. Malfunction or failure of FHD components has no adverse impact on any safety-related systems or components.

9.1.7.3.2 Welding System

The Automated Welding System and manual welding equipment have no safety functions. Malfunction or failure of these components has no adverse impact on any safety-related system or component.

9.1.7.3.3 Fuel Handling Components

The HI-TRAC VW seismic restraint, lifting yoke, and lifting yoke extension are designed to ensure the safe handling and storage of spent fuel throughout fuel transfer operations. These components are Seismic Category I and are analyzed for the site's design basis earthquake to ensure stability under all operational conditions.

9.1.7.3.4 Spent Fuel Pool Purification System

As described in Section 9.1.2, the vacuum and filter pump support platform is restrained to the spent fuel storage racks via support legs that are inserted into the fuel cells. This ensures that the vacuum and filter pump assemblies will not slide or tip over during a design basis earthquake. The effect of the vacuum and filter pumps on the underlying spent fuel storage racks is minimal as a vacuum/filter pump with support platform weighs less than a fuel assembly and represents only a small percentage of the total weight of a partially loaded spent fuel rack.

In the event that the vacuum filter and pump separates from its support platform spent fuel stored inside the spent fuel storage racks will not be damaged since the top of the fuel is approximately one foot below the top of the racks. In addition, the non-fuel upper end fitting of the fuel assembly will prevent and large fragments from damaging the fuel rods.

9.1.7.3.5 Pumps and Water Storage Systems

The pumps and water storage containers (bladders) do not perform any safety functions. However, when the submersible pumps are used to move water from the spent fuel pool to the MPC, administrative controls ensure the spent fuel pool is not diluted and the water level in the spent fuel pools is not lowered past safe limits. Additionally, administrative controls prohibit the submersible pumps and hoses from being installed lower than elevation 56'-6."

9.1.7.3.6 Cask Work Platforms

The cask work platforms have no safety function. The malfunction or failure of the cask work platforms has no effect on any safety-related components.

9.1.8 REFERENCES

1. NUREG-0612 "Control of Heavy Loads At Nuclear Power Plants," July 1980.

2. Ederer's X-SAM Licensing Topical Report, EDR-1.

3. (DELETED)

4. CENPD-289-P, "Use of Inert Replacement Rods in ABB CENF Fuel Assemblies," September 1993.

5. NRC SER to SCE dated March 11, 2016; SUBJECT: SONGS, Units 2 and 3 - Issuance of Amendments Modifying Licenses to Allow Changes to Specific Regulatory Guide Commitments (CAC NOS. L53073 AND L53074, PDSFPC)

6. SO23-V-5.100, SONGS Mitigating Strategies

7. Design Calculation N-0220-0037 Rev.3, Spent Fuel Pool Time To Boil.

8. 1814-AA086-M0262 REV.0, San Onofre Spent Fuel Pool Island Design Plan.

9.2 WATER SYSTEMS

Not all subsystems of Water Systems are required to support permanent plant shutdown or defueled operations. The status of these subsystems is listed in the table below. Design Basis, Licensing Basis, and operational information contained in this section has been updated to reflect the current status. Although the subsystems removed or partially removed from service no longer support operation, they may still contain fluids, gases, or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration.

Structures / Systems / Components	Status
Saltwater Cooling System	Removed from Service
Component Cooling Water System	Removed from Service
Makeup Demineralizer System	Removed from Service
Domestic Water System	Partially Removed from Service
Ultimate Heat Sink (Pacific Ocean)	Removed from Service
Ultimate Heat Sink (Atmosphere)	Available
Condensate Storage and Transfer System	Removed from Service
Nuclear Service Water System	Removed from Service
Turbine Plant Cooling Water System	Removed from Service
Dilution System	Available

9.2.1 DOMESTIC WATER SYSTEM

9.2.1.1 Design Bases

The domestic water system serves no safety function and, therefore, has no safety design basis. The domestic water system is designed to:

A. Prevent contamination due to potential radioactivity or due to backflow from cross-connected systems using water unfit for human consumption.

B. Provide a quantity of 50 gallons per person per day for permanent personnel, plus 25 gallons per person per day for nonpermanent personnel, for the largest number of persons expected to be at the station during a 24-hour period of plant refueling and maintenance operations.

C. Provide domestic water system outlets in compliance with the intent of Title 29 Part 1910 (Occupational Safety and Health Standards) of the Code of Federal Regulations.

The domestic water system is designed to the equipment classification requirements indicated in Controlled Document 90034, “Q-List.”

9.2.1.2 System Description

9.2.1.2.1 General Description

The domestic water system is shown in Controlled Drawings 40182A, 40182B, and 40182C. The source of water for the domestic system is the local water agency, which normally furnishes adequate flow and pressure directly to the domestic system. Backflow preventers in the domestic and service water systems are provided to prevent possible contamination of the domestic system.

9.2.1.2.2 Component Description

9.2.1.2.2.1 Valves

ASME Code rated and approved relief valves, but without ASME certification or N-stamping, are provided on all equipment and in all piping requiring temperature or pressure relief.

9.2.1.2.2.2 Piping

Construction materials used in the domestic water distribution system prevent the introduction by the system piping of objectionable tastes, odors, discoloration, and toxic conditions into the system, and conform to the provisions of the Uniform Plumbing Code.

Piping is sized to limit flow velocity to 6 ft/s and thus minimize system shock and water hammer. This is supplemented by the installation of approved water-hammer arresters at appropriate locations.

9.2.1.2.2.3 Protection Against Contamination

No cross-connections exist between the domestic water system and any potentially radioactive system. A cross-tie connection with a backflow preventer is installed between Unit 2 and 3 common domestic water system and Unit 3 side of the service water. All branches of the system supplying the plumbing fixtures located in areas to which access is restricted due to a potential radiological hazard are provided with backflow prevention devices of the reduced pressure zone type.

Because of the above design features in the domestic water system, sharing of the domestic water system between Units 2 and 3 does not degrade contamination protection.

9.2.1.2.2.4 Emergency Shower and Eyewash Station

The domestic water system provides potable water for emergency shower and eyewash stations throughout the power block and outside areas.

9.2.1.3 Safety Evaluation

The domestic water system has no safety functions. The malfunction or failure of a component has no adverse effect on any safety-related system or component.

9.2.1.4 Tests and Inspections

The domestic water system is tested for leak tightness in conformance with Uniform Plumbing Code requirements. Inspection of the entire system for compliance with the provisions of the Uniform Plumbing Code is performed. Reworked or new piping is disinfected, flushed with potable water, and placed in service.

9.2.1.5 Instrumentation Applications

Thermostats, high-temperature limit switches, and temperature gages are installed on hot water storage heaters. A pressure regulator downstream of the main water line prevents overpressurization of the system.

9.2.2 ULTIMATE HEAT SINK

The ultimate heat sink provides a means for rejecting heat from the spent fuel pool to the atmosphere.

9.2.2.1 Design Bases

To ensure that adequate margin exists in the design, 100% of the SFP decay heat is assumed to be transported to the atmosphere via the ISFPCS primary to secondary side heat exchanger to the secondary side chillers. Calculations and equipment testing has demonstrated adequate capacity of the atmosphere / ISFPC as a heat sink.

See Table 9.1-1B (Section 9.1.3.3) for description of spent fuel heat loads.

9.2.3 DILUTION SYSTEMS

9.2.3.1 Circulating Water System

In the permanent defueled plant condition, portions of the Circulating Water System are required to support dilution. See P&IDs, One Line Diagrams, and General Arrangement drawings for current plant configuration.

Structures / Systems / Components	Status
Unit 2 and 3 Intake Conduits	Available
Unit 2 Discharge Conduit	Available
Unit 3 Discharge Conduit	Removed from Service
Unit 2 and 3 Gate Slots 1 and 2	Available
Unit 2 Recirculating Gates 4 and 5	Available
Unit 2 Circulating Water Pumps	Removed from Service
Unit 3 Circulating Water Pumps	Removed from Service

9.2.3.1.1 Design Bases

The circulating water system has no safety function. The portions that supported the condenser, Salt Water Cooling System, and Turbine Plant Cooling Water System have been removed from service. The portion required to support the functions of the Saltwater Dilution System remain available. The following design bases apply to the circulating water system in the permanent defueled plant condition:

A. Units 2 and 3 gates, slots 1 and 2, used to support the Saltwater Dilution System (SWDS) pump frames and pipe supports. Gate slots 1 and 2 are also required for dewatering the intake/outfall structures with the insertion of stop gates.

B. Units 2 and 3 intake conduits used for drawing Pacific Ocean water for dilution.

C. Unit 2 discharge conduit used for discharging diluted effluents to the Pacific Ocean.

D. Unit 2 Recirculating gates, in the closed position, to prevent recirculation of diluted effluents. No gate operators are required.

9.2.3.1.2 System Description and Operation

9.2.3.1.2.1 General Description

The portion of the circulating water system that remains in-service consists of Units 2 and 3 intake conduits, Unit 2 discharge conduit, Unit 2 Recirculating Gates 4 and 5 (in closed position), and the Units 2 and 3 Gate Slots 1 and 2. The system is shown on the following SCE controlled drawings.

40166A	40166C	40167B	40167D
40166ASO3	40166D	40167BSO3	40167DSO3
40166B	40167A	40167C	
40166BSO3	40167ASO3	40167CSO3	

9.2.3.1.2.2 Component Description

9.2.3.1.2.2.1 Intake and Discharge Structures

The offshore circulating water conduits are of reinforced concrete construction. One intake and conduit is provided for each unit. Only the Unit 2 discharge conduit is used for dilution. Each unit has one 18-foot ID intake conduit approximately 3200 feet long. The Unit 2 discharge conduit is approximately 8400 feet long. Approximately the last 2500 feet (offshore end) of the discharge conduit consists of a diffuser containing 63 discharge nozzles evenly spaced at 40-foot intervals. The nominal throat diameters are approximately 2 feet. The nozzles are oriented at a vertical angle of 20° above the horizontal and direct the discharge offshore alternatively at angles of 25° to the right and 25° to the left of the diffuser section centerline. The diffuser portion is progressively stepped down in diameter to balance the hydraulics of the flow in the diffusers and to produce a uniform discharge at each nozzle. The smallest diameter of the main conduit is 10 feet ID.

Circulating water system offshore intake structures are designed and constructed to withstand maximum uprush and withdrawal velocities of the current associated with the postulated tsunami discussed in Chapter 2.

Design and construction of the onshore intake structure is based on the maximum and minimum water levels at offshore intake structures associated with the postulated tsunami discussed in Chapter 2 with appropriate consideration given to head losses through the offshore conduit and intake structure.

9.2.3.1.2.3 Large Organism Exclusion Device (LOED)

A Large Organism Exclusion Device (LOED) is installed at the Primary Offshore Intake Structure (POIS) and Auxiliary Offshore Intake Structure (AOIS) as required by the State Water Resource Control Board (SWRCB) to prevent large marine organisms from entering the plant intake structures. The LOED uses a 9-in. x 9-in. netting constructed from ultra-high molecular weight (UHMW) polymer braided ropes.

9.2.3.1.2.4 System Operation

The portions of the Circulating Water System that support the Saltwater Dilution System are structures and have no active operation.

9.2.3.1.2.5 Safety Evaluation

The portions of the Circulating Water System that support the Saltwater Dilution System is not safety related and therefore no safety evaluation is provided.

9.2.3.2 SALTWATER DILUTION SYSTEM

The Saltwater Dilution System (SWDS) provides saltwater from the Pacific Ocean to the Unit 2 circulating water system outfall for diluting radiological and non-radiological effluents. The saltwater dilution system is common to both units. Two 50% capacity pumps are located in the Unit 2 circulating water system intake and two 50% capacity pumps are located in the Unit 3 circulating water system intake. However, all four pumps discharge to the Unit 2 circulating water system outfall gate slot #1. The pump discharge heads are located approximately 4-feet below 30-ft elevation in the gate slot #2 on the west road. The gate slots are also used for inserting stop gates to dewater the circulating water system intake structures. In the permanently defueled condition, the circulating water system is no longer in operation but portions of the circulating water system support the SWDS.

9.2.3.2.1 Design Bases

The design bases for the saltwater dilution system is as follows:

A. The saltwater dilution system is designed so that the dilution water flows may return to the Pacific Ocean via the Unit 2 circulating water system outfall through Unit 2 and Unit 3 independent piping systems. The circulating water system is discussed in Section 9.2.3.1.

B. The saltwater dilution system is designed to provide the minimum flow rate to meet the dilution factors. Dilution is discussed in Chapters 2 and 11 but controlled by the ODCM and NPDES permits.

C. The saltwater dilution system is also designed to provide dilution water supply for radiological effluent releases. Radiological effluent release point is discussed in Chapter 11.

D. The saltwater dilution system is designed to provide dilution water supply for non-radiological effluent releases. Non-radiological effluent releases consists of the North Industrial Area (NIA) sump discharge, the Sewage Treatment Plant (STP) discharge, and the Unit 2 Oily Waste Holding Sump discharge. The NIA sump, STP, and Unit 2 Oily Waste Holding Sumps are discussed in Section 9.3.1.

9.2.3.2.2 System Description

9.2.3.2.2.1 General Description

The saltwater dilution system is shown schematically in Controlled Drawings 40166B and 40166BSO3 which also shows a diagram of the intake structure and associated piping. The piping layout is shown on Controlled Drawing S2-1401-ML-369.

The saltwater dilution system for each unit consists of two completely independent piping systems (one for each unit) that discharge into a common point, the Pacific Ocean via the Unit 2 circulating water system outfall. Each piping system consist of two 50% capacity pumps, two check valves, two pressure gauges, and two pressure transmitters. All four pumps are required for liquid radwaste releases.

9.2.3.2.2.2 Component Description

9.2.3.2.2.2.1 Saltwater Dilution Pumps S2(3)1401MP128/129

Each 50% capacity pump is capable of providing a minimum required flowrate of 7,000 gal/min of dilution flow, taking into consideration low-low tide level, in the permanently defueled condition. The pumps are the vertical turbine type and are installed in the intake structure gate slot #2, two pumps per gate slot. All four pumps are powered by the same ring bus load center, LDC04.

The saltwater dilution pump packing and bearings are self-cooled and lubricated by the saltwater passing through the pump internals. The pump characteristics are:

Table 9.2-1

SALT WATER DILUTION PUMPS CHARACTERISTICS

Type	Vertical turbine
Design Flow	7,350 gal/min at 76°F
Design Head	50 feet
Performance Standard	ANSI/HI 14.6 14.6 Grade 1B

The saltwater dilution pumps are made of 316L stainless steel (impeller, columns, discharge head, bowl, and bell). The majority of the 316L components are coated to extend the life of the pump. The pump internals (shafts, shaft couplings, and shaft keys) are made of a duplex 2205 alloy. The pump bearings are made of thermoplastic with the exception of the suction bearing that is made of bronze packed in grease. The pump hardware is made of Monel K-500. The pump materials were carefully selected in order to meet a design life of 15 years while taking into consideration the severe corrosive environment and intermittent service.

9.2.3.2.2.2.2 Saltwater Dilution Motors S2(3)P128/129

Each saltwater dilution pump is coupled to an electric motor capable of providing 125 hp. The electric motors are equipped with a 120V space heater to keep the windings free of moisture during standby.

Table 9.2-2

SALT WATER DILUTION PUMPS MOTOR CHARACTERISTICS

Motor hp	125
Motor Speed	1200 rpm
Motor	60hz/460VAC/3phase
Enclosure	IP55 (TEFC)
Service Factor	1.15
Rotation	Both
Insulation Class	F
Temperature Rise (K)	80

9.2.3.2.2.2.3 Check Valves S2(3)1401MU374/375

Each saltwater dilution pump has a check valve at the discharge to prevent backflow when one pump is operating and the other is in standby. The check valves are made of 316L stainless steel to extend the life of the pump due to corrosion.

9.2.3.2.2.2.4 Piping

The saltwater dilution piping is made from 316L (seamless) stainless steel to extend the life of the piping due to corrosion. 317L weld filler material was used to enhance the weld chemical properties with the higher chromium content. Each pair of pumps discharge into independent 16" diameter piping and combine to a single 20" diameter piping where it then opens into the intake structure gate slot #1, approximately 3-feet below the grating. The piping layout is shown on Controlled Drawing S2-1401-ML-369.

9.2.3.2.2.2.5 Supports

The saltwater dilution piping supports are shown on Controlled Drawing S2-1401-ML-369. The pipe supports are made from A36 carbon steel, and coated with a marine grade epoxy coating to extend the life of the pipe support due to corrosion. The pipe supports are shared between both units; with the exception of pipe supports only required for Unit 3 piping.

The saltwater dilution pump frames are shown on Drawing 28813. The pipe supports are made from A36 carbon steel, and coated with a marine grade epoxy coating to extend the life of the frames due to corrosion.

The pipe supports and pump frame were designed to the 2013 California Uniform Building Code and ASCE 7-10 as documented in calculation 1814-AA021-C0145 and C0140, respectively.

9.2.3.2.2.2.6 Pressure Transmitters 2(3)PT0128/0129

Each pump has a pressure transmitter on the pump's discharge head that is used to calculate volumetric flowrate. The pressure transmitters send a 4-20 mA signal to the CDAS for pressure indication and for a low pressure alarm. The pressures are correlated into volumetric flowrate by calculation M-DSC-457 using the Bernoulli energy balance method. The low pressure setpoints are also calculated by this calculation and are set consistent with the ODCM. Depending on mode of operation (single vs dual pump operation), the setpoints are manually revised in CDAS.

The original ultrasonic flowmeter instrumentation are no longer maintained or used for SWD operation. However, until they fail, the ultrasonics will continue to read and CDAS will continue to record data [if available] for historical purposes.

9.2.3.2.2.3 System Operation

The saltwater dilution system was not an original system to San Onofre. The SWDS was installed under the Cold and Dark modifications for dilution effluents in the permanently defueled condition. In the permanently defueled condition, two saltwater dilution pumps are required to dilute radiological effluents, but only one is required for non-radiological effluents.

Each saltwater dilution pump motor is started using a hand switch located in load center LDC04. The pump has no throttling valve. A check valve prevents flow from being diverted back into the suction through the other pump on the same piping system. The same hand switch is used to secure the pump. The pumps are normally rotated to prevent aggravated pitting corrosion on the submerged components of the pumps. While in standby condition, the 120V motor space heaters keep moisture out of the motor windings. The space heater push buttons are located in panel HL04, adjacent to load center LDC04.

9.2.3.2.2.4 Safety Evaluation

The saltwater dilution system is not safety related and therefore no safety evaluation is provided.

9.2.4 REFERENCES

1. Wilson, Dr. B. W., "Estimate of Tsunami Effects at San Onofre Nuclear Generating Station, Units 2&3," December 1972.
2. Letter from Peter T. Dietrich to U.S. Nuclear Regulatory Commission, "Docket No. 50-361 Permanent Removal of Fuel from the Reactor Vessel San Onofre Nuclear Generating Station Unit 2," dated July 22, 2013.
3. Letter from Peter T. Dietrich to U.S. Nuclear Regulatory Commission, "Docket No. 50-362 Permanent Removal of Fuel from the Reactor Vessel San Onofre Nuclear Generating Station Unit 3," dated June 28, 2013.

9.3 PROCESS AUXILIARIES

Not all subsystems of Process Auxiliaries are required to support permanent plant shutdown or defueled operations. The status of these subsystems is listed in the table below. Design Basis, Licensing Basis, and operational information contained in this section has been updated to reflect the current status. Although the subsystems removed or partially removed from service no longer support operation, they may still contain fluids, gases, or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration.

System	Status
Compressed Air System	Removed from Service
Process Sampling System	Removed from Service
Sump and Drain Systems	Partially Removed from Service
Chemical and Volume Control System	Removed from Service
Hydrogen System	Removed from Service
Post-Accident Sampling System	Removed from Service
Reactor Coolant Gas Vent System	Removed from Service

9.3.1 SUMP AND DRAIN SYSTEMS

Portions of the Sump and Drain Systems are required in the permanently defueled condition. The sumps and drains systems consist of collection piping, equipment drains, floor drains, vents, traps (in nonradioactive systems only), cleanouts, oil separators, and the collection sumps. Portions of the Sump and Drain Systems have been removed from service. The applicable operational information has been removed to indicate that the system performs no licensing bases or design bases function. Although portions of the system do not support operation, the system may still contain fluids, gases or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See P&IDs, One Line Diagrams, and General Arrangement drawings for current plant configuration.

Structures / Systems / Components	Status
Diesel Generator Building Sump (Non-Radioactive)	Available
Intake Structure Area Sump (Non-Radioactive)	Available
Oily Waste Sump (Non-Radioactive)	Available
Storm Drainage (Non-Radioactive)	Available
Sanitary Drainage and Sewage Treatment Plant (Non-Radioactive)	Available
South Yard Facility Interceptor (Non-Radioactive)	Available
East and West Oily Waste Holding Sump (Non-Radioactive)	Available

Structures / Systems / Components	Status
MSIV Area Sump [Rain Water] (Non-Radioactive)	Available
Component Cooling Water Area Sump (Radioactive)	Partially Removed from Service*
Containment Area Sump (Radioactive)	Partially Removed from Service*
Fuel Handling Building Area Sump (Radioactive)	Available
Penetration Building Area Sump (Radioactive)	Available
Safety Injection Area Sump (Radioactive)	Available
Storage Tank Area Sump (Radioactive)	Partially Removed from Service*
Auxiliary (Control) Building Area Sump (normally non-radioactive)	Available
Radwaste Area Sump (Radioactive)	Available
East Turbine Building Area Sump (normally non-radioactive)	Available
West Turbine Building Area Sump (normally non-radioactive)	Available
North Industrial Area Sump (normally non-radioactive)	Available
BPS Neutralization Sump [Holding] (normally non-radioactive)	Available
South Yard Facility Decon Tank and Sump (normally non-radioactive)	Available

*Since collection of fluids in these sumps is unlikely, the pumps have been removed.

9.3.1.1 Design Bases

The design bases for the sump and drain systems are as follows:

A. The design and arrangement of the nonradioactive drainage systems ensure that potentially radioactive materials will be diverted to the radioactive sumps if contamination should occur. In some cases this is ensured by administrative means.

B. The radioactive sumps and drain system collects potentially radioactive liquid wastes, at atmospheric pressure, from equipment and flood drainage of the radwaste building, fuel handling building, Unit 2 East Turbine Building sump (if contaminated), penetration area, and the safety injection area. Processing of liquid radwaste is discussed in Chapter 11.

C. Systems that are not potentially radioactive are provided for the collection and disposal of storm drainage, oily waste, sanitary drainage, and clear water waste. Water is separated from oil and sediment using the East Oily Waste Holding Sump separator.

D. Sump pumps are designed to discharge at a flowrate adequate for preventing sump overflow during normally anticipated drainage periods. During heavy rain, the Turbine Building Sumps may overflow onto the condensate system pipe trench and water will accumulate temporarily on the floor of the 7' elevation of the turbine building. Flooding of the condensate system pipe trench and 7' elevation of the turbine building is inconsequential as there is no operating equipment that would be impacted by flooding (non-essential operating equipment protected by pedestals/berms) and/or there are no areas requiring access for operator action in the permanently defueled condition.

E. The sumps for potentially radioactive drainage are fitted with covers and liners (except as noted).

Codes and standards applicable to the floor drainage systems are listed in Controlled Document 90034, "Q-List." Generally, equipment and floor drainage collection piping from the areas of potential radioactivity is constructed in accordance with ANSI B31.1.0. All other drainage systems comply with the requirements of the Uniform Plumbing Code.

9.3.1.2 System Description

9.3.1.2.1 General Description

The arrangement for nonradioactive drain systems is such that they only serve areas where no radioactivity is expected. The nature of the sanitary waste system makes it unlikely that radioactive wastes would enter through this path. The Unit 2 and 3 area storm drain system are conveyed to the Units 2 and 3 circulating water system intake.

In the permanently defueled condition, the MSIV sump is used for collection and discharge of rain water and does not have the potential to become radioactive, but discharges into the respective unit's East Turbine Building sump that has a monitored release path.

The North Industrial Area (NIA) Yard Sump effluents are only conveyed to the Unit 2 circulating water system outfall. The NIA yard sump is normally non-radioactive. However, due to historical contamination events, the NIA discharge path is monitored as described in Section 9.3.1.2.3.2 G.

The arrangement for potentially radioactive drain systems is such that they serve areas where radioactivity is not normally expected, but has the potential to become contaminated. The radwaste area sump collects radioactive and potentially radioactive water from various sources.

Several non-radioactive and potentially radioactive drains and sumps discharge into the Unit 2 East Turbine Building Sump. The Unit 2 East Turbine Building sump discharge is monitored for radioactivity with radiation monitor 2RE7821. If radioactivity is detected, the radiation monitor alarms to CDAS and trips the sump pumps. The contaminated water is manually diverted to the radwaste area sump for processing. Processing of liquid radwaste is discussed in Chapter 11.

If no radioactivity is detected, the Unit 2 East Turbine Building sump normally discharges to the East Oily Waste Holding Sump where oil and sediment is separated [nonradioactive contaminants] and conveyed to the storm drains that discharge into the Unit 2 circulating water system intake.

9.3.1.2.2 Component Description

9.3.1.2.2.1 Cleanouts

In all collection system piping from areas of potential radioactivity, cleanouts are provided, when practicable, at the base of each vertical riser, where the change of direction in horizontal runs is 90º, at offsets where the aggregate change is 135º or greater, and at maximum intervals of 50 feet. Cleanouts are welded directly to the piping and located with their access covers flush with the finished floor or wall.

9.3.1.2.2.2 Equipment Drains

Drain lines from equipment that may be pressurized during drainage, and where the flow is by a direct or indirect connection to the floor drain system, are equipped with valves that may be throttled, so that the equipment discharge flow will not exceed the gravity flow capacity of the drainage header at atmospheric pressure.

9.3.1.2.2.3 Floor Drains

All floor drains are installed with rims flush with the low-point elevation of the finished floor. Floor drains in areas of potential radioactivity are welded directly to the collection piping. Floor drains in areas where there is no potential for radioactivity are provided with caulked or threaded connections.

9.3.1.2.2.4 Traps

Inlets to all drainage systems, except those in areas of potential radioactivity and those in storm drainage and gravity collection service, are provided with a water seal in the form of a vented P-trap to minimize entry into the building of vermin, foul odors, and toxic, corrosive, or flammable vapors. Air pressure vent lines to the outside atmosphere are provided downstream of the P-traps to prevent excessive backpressures that could cause blowout or siphonage of the water seal. Traps are not installed at inlets in areas of potential radioactivity in order to preclude either a potential for an accumulation of radioactivity in the trap or difficult maintenance of seal water level.

9.3.1.2.2.5 Collection Piping

In areas of potential radioactivity, the collection system piping for the liquid system is stainless steel. Potentially radioactive chemical waste and detergent waste collection system piping is stainless steel. Where necessary to vent potentially radioactive liquid waste collection systems, connections are provided to the gaseous radwaste system. Offsets in the piping are provided where necessary for radiation shielding. The fabrication and installation of the piping provides for a uniform slope that induces waste to flow in the piping at a velocity of not less than 2 ft/s. Equipment drainage piping is terminated not less than one and one-half nominal pipe diameters above the finished floor or drain receiver at each location where the discharge from equipment is to be collected. The final connections are made after the equipment is installed in its proper location.

9.3.1.2.2.6 Pumps

Redundant sump pumps are provided in the Unit 2 East Turbine Building and Fuel Handling Building sumps. Other area sumps are fitted with a single pump. Individual pump capacities are determined by the expected normal maximum inflow from the associated drainage subsystem. Pumps are capable of starting eight times per hour for one day without damage. Pumps are submersible with local control (auto/manual/off).

9.3.1.2.2.7 Leakage Detection

A. Spent Fuel Pool

   There are 59 separate 3/4 inch lines located on the spent fuel pool liner plate that discharge to the spent fuel pool leak detection compartment located inside the fuel handling building. This arrangement allows the operator to determine which area of the liner plate may be leaking and to take corrective action if warranted. The spent fuel pool leak detection compartment discharges to the fuel handling building sump.

B. Radwaste Area

   Each separate drain header in the radwaste area discharges to a leak detection compartment located in the radwaste area sump room. In addition there are local sumps located outside of tank and filter rooms.

9.3.1.2.2.8 Collection Sumps

Portions of some systems, which are at too low an elevation-to-drain by gravity to the designated collection point, drain to a collection sump from which the waste is pumped to an elevation sufficient to enter the gravity drainage portion of that system from above.

The various sump parameters are tabulated in Table 9.3.4.

9.3.1.2.3 System Operation

The various subsystems drain directly to the appropriate collection point by gravity. Sump pumps have two options; they can be started manually or automatically. The subsystems and their operation are described in subsequent paragraphs according to their classification as nonradioactive or potentially radioactive.

Manual operation of the sump pumps is maintained when needed for the following purposes:

- Analysis for chemical and radioactivity contamination
- Prevent overflow of radwaste sump
- Prevent oil contamination of radwaste sump
- Leakage observation and leakage source determination

The following sump pumps are normally controlled in automatic operation via a float-type switch. The control circuit provides the ability for manual operation. When the sump level rises to a preset point, action of the float switch (integral to the pump) starts the pump.

- Diesel Generator Building Sump (Unit 3 Only)
- Intake Structure Area Sump
- Oily Waste Sumps
- Sanitary Drainage and Sewage Treatment Plant
- MSIV Area Sumps
- Fuel Handling Building Area Sump
- Penetration Building Area Sump
- Safety Injection Area Sump
- Auxiliary (Control) Building Area Sump
- Radwaste Area Sump
- East Turbine Building Area Sumps
- West Turbine Building Area Sumps
- BPS Neutralization Sumps (repurposed as an additional holding sump)

The East and West Oily Waste Holding Sumps do not have pumps. A temporary submersible pump is used and manually controlled for the West Oily Waste Holding Sump. The West sump is normally empty and only used for a few conditions as described in Section 9.3.1.2.3.1 H.

The North Industrial Area Yard Drain Sump pumps are operated automatically, as described in Section 9.3.1.2.3.2 G.

The Radwaste Area Sump, Unit 2 East Turbine Building Area sump, the Auxiliary Building Area Sump, the North Industrial Area Yard Drain sump, and the East and West Oily Waste Holding Sumps are shared by Unit 2 and Unit 3. All other areas have identical sumps and sump pumps in each unit.

9.3.1.2.3.1 Nonradioactive Sumps

A. Diesel Generator Building Sump (MW832)

The Diesel Generator Building Sumps are located just outside the diesel generator building. It collects normal equipment and floor drainage from this area. Only the Unit 3 Diesel Generator Building sump has a permanently installed submersible sump pump. If required to transfer contents out of the Unit 2 Diesel Generator Building sump, a temporary submersible pump is placed in service and discharges to the East Oily Waste Holding Sump. The Unit 3 sump pump discharges into the Unit 3 East Turbine Building Sump.

B. Intake Structure Area Sump (MW833)

The Intake Structure Area Sumps are located in the intake structure area and collects normal equipment and floor drainage. Each unit is provided with one submersible pump. The sump pumps normally discharge to the East Oily Waste Holding Sumps but can also discharge to the West Oily Waste Holding Sump.

C. Oily Waste Sump (MW834)

The Oily Waste Sumps are located near the unit circulating water system gates on elevation 30-ft. The sump collects drainage from the following areas:

- Area equipment and floor drains
- Clean and Dirty Lube Oil Storage Tank Area

Each unit is provided with one submersible pump. Both unit's sump pumps normally discharge into the Unit 2 East Oily Waste Holding Sumps where it is processed of oil contaminants (nonradioactive) and released to the Unit 2 circulating water system intake via storm drains. Alternatively, the sump pumps can discharge into the Unit 2 West Oily Waste Holding sump.

D. Storm Drainage

The Unit 2 and 3 storm drainage system collects water resulting from precipitation on all Unit 2 and 3 building roofs and areaways, paved and unpaved surfaces, and irrigation runoffs outside the buildings and conveys it to the intake structure.

E. Sanitary Drainage and Sewage Treatment Plant

The sanitary drainage system collects liquid wastes and some entrained solids discharged by all plumbing fixtures located in areas not sources of potentially radioactive waste, and conveys them to the plant sanitary waste treatment system. The Sewage Treatment Plant (STP) is located in the North Industrial Area. The sewage treatment plant overflow is routed to the NIA sump. The STP discharges to the Unit 2 circulating water system outfall.

Table 9.3-4
SUMP PARAMETERS

Sump	Project Classifi-cation	Elevation		Dimensions (ft) Long x Wide x Deep	Pump Capacity (gal/min)	Pump Head (ft)	Gorman-Rupp Pump Curve	Remarks
		ft.	in.					
Nonradioactive:								
Diesel generator building	32C*	30	0	4.5x5.5x6.0	95	20	S2F-E1-1	See Note 1 for Unit 3
Intake structure area	43C*	(-)7	5	(9.0x9.6x11.3x8.0)x15.0	275	58	S3B-1	Trapezoidal-plan dimensions, Note 1
Oily waste area sump	43C*	30	0	14.5x18.0x21.1	145	80	S3A-1	Note 1
South Yard Facility oil Interceptor	-	104	6	21.25x13x13.25 (inches)	-	-	N/A	Dimensions are in inches
MSIV Area Sump	43C*	18	0	(trench)	105	50	S2E-1	Notes 1 and 3
East and West Oily Waste Holding Sumps	43C*	30	0	multiple	N/A	N/A	N/A	Note 4
Sewage Treatment Plant (STP)	-	14	0	N/A	N/A	N/A	N/A	100,000 GPD capacity
Potentially radioactive:								
Fuel handling building	32ND	17	6	4.5x5.5x6.0	95	20	S2F-E1-1	Note 1
Penetration area	32ND	9	0	4.5x5.5x6.0	85	25	S2F-E1-1	Note 1
Safety injection area	32ND	(-)15	6	9.5x7.5x9.0	45	65	S2E-1	Note 1
Auxiliary building	32C*	9	0	4.5x5.5x6.0	85	25	S2F-E1-1	Notes 1 and 2
BPS Neutralization Sump (holding)	43C*	7	0	12x30x8	115	35	S2B-1	Notes 1 and 5
Radwaste area	32ND	9	0	14.0x16.0x15.0	100	40	S2B-1	Note 1

Table 9.3-4
SUMP PARAMETERS (cont.)

Sump	Project Classification	Elevation		Dimensions (ft) Long x Wide x Deep	Pump Capacity (gal/min)	Pump Head (ft)	Gorman-Rupp Pump Curve	Remarks
		ft.	in.					
South Yard Facility decon sump	-	105	0	6.0x6.0x4.0	80	12	N/A	Note 2
South Yard Facility decon Shower tank	-	105	6	(100 gallons)	N/A	N/A	N/A	
Unit 2 East turbine plant area	32C*	7	0	4.5x5.5x8.0	250	95	S4C-1	Notes 1 and 2
Unit 3 East turbine plant area	32C*	7	0	4.5x5.5x8.0	115	35	S2B-1	Notes 1 and 2
Unit 2 and 3 West turbine plant area	32C*	7	0	4.5x5.5x6.0	165	20	S2B-1	Notes 1 and 2
North Industrial Area Yard Drain Sump	43C*	15	0	19x43x14	2000 4000	100 60	N/A	Controls and discharge piping are 32ND

Notes:

1. Flow will vary depending on operating condition (variable system demand).
2. No liner is required.
3. MSIV area sump is for collection of rain water; non-radioactive sump that discharges into a monitored path 2RE7821.
4. A temporary submersible sump is used to manually transfer to the east oily waste holding sump. Treated water from east sump empties into the Unit 2 storm drains by way of overflow. The storm drains empty into the Unit 2 circulating water system intake. Releases are unmonitored.
5. Repurposed as a holding sump for potentially radioactive liquids.

F. South Yard Facility Oil Interceptor

The oil interceptor is located in the cold machine shop. It collects floor water from this area. The oil is manually cleaned and the water is gravity discharged to the sewer system. The South Yard Facility Oil Interceptor is not shown on Control Room / Command Center drawings. See Controlled Drawing 48716 for aerial view of oil interceptor (OI-1).

G. MSIV Area Sump (MW848)

In the permanently defueled condition, the Units 2 and 3 MSIV Area Sumps do not have the potential to become contaminated. The MSIV Area sump is used for collection of rain water in the MSIV area. Each unit is provided with one submersible pump. The sump pump discharges into its respective unit's East Turbine Building Sump.

H. East and West Oily Waste Holding Sump and Oil Separator (MW1251)

The East and West Oily Waste Holding Sumps are unique to Unit 2 and located in front of the Unit 2 Emergency Diesel Generator Building on elevation 30-ft. The east sump's two incoming collection lines are equipped with commercial syphon breakers to prevent syphoning. The west sump's single collection line does not require a syphon breaker.

The East and West Oily Waste Holding Sumps receive and hold liquids from the following:

- Either unit's Oily Waste Sumps
- Either unit's Intake Structure Sumps
- Unit 2 East Turbine Building Sump (if not contaminated)
- Unit 2 Diesel Generator Building (east sump only)

The East Oily Waste Holding sumps provide water separation from oil and sediments and discharge to:

- Storm drain that conveys to Unit 2 circulating water system intake (via overflow of treated water)
- Truck Disposal

The West Oily Waste Holding Sump is not normally used and is intended for the temporary storage of oily waste water awaiting processing. The west sump is normally empty. It could be used in situations where processing facilities are not available or drainage exceeds processing capabilities. The west sump could also be used to store waste water that has emulsions or chemicals which cannot be treated. The west sump is manually pumped, with temporary submersible pumps, to transfer water to the East Oily Waste Holding Sump.

The East Oily Waste Holding Sump is to provide for the normal processing of oily waste water. The sump has an oil water separator and is divided into multiple areas:

- Inlet pool is where oily waste water enters the system for processing. The inlet pool capacity is approximately 375 gal/in. The inlet pool's overflow weir has a normally closed drain valve which is operated via reach rod to allow draining.
- The oil separator assemblies has three racks; one coalescer and two separators, all divided into six equal areas. Oil and water weir separator height is 95" with approximately 24" below for sludge storage.
- Oil and water weirs are used in directing oil and water into the proper storage section. The oil weir is 1-1/2" higher than the water weir to provide a maximum water capacity of 400 gpm.
- An oil storage section for separated oil is provided for transferring separated oil to a tanker truck for disposal. The oil storage section capacity is 10,500 gallons (875 gals/foot x 12 feet).
- Treated water is temporarily stored and empties into the storm drain (by overflow). The storm drains convey into the Unit 2 circulating water system intake.

The raw water containing oil and sediments passes in the horizontal direction between the closely spaced plates in the pack. Laminar flow conditions are established while the water flows across the pack from the inlet to the outlet side. Laminar flow conditions are essential conditions for the effective separation of the oil, water, and solids. In the course of passing from the pack inlet to pack outlet, the oil rises to the top of the plates and slides up the incline of the plate to the top of the process tank and the solids settle to the bottom of the plates and slide down the incline to the bottom of the process tank.

9.3.1.2.3.2 Potentially Radioactive Sumps

A. Fuel Handling Building Sump (MW841)

This sump is located in the fuel handling building and collects normal and potentially radioactive equipment and floor drainage. The pumps discharge to the radwaste area sump. Pump control switches are installed locally.

B. Penetration Area Sump (MW842)

This sump is located in the penetration area between the containment and the fuel handling building, and collects normal and potentially radioactive equipment and floor drainage. The pumps discharge to the radwaste area sump. Pump control switches are mounted locally.

C. Safety Injection Area Sump (MW843)

This sump is located in the safety equipment building on the safety injection side. It collects normal and potentially radioactive equipment and floor drainage from this area plus some potential ground water intrusion. The pumps discharge to the radwaste area sump. Pump control switches are mounted locally.

D. Auxiliary Building Sump (SA2419AUXSUMP)

This sump is located on the Control Room / Command Center side of the auxiliary building, and collects normal and potentially radioactive equipment and floor drainage from the area. The pump discharges to Unit 2 East Turbine Plant Area Sump. Sump pump control switches are mounted locally.

E. Radwaste Area Sump (MW845)

This sump is located in the radwaste building. It collects all normal and potentially radioactive equipment and floor drainage from the radwaste building, the discharge from all potentially radioactive sumps as discussed above, and from the Unit 2 East Turbine Building Sump if it becomes contaminated. The radwaste sump pumps discharge to the chemical waste tanks T-064. The chemical waste tank and processing of liquid radwaste is discussing in Chapter 11. Pump control switches are mounted locally.

F. East (MW835) and West (MW836) Turbine Plant Area Sumps

These sumps collect all normal equipment and floor drainage from the turbine plant area.

Additionally, the Units 2 and 3 East Turbine Building sumps have been repurposed in the permanently defueled condition for the following functions.

The Unit 2 East Turbine Building sump also collects drainage from the following:

- Unit 2 MSIV area sump
- Unit 2 BPS sump
- Unit 2 West Turbine Plant Area sump
- Common Auxiliary Building sump

The Unit 3 East Turbine Building sump also collects drainage from the following:

- Unit 3 MSIV area sump
- Unit 3 BPS sump
- Unit 3 West Turbine Plant Area sump
- Common Auxiliary Building sump

- Unit 3 Diesel Generator Building sump

In the permanently defueled condition, the Unit 3 East Turbine Building sump pump discharges into the Unit 2 East Turbine Building sump.

The Unit 2 East Turbine Building sump pump normally discharges into the East Oily Waste Holding Sump for processing (nonradioactive). An alternate alignment would be to the West Oily Waste Holding Sump which is normally empty. The East Oily Waste Holding sump separates water from oil and sediments. Treated water overflows into the storm drains that empty into the Unit 2 circulating system intake.

However, if the Unit 2 East Turbine Building sump should become contaminated, radiation monitor 2RE7821 alarms on high radiation level to the CDAS and trips the Unit 2 East Turbine Building Sump pumps. The discharge is manually diverted to the Radwaste Area Sump for processing. Processing of liquid radwaste is discussed in Chapter 11.

G. North Industrial Area Yard Drain Sump (MW828)

This sump collects water resulting from precipitation on paved and unpaved surfaces within the North Industrial Area (formerly Unit 1 yard area), areas near the AWS building, the sewage treatment plant overflow and dewatering of ground water from Unit 1 decommissioning. The sump normally discharges to the Unit 2 outfall. Because of contamination events at Unit 1, the yard drain sump is credited as a liquid radioactive effluent release point and equipped with a continuous radiation monitor. The sump radiation monitor alarms on high radiation level and stops the pump(s).

The sump has two pumps of different capacity which do not run simultaneously. The smaller pump will manage normal rainfall. The larger pump will manage up to a 50 year storm. The pumps are normally controlled in automatic operation. An ultrasonic-type level indicating controller controls the sump pumps. When the sump level rises to a preset point, actuation of the first ultrasonic level controller setpoint starts the small pump. When the pump lowers the sump level to a point just above the pump volute, the ultrasonic level setpoint resets, stopping the pump. If the level continues to rise, a second ultrasonic level controller setpoint starts the larger pump and stops the smaller pump. If the level still continues to rise, a third setpoint of the ultrasonic level controller actuates an alarm in the Control Room / Command Center which advises the operators of a potential flooding condition. After the pump lowers the sump level to a preset point, the ultrasonic level setpoint resets, stops the large pump and restarts the small pump. The ultrasonic level switch is configured such that a loss of instrument power or instrument failure will cause a trouble alarm, alerting the operators of a malfunction.

The sump is a reinforced concrete structure designed in accordance with Uniform Building Code. It has a cover and is not lined. The sump inlet piping is PVC and the discharge is Stainless Steel.

H. BPS Neutralization Sump (MW846)

In the permanent defueled condition, the Units 2 and 3 BPS neutralization sumps have been repurposed as additional holding sumps for storing potentially radioactive water if the normal process sumps are full or unavailable. The sump has an operating volume of approximately 17,000 gallons, 2 HP pump motors, and sump pumps rated at approximately 180 gal/min at 10 feet of total developed head. The sump pumps discharge to the East Turbine Plant Sump. As additional sump volume is required, other sumps will discharge into this sump using portable submersible pumps.

I. South Yard Facility Decon Tank and Sump

The South Yard Facility Decon Sump and pump are not shown on Control Room / Command Center drawings. See Controlled Drawing 48717 for piping isometric of decon area sump, pump (P-1/P-001), and the connection to the sewer line.

All potentially radioactive liquids generated in the South Yard Facility Building are routed to a sump located in the Decontamination Shop. Liquids from the areas of the building that are designed for processing radioactive materials reach the sump from the floor. Liquids from the Decon Shower are collected in a tank and trucked to the plant for release through a credited liquid effluent release point, such as the Turbine Plant Sump.

Water collected in the Decon Sump is mixed, sampled, and normally discharged to the sanitary sewer system in the South Yard. However, when activity is detected, the sump is drained and transported to a credited liquid effluent release point, such as the Turbine Plant Sump, for release.

9.3.1.3 Safety Evaluation

An evaluation of radiological considerations for normal operation and postulated spills and accidents is presented in Chapters 11 and 15.

9.3.1.4 Tests and Inspections

9.3.1.4.1 Preoperational Testing

All waste collection systems from areas of no radioactivity potential were tested for 15 minutes at a hydrostatic test pressure equal to a 10-foot head of water. All collection systems from areas with a radioactivity potential are hydrostatically tested to 15 lb/in.^{2}g in accordance with ANSI B31.1.0.

9.3.1.4.2 Operational Testing Capability

The operability of equipment and floor drainage systems dependent on gravity flow can be checked by normal usage. Portions of these systems, dependent upon pumps to raise liquid waste to gravity drains, may be checked through instrumentation and alarm registry in the Control Room / Command Center.

9.3.1.5 Instrumentation Applications

For leak detection purposes, a level alarm is provided in the CDAS for the Fuel Handling Building Sump and the Radwaste Building Sump levels.

9.3.2 REFERENCES

1. National Pollution Discharge Elimination System (NPDES) Permit CA0109282, Order No. R9-2015-0073, December 16, 2015.

9.4 HEATING, VENTILATING, COOLING, AND AIR CONDITIONING SYSTEMS

Not all subsystems of the Heating, Ventilating, Cooling, and Air Conditioning Systems are required to support permanent plant shutdown or defueled operations. The status of these subsystems is listed in the table below. Design Basis, Licensing Basis, and operational information contained in this section has been updated to reflect the current status. Although the subsystems removed or partially removed from service no longer support operation, they may still contain fluids, gases, or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration.

Systems	Status
Containment Building Ventilation Systems	Removed from Service
Auxiliary Building Heating, Ventilating, and Air Conditioning Systems	Partially Removed from Service
Support Building Ventilation Systems	Partially Removed from Service

This section describes the air conditioning, heating, cooling, and ventilation systems employed in the containment building, auxiliary building, and support buildings and structures. The outside ambient air temperatures used as the basis for all heating, ventilation, and air conditioning (HVAC) system designs are 36°F minimum and 85°F maximum except for the South Yard Facility building which uses 35°F minimum.

9.4.1 CONTAINMENT BUILDING VENTILATION SYSTEMS

The Containment Building Ventilation Systems have been removed from service as indicated in the table below.

Systems	Status
Containment Normal Cooling System	Removed from Service
Large Volume Purge and Recirculation Cleanup System	Removed from Service
CEDM Cooling System	Removed from Service
Reactor Cavity Cooling System	Removed from Service
Lower-Level Circulation System	Removed from Service
Tendon Gallery Ventilation System	Removed from Service
Mini-Purge System	Removed from Service
MSIV Enclosure and Penetration Area Cooling System	Removed from Service
Containment Emergency Cooling Units	Removed from Service
Dome Air Circulating Units	Removed from Service

9.4.2 AUXILIARY BUILDING HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS

The normal and emergency auxiliary building HVAC systems are discussed in this subsection. Normal auxiliary building HVAC systems include several subsystems and ducting that serve the various areas of the auxiliary building. Emergency auxiliary building ventilation systems include ventilating, and air conditioning subsystems that service the auxiliary building. Following is the status of these systems.

Systems	Status
Normal Auxiliary Building HVAC Systems	Partially Removed from Service
Emergency Auxiliary Building HVAC Systems	Partially Removed from Service
Normal Chilled Water System	Removed from Service
Emergency Chilled Water System	Removed from Service
Chilled Water System (New)	Available

9.4.2.1 Normal Operation - Auxiliary Building HVAC Systems

The auxiliary building HVAC systems are described in this subsection.

9.4.2.1.1 Design Bases

The auxiliary building normal HVAC system is designed to:

A. Maintain the ambient air temperature at a level which permits continuous personnel comfort and equipment safety and operation.

B. Minimize the possibility of exfiltration from the radwaste area, the turbine laboratory located in the Control Room / Command Center complex, the control access area located in the health physics and locker rooms, and the battery rooms.

C. Prevent combustible concentrations of hydrogen gas from accumulating within the battery rooms.

D. Not collapse and cause damage to safety-related equipment during a design basis seismic event.

E. Maintain the space design conditions presented in Table 9.4-4.

Codes and standards applicable to the auxiliary building HVAC system are listed in Controlled Document 90034, “Q-List.”

Table 9.4-4

NORMAL OPERATION - AUXILIARY BUILDING HVAC SPACE DESIGN CONDITIONS

	Elevation			Temperature (°F)	
System	(ft)	(in)	Type[a]	Summer (Dry Bulb)	Winter (Dry Bulb)
Control Room / Command Center Mezzanine Level	30 39	0 2	VAC	80 and 65% RH[a] (max)*	68
Central Alarm Station	30	0	VAC	80 and 65% RH (max)*	68
Computer room	30	0	VAC	80 and 65% RH (max)*	68
Public Address and Radio Room and Communications Equipment Room	9	0	VAC	85 (cooling mode) 104 (max)	70
ESF[c] switchgear rooms, Lobby/Corridors West, and Vital Power/Distribution rooms	50	0	V	104 (max)	50
Radwaste area – General			V	104 (max)	50
Battery rooms	9 50	0 0	V V	104 (max)	77 77[b]
Chiller rooms	9	0	V	95	50
Health physics Zone I	70	0	HVAC	80*	68
Health physics Zone II	70	0	HVAC	80*	68
Communication Room	70	0	AC	85(normal), 95(max)	50

a) HVAC-Heating, ventilating, air conditioning; AC-Air conditioning; HV-Heating and ventilating; V-Ventilation; RH-Relative Humidity
b) Max annual average battery temp = 77°F.
c) The term Engineered Safety Feature (ESF – here and elsewhere in this chapter) is used for historical descriptive purposes only. In the permanently defueled condition there are no ESF systems.
* California Building Code.

9.4.2.1.2 System Description

9.4.2.1.2.1 General Description

The auxiliary building HVAC systems are shown on the following controlled drawings.

40082	40099	40174A	40177B
40083	40173A	40174ASO3	40177BSO3
40084	40173ASO3	40174B	40177C
40085	40173B	40174C	40178A
40095	40173C	40174CSO3	40178ASO3
40096	40173D	40177A	40178B
40097	40173DSO3	40177ASO3	40178BSO3

These HVAC systems consist of the following:

- Heating, ventilating, and air conditioning systems for Health Physics Zones I and II.
- Ventilating and air conditioning systems for the following areas:
    - Control Room / Command Center complex
    - Public Address and Radio Room and Communications Equipment Room
    - Communication Room
    - Radwaste Room 337 on 37 ft elevation.
- Ventilation systems for the following areas:
    - ESF Switchgear Rooms
    - Chiller Rooms
    - Battery Rooms
    - Radwaste Area
- Continuous exhaust system

Following is a description by area.

A. Control Room / Command Center Complex

The Control Room / Command Center complex includes the Control Room / Command Center, Control Room / Command Center cabinet area, computer rooms, turbine lab, and other facilities at the 30 ft elevation needed to support operations personnel in their day to day activities, as well as in the event of an accident. The mezzanine area including all areas at elevation 39 ft 2 in., is also part of the Control Room / Command Center complex. The mezzanine area does not require operator access.

The Control Room / Command Center VAC system is common to both Units 2 and 3 and is arranged for ease of access, control, and monitoring. The VAC unit is located at the 9 ft elevation. There is also a duct heater upstream of the ventilation unit. The duct heater and ventilation unit are discussed in Section 9.4.2.2.

The Control Room / Command Center is maintained at positive pressure compared to ambient and the other non-radioactive air conditioned areas are maintained at a slightly positive pressure compared to ambient while potentially contaminated areas are maintained at a slightly negative pressure compared to ambient. The turbine laboratory hood exhaust is directed to the plant vent stack through the plant continuous exhaust system.

B. Radwaste Area

Two (2) air handling units and two (2) exhaust fans, located at elevation 85 ft, serve the radwaste area. The radwaste area is maintained at a slight negative pressure compared to ambient to minimize the possibility of exfiltration of building air to the outside atmosphere. The radwaste area ventilating system is common for Units 2 and 3.

Two (2) water cooled fan coils provide cooling to the Radwaste Building Room 337 on 37 ft elevation to offset the heat loads from transformers and other electrical equipment installed as part of the Cold and Dark power distribution system.

C. Elevation 50 ft Engineered Safety Feature (ESF) Switchgear rooms, Vital Power/Distribution rooms, Cable Spreading Galleries, Cable Riser Galleries, Battery rooms previously classified as non-Class 1E, Lobby, Motor Control Center, Evacuation Shutdown Panel room, HVAC room and Corridors.

A separate ventilation system is provided for each unit. The supply fans are located on the roof at elevation 85 ft. The exhaust fans are located at elevation 68 ft of the intake structure. The air distribution system is a once-through system. The SWGR rooms, Vital Power/Distribution rooms and the general areas are maintained at a slight positive pressure compared to ambient. However, battery rooms previously classified as non-Class 1E, which are being served by the previously classified Class 1E Battery rooms normal exhaust system, are maintained at a slight negative pressure compared to ambient.

In addition to the areas listed above, the Unit 2 ventilation system serves the Evacuation Shutdown Panel room and the Job Ticket Dispersal area and the Respirator Test Booth at elevation 70 ft (unique to Unit 2).

D. Health Physics Zones I and II

Health physics Zones I and II are located at elevation 70 ft. The air conditioning units are located at elevation 85 ft. Transfer fans and exhaust fans are located at elevation 70 ft of the auxiliary building.

The Health Physics Zone I area which includes the Hot Sample Lab, Radio Chem Lab, Radio Chem Instrument Lab, Radio Chem Counting Rooms, and Multi-Channel Analyzer (MCA) Lab are served by one air conditioning. The air conditioning unit consists of an air cooled condensing unit and an air handling unit equipped with pre-filter HEPA filters, electric heating coils, Direct Expansion (DX) cooling coils and fan. A portion of the air supplied to the MCA Lab, Radio Chem Lab, Radio Chem Instrument Lab and Hot Sample Lab including a small quantity of air from the ceiling space and the fume hoods in the Radio Chem Lab and Hot Sample Lab is exhausted through the continuous exhaust plenum to the plant vent stack.

A portion of the air supplied to the MCA Lab, Radio Chem Instrument Lab, Radio Chem Counting Rooms and HP Counting Room is returned to the air conditioning unit and mixed with the outside air stream for further cooling or heating.

The Health Physics Zone II area which includes Office Areas, Chemical Storage Area, Toilets, Kitchen, and vestibules is served by one air conditioning unit. The air supplied by this unit is exhausted to the atmosphere through exhaust fans A-150, 151, 152, 153 and 155, and to the plant vent stack via a transfer fan, A-154 serving the continuous exhaust plenum.

E. Public Address and Radio Room and Communications Equipment Room

Public Address and Radio Room and Communications Equipment Room and the air handling unit serving these rooms are located at elevation 9 ft. The Public Address and Radio Room and Communications Equipment Room are maintained at a slight positive pressure compared to ambient. This system is common to Units 2 and 3.

A communication room is located at elevation 70 ft and is served by two air handling units. One air handling unit is mounted in the room with the associated air cooled condenser mounted on the roof of the auxiliary building and the second air handling unit is mounted outside of the room (in the Cable Riser Gallery) with the associated air cooled condenser mounted on the roof of the auxiliary building. This system is common to Units 2 and 3.

F. Chiller Rooms

The chiller rooms and the ventilating unit are located at elevation 9 ft. The exhaust fan is located at elevation 50 ft of the intake structure. The chiller rooms are maintained at a slight negative pressure compared to ambient. This system is common to Units 2 and 3.

G. Battery Rooms

The ESF battery rooms are located at elevation 50 ft and no longer contain battery banks. A separate ventilating system is provided for each unit. The ventilation unit is located at elevation 85 ft of the auxiliary building. The exhaust fan is located at elevation 68 ft of the intake structure. This exhaust fan also serves the battery room previously classified as non-Class 1E at elevation 50 ft. The ESF battery rooms are maintained at slight negative pressure compared to ambient.

H. Continuous Exhaust System

The continuous exhaust system consists of a large plenum mounted on the auxiliary control building roof at elevation 98 ft. Two out of three fans are normally operating to provide the required boosting so that the plant gaseous effluent can be discharged to the plant vent stacks for dilution. This includes effluents coming from the Units 2 and 3 fuel handling buildings, from the Units 2 and 3 penetration buildings, radwaste building, control area turbine lab, control area fume hoods, and the control area health physics. The continuous exhaust plenum is maintained at a negative pressure, compared to ambient between (-) 3.0 to (-) 2.0 inches W.C. The plant vent stacks are continuously monitored for radioactivity.

I. Chilled Water

There is no chilled water system remaining at SONGS. Three HVAC units utilize remotely located chillers. These chillers are located as follows:

- E881 is a 45 ton chiller located on the roof of the Control Building. It services ME220 which cools the 70 ft. Control Building area.
- E882 is a 45 ton chiller located on the roof of the Fuel Handling Building. It serves ME883 and ME884 which cools the Electrical Distribution Room which is located on 37 ft. elevation of the Radwaste area.
- E888 is comprised of a 60 and 30 ton chiller located on the roof of the Unit 2 Salt Water Pump Building. They service ME295 which cools the Control Room / Command Center Complex and ME411 which cools the telecommunications rooms on the 9 ft. elevation of the Control Building.

9.4.2.1.2.2 Component Description

Design data for major components of the normal HVAC systems are listed in Table 9.4-5.

A. Control Room / Command Center Complex

The VAC system for the Control Room / Command Center complex consists of the following:

- Two outside air intakes
- One air handling unit
- Dampers
- Associated ductwork

The air handling unit consists of moderate- or high-efficiency pre-filters, a fan section, and a chilled water cooling coil. There is an electric duct heater upstream of the ventilation unit used (if required) during extreme cold temperatures. The duct heater and the ventilation unit are discussed in Section 9.4.2.2.

Chilled water to the air handling unit for the Control Room / Command Center complex is provided by chiller E888.

B. Radwaste Area

The ventilation system consists of two 50% air handling units and two 50% exhaust fans. Each air handling unit consists of moderate-efficiency pre-filters and fan section, backdraft and volume control dampers, and associated ductwork.

Two water cooled fan coils provide cooling to Radwaste Building Room 337 on 37 ft elevation. Chilled water is provided to the fan coils by an air-cooled chiller (E882) installed on the Fuel Handling Building roof. The cooling is sufficient to offset the heat loads from transformers and other electrical equipment installed as part of the Cold and Dark power distribution system.

The Truck Bay Area supply ducts and exhaust ducts are provided with motor operated dampers (8 total). These dampers are interlocked with the main truck door such that the truck door cannot be opened unless all dampers are closed.

C. Elevation 50 ft ESF Switchgear rooms, Vital Power/Distribution rooms, Cable Spreading Galleries, Cable Riser Galleries, Battery rooms previously classified as non-Class 1E, Lobbies, Motor Control Center, Evacuation Shutdown Panel Room, HVAC rooms, and Corridors.

The ventilation system serving the above areas consists of one air handling unit, one exhaust fan, outside air intake with volume control dampers, and associated ductwork. The air handling unit consists of a moderate efficiency pre-filter and fan section.

D. Health Physics Zones I and II

The HVAC system for the health physics area is divided into two zones. Zone I consists of one air conditioning unit. The air conditioning unit consists of an air cooled condensing unit and an air handling unit equipped with pre-filters, HEPA filters, electric heating coils, DX cooling coils and an air cooled condensing unit. The Zone I air conditioning system serves the Hot Sample Lab, Radio Chem Lab, Radio Chem Instrument Lab, Radio Chem Counting Rooms, HP Counting Room and MCA Lab. A portion of the air supplied to the MCA Lab, Radio Chem Lab, Radio Chem Instrument Lab and Hot Sample Lab and the fume hoods in the Radio Chem Lab and Hot Sample Lab, including a small quantity of air from the ceiling space, is exhausted through the continuous exhaust plenum to the plant vent stacks by the transfer exhaust fan. The balance of the supply air distributed to the rooms is conveyed through ducting back to the air conditioning unit and mixed with the outside air stream for further cooling or heating. The dose assessment computers are located in Radio Chem Counting Room 420.

The Zone II HVAC system is served by one air handling unit, ductwork, and five exhaust fans. The air handling unit consists of pre-filters, electric heating coils, chilled water cooling coils, and supply air fan. The following rooms/groups of rooms are being served by one exhaust fan complete with ductwork, volume control dampers, and louvers which discharge directly to the atmosphere.

A-153	Kitchen
A-150	REP and ALARA, Field Badge/TLD Issue, Electrical Test Admin and Electrical Test GRP
A-151	Lobby, corridors, chem storage, women's toilet, and chem storage
A-152	Radwaste and Decon, HP Tech work area, janitor, corridor, custodians, and men's toilet
A-155	Electrical SWGR, chem storage, OSC staging and multipurpose area

Transfer fan A-154 directs the air exhausted from the HP office, whole body counter, vestibule, corridor, chem storage, HP storage, HP and ICC, DPT, personnel decon and the space above the ceiling to the continuous exhaust plenum up to the plant vent stacks.

Chilled water to the air handling unit for the Health Physics Zone I is provided by chiller E881.

E. Public Address and Radio Room and Communications Equipment Room

The VAC system for the Public Address and Radio Room and Communications Equipment Room located at elevation 9 ft consists of one dual mode air handling/ventilation unit, supply and return ductwork, manually operated dampers, backdraft dampers, and relief dampers. The air handling units consist of moderate efficiency pre-filters, a chilled water cooling coil, and a fan. The Public Address and Radio Room and Communications Equipment Room are maintained at a slight positive pressure compared to ambient. Dampers, backdraft dampers, and relief dampers are also provided so that air supplied to the rooms can be diverted to the adjacent corridors. The air handling unit can also be used as a ventilation unit. In the ventilation mode, ventilation air will be extracted from Room 107, distributed to the rooms and be diverted to the adjacent corridors. The normal positions of the dampers and backdraft dampers located in the air distribution system are changed in order to operate the air handling unit as a ventilation unit.

The communications room located at elevation 70 ft of the auxiliary building is cooled by two split type air conditioning system. Each system consists of an (one in the room and one outside of the room) air cooled condensing unit mounted on the auxiliary building roof at elevation 85 ft, ductwork and controls. Each air handling unit consists of a medium efficiency pre-filter, a DX cooling coil, and fan section.

Chilled water to the air handling unit for the Public Address and Radio Room and Communications Equipment Room is provided by chiller E888.

F. Chiller Rooms

The ventilating system for the chiller rooms consists of one air handling unit, one exhaust fan, and associated ductwork. The ventilating unit consists of a moderate efficiency pre-filter and a fan section.

G. Battery Rooms

The ESF battery rooms located at elevation 50 ft of the auxiliary building no longer contain battery banks. Those rooms are served by two separate (one system per unit) ventilating systems, which consist of a supply air fan with moderate efficiency pre-filters, an exhaust fan, and associated ductwork. The one exhaust fan remains in-service for the Unit 3 battery room previously designated as non-Class 1E located at the 50 ft elevation. These rooms are maintained at a slight negative pressure compared to ambient.

H. Continuous Exhaust System

The continuous exhaust system is composed of three fans, three motor operated dampers, four manual shut-off dampers, associated ductwork, and controls.

I. Chilled Water

Chilled water is provided to the Control Room / Command Center complex and the Public Address and Radio Room and Communications Equipment Room air handling units (E295 and E411) cooling coils by air-cooled chillers (E888) installed on the roof of the salt water cooling pump room.

Chilled water is provided to the Health Physics Zone II air handling unit (E220) by an air-cooled 45 ton chiller (E881) installed on the roof of the Control Building 85 ft elevation. The air-cooled chiller also provides chilled water to the Cabinet Area air handling units (E423 and E426) discussed in Section 9.4.2.2.

Chilled water is provided to two water cooled fan coil units (E883 and E884) to the Radwaste Building Room 337 (new Cold & Dark switchgear room) on the 37 ft elevation by an air-cooled 45 ton chiller (E882) installed on the roof of the Fuel Handling Building.

Table 9.4-5

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Control Room / Command Center Complex Control Room and Other Rooms	Public Address & Radio Rm and Communications Equipment Room	ESF Switchgear, Vital Power/ Distribution and Electrical Areas	Radwaste Area	Radwaste Room 337 (El 37 ft)
Air Conditioning / Ventilating Supply Unit	E295	E411 (AC Mode)	E430	E433, E434	E883, E884
Type	Horizontal	Horizontal	Horizontal	Horizontal	Water Cooled Fan Coils
	Blow-through Floor mounted	Draw-through Floor mounted	Draw-through Roof mounted	Draw-through Roof mounted	N/A N/A
Number	One (Common)	One (Common)	One (Unit 2) One (Unit 3)	Two (Total) (Common)	Two (Common)
Flowrate each, ft^3/min	35,705	1,440	36,100 (Unit 2) 34,215 (Unit 3)	36,100	N/A
Total pressure, in. w.g.	5	3.2	4.0 (Unit 3) 4.5 (Unit 2)	4.5	N/A
Motor hp, each	50	3	50	50	N/A
Drive	Belt	Belt	Belt	Belt	N/A
Cooling coil capacity, Btu/h	*1,152,000	49,980	N/A	N/A	15 Ton (each)

* Cooling coil capacity is nominal.

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Control Room / Command Center Complex	PA and Radio Room and Comm Equipment Room	ESF Switchgear, Vital Power/Distribution and Electrical Areas	Radwaste Area
Pre-filter			24-24 x 24 x 2 (Unit 2) 24-24 x 24 x 12 (Unit 2)	
Quantity	24-24 x 24 x 12	1-24 x 24 x 6	24-24 x 24 x 2 (Unit 3) 6-12 x 24 x 2 (Unit 3) 24-24 x 24 x 12 (Unit 3) 6-12 x 24 x 12 (Unit 3)	24-24 x 24 x 6
	4-12 x 24 x 12		2 Pre-filters 24-24 x 24 x 12 4-24 x 24 x 12 (Med Eff)	4-12 x 24 x 6
Pressure drop clean/dirty, in. w.g.	0.33	0.33	0.30 (Pre-filter) 0.58 (Medium Eff Filter)	0.33
Efficiency	> 55% average dust spot atmospheric	55% average dust spot atmospheric	25% (Pre-filter) 90% (Medium Eff Filter) spot atmospheric	55% average dust spot atmospheric

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	ESF Switchgear Area
Exhaust Fan	A165
Type	Vane-axial
Number	One (Unit 2) One (Unit 3)
Flowrate, each ft^3/min	33,235 (Unit 2) 31,355 (Unit 3)
Total pressure, in. w.g.	1.4
Motor hp, each	15
Drive	Direct

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	PA and Radio Room and Comm Equipment Room	Battery Rooms	Chiller Rooms	Health Physics Zone II
Air Conditioning / Ventilating Supply Unit	E411 (Ventilation Mode)	A355	A051	E220
Type	Horizontal Draw-through Floor mounted	Horizontal Draw-through Floor mounted	Horizontal Draw-through Ceiling mounted	Horizontal Draw-through Roof mounted
Number	One (Common)	One (Unit 2) One (Unit 3)	One (Common)	One (Common)
Flowrate each, ft^3/min	1,440	4,540	9,550	26,325
Total pressure, in. w.g.	3.2	3.25	2.0	4.5
Motor, hp, each	3	5	10	50
Drive	Belt	Belt	Belt	Belt
Cooling coil capacity, Btu/h	N/A	N/A	N/A	1,347,200

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	PA and Radio Room and Comm Equipment Room	ESF Battery Rooms (El. 50 ft)	Chiller Rooms	Health Physics Zone II
Heating coil capacity, kW	N/A	N/A	N/A	170.8 (OSA) E288
Pre-filter Quantity	4-20 x 16 x 2	3-24 x 24 x 6	8-16 x 25 x 2	24-24 x 24 x 6 4-12 x 24 x 6
Pressure drop clean, in. w.g.	0.1	0.33	0.17	0.33
Efficiency	20% average dust spot atmospheric	55% average dust spot atmospheric	20% average dust spot atmospheric	50% average dust spot atmospheric

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS - NORMAL OPERATION

Item	Battery Rooms El 50 ft	Chiller Rooms	Health Physics and Locker Rooms Zone II						Continuous Exhaust
Exhaust Fan	A169	A052	A152	A153	A150	A151	A155	A154	A310, 311, 312
			Radwaste Decon, HP Techs Toilets	Kitchen	Rep ALARA Elect Test Rooms	Corridors Chem Storage Rooms	Chem Storage Multi-Purposes and Switchgear	HP, DPT Personnel Decon	
Type	Vane-axial Explosion Proof	Vane-axial	Vane-axial	Centrifugal	Vane-axial	Vane-axial	Vane-axial	Vane-axial	Centrifugal
Number	One (Unit 2) One (Unit 3)	One	One	One	One	One	One	One	3
Flowrate, each ft^3/min	6,111	10,500	2,650	430	6,340	3,235	5,970	7,820 (Note 1)	78,000 - 85,000
Total pressure, in. w.g.	0.76	0.90	0.95	0.95	1.0	0.83	1.00	1.5	6.8 (nominal)
Motor hp, each	2	3	2	0.5	2	1	3	5	150
Drive	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Direct	Belt

Note 1: Actual flow rate has been measured to be 10,475 ft^3/min. There is no impact to associated rooms design differential pressure.

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Radwaste Area	Health Physics and Locker Rooms Zone I
		Hot Sample Lab, Radio Chem Lab, Radio Chem Instrument Lab, MCA Lab, and ceiling
Transfer Fan	A192, A193	A378
Type	Vane-axial	Centrifugal
Number	Two	One
Flowrate, ft^3/min	39,050	6,150
Total pressure, in. w.g.	2.85	8.47
Motor, hp	30.0	15
Drive	Direct	Belt

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Health Physics and Locker Area
	Communications Room 70 ft elev.
Air Handling Unit (cont.)	
Flowrate ft^3/min	3,250 (lead) 3,000 (back-up)
Total pressure, in. w.g.	3.25 (lead) 0.76 (back-up)
Motor hp, each drive	5 (lead) 2 (back-up) Belt
Cooling coil capacity, BTU/hr	113,090 (lead) 70,015 (back-up)
Pre-filter Qty./Size	2-24 x 24 x 4 (lead) 2-16 x 25 x 2 (back-up)
Efficiency	20% average dust spot, atmosphere
Condensing Unit	
Type	Air cooled, vertical propeller mounted on roof
Condenser Fan Motor (Qty.) Hp	(2) 1/4 (lead) (2) 1/4 (back-up)
Air quantity, ft^3/min	6,500 (lead) 5,000 (back-up)
Compressors, (Qty.) RLA	(1) 19.4@ 460V, 3 phase (lead) (1) 12.8@460V, 3 phase (back-up)
Refrigerant	R22

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Health Physics Zone I
Air Cooled Condensing Units	E814
Type	Roof Mounted
Quantity	1
Compressors	(2) per condensing unit
Capacity	514,000 Btu/hr
kW Rating	43
Refrigerant	R-22
Condenser Coil Face Area	35.4 sq. ft.
Condenser Fans	
Quantity per unit	2
CFM	26,120 total
Fan Motor	(2) - 1/2 Hp

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Health Physics Area Zone I
Air Conditioning / Ventilating Supply Unit	A512
Type	Roof Mounted
Number	One (Common)
Flowrate each, ft^3/min	12,850
Total pressure, in. w.g.	7.5
Motor, hp each	25
Drive	Belt
Cooling coil capacity, Btu/h	490,280
Heating coil capacity, kW	74 (E837)

Table 9.4-5, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
NORMAL OPERATION

Item	Health Physics and Locker Area Zone I
Pre-filter HEPA	(8) 24 x 24 x 11 1/2 (HEPA)
Quantity - in.	(8) 24 x 24 x 2
Pressure drop clean, in. w.g.	0.17 (1.0 HEPA), (Note 1)
Efficiency	20% average dust spot atmospheric

1) The acceptance criterion for the pre-installation (manufacturer) test is greater than 99.97 % removal of 0.3 micron minimum particle monodisperse generated DOP aerosol.

9.4.2.1.2.3 System Operation

A. Control Room / Command Center Complex

One air handling unit provides cooling to the Control Room / Command Center. Outside air is mixed with recirculated air and is filtered through pre-filters, is cooled to the required design temperature, and is discharged into a duct system which distributes the air to the computer rooms, Control Room / Command Center, Control Room / Command Center work area, mezzanine area, cabinet areas, shift superintendent's office, central alarm station, supervisor's office, electrical equipment, offices, Nuclear Operations Assistant (NOA) area, foreman's office, instrument repair room, lobby, turbine laboratory, man trap, and corridors. Two fan coil units supply air to the Control Room / Command Center cabinet areas for additional cooling and are discussed in Section 9.4.2.2. The ventilation unit and duct heater are discussed in Section 9.4.2.2.

The exhaust air from the turbine laboratory is discharged to the continuous exhaust system by the turbine laboratory transfer fan.

The exhaust air from the NOA area and offices, lunch area, kitchen, men's and women's toilets, janitor's room, and foreman's office is exhausted to the atmosphere by differential air flow and is not supplied with a central exhaust fan.

B. Radwaste Area

Two air handling units each interlocked with an exhaust fan provide ventilation to the Radwaste area. Outside air that is filtered through pre-filters is delivered to areas having low or no radioactivity. The air then goes to areas with a potential for having progressively higher activity levels. The exhaust air from these areas is discharged to the continuous exhaust plenum by the exhaust (transfer air) fans.

All supply and return ventilation ducts (eight) for the radwaste building loading dock area are fitted with motor-operated dampers which are interlocked with the main truck door such that the truck door cannot be opened unless all dampers are closed. A local control panel is provided with position indicating lights for each damper, an alarm for dampers out of position, and a control switch for the main truck door. Interior doors are self-closing and may be padlocked shut.

C. Elevation 50 ft ESF Switchgear rooms, Vital Power/Distribution rooms, Cable Spreading Galleries, Cable Riser Galleries Battery rooms previously classified as non-Class 1E, Lobbies, Motor Control Center, Evacuation Shutdown Panel room, HVAC rooms, and Corridors.

The elevation 50 ft electrical areas are provided with 100 percent outside air by means of an air handling unit located at the elevation 85 ft roof. A separate ventilation system is provided for each unit. During operation, outside air is passed through pre-filters and is discharged to a duct system for distribution to the electrical areas. Exhaust air is collected from the areas through a network of ducting and is discharged by an exhaust fan to the atmosphere. The exhaust fan is interlocked with the air handling unit. On an area fire detector actuation, the normal air handling unit is deactivated.

D. Health Physics Zones I and II

The Zone I air conditioning unit operates continuously but trips on fire detector actuation. The air conditioning unit consists of an air cooled condensing unit and air handling unit. Return air is mixed with outside air and is filtered through the pre-filters and HEPA filters and is cooled or heated before it gets distributed to the areas to maintain the design temperature. The Zone I air handling unit is interlocked with the fume hood transfer exhaust fan.

The Zone II air handling unit operates continuously but trips on fire detector actuation or if any transfer fan serving the area stops. Outside air is filtered through the pre-filters and is cooled or heated before it gets distributed to the areas to maintain the preset temperature supply duct temperature.

E. Public Address and Radio Room and Communications Equipment Room

Recirculated air and makeup air drawn from Room 107 is filtered through pre-filters, cooled, and is discharged into a duct system which distributes the air to the 99 ft elevation Public Address and Radio Room and Communications Equipment Room.

The air handling unit fan may serve as a ventilation unit. Ventilation air will be extracted from Room 107 by opening and closing the appropriate dampers. This allows ventilation air to be distributed to the rooms and be diverted to the adjacent corridor through the duct mounted damper. Operation of this fan is controlled by a hand switch located in the Public Address and Radio Room and Communications Equipment Room.

The air in the 70 ft level communication room is cooled by a split type air conditioning system consisting of an air handling unit and two air cooled condensing units. The required room temperature is controlled by a thermostat, one for each unit.

F. Chiller Rooms

The three Chiller Rooms are served by one ventilation system. One supply fan and one exhaust fan provide the ventilation to all three rooms. An exhaust fan exhausts the air directly to the atmosphere. The exhaust fan is interlocked with the supply fan.

G. Battery Rooms

Outside air is filtered through pre-filters and is discharged into a duct system that distributes the air to the four ESF battery rooms (per Unit) at elevation 50 ft to maintain the required design temperature. The room air combined with exhaust air from the non-ESF battery room is exhausted directly to the atmosphere. If the hydrogen concentration in any battery room becomes high, an alarm sounds in the Control Room / Command Center.

H. Continuous Exhaust System

Three 50%-capacity exhaust fans (any two fans are normally operating and the third fan is a standby) serve the entire plant by continuously maintaining the exhaust plenum under negative pressure. Effluents from the fume hoods, laboratories, fuel handling area, radwaste area, and safety equipment and penetration buildings are drawn from the plenum and are discharged to the atmosphere through the Units 2 and 3 plant vent stacks.

9.4.2.1.2.4 System Performance Parameters

The performance parameters for the auxiliary building normal HVAC system described in this subsection are shown in Table 9.4-5.

9.4.2.1.3 Safety Evaluation

Inasmuch as these systems have no safety design bases, no safety evaluation is provided.

9.4.2.1.4 Inspection and Testing Requirements

Each component is inspected prior to installation. Components of each system are generally accessible for periodic inspection during normal plant operation. Systems air balance test and adjustments to design conditions were conducted during the plant preoperational test program implementation. Instruments are calibrated during testing. Automatic controls are tested for actuation at the proper setpoints. Alarm functions are checked for operability and limits during preoperational testing.

Each system is operated and tested initially for flow capacity and mechanical operability. Ductwork is tested for leakage during installation. Fans are initially tested in accordance with AMCA standards.

9.4.2.2 Emergency Operation - Auxiliary Building VAC Systems

There is no emergency operation for the Auxiliary Building ventilation in the permanently defueled plant condition. Equipment in this section was repurposed for permanently defueled plant operation. Although “ESF” and “emergency” may be used throughout this section, they no longer refer to a “safety” function in the permanently defueled plant condition.

The auxiliary building ventilation unit described in this subsection includes components that function during permanently defueled plant operation within the Control Room / Command Center complex.

9.4.2.2.1 Design Bases

A. The auxiliary building ventilation unit is designed to maintain the space design conditions of Table 9.4-6 to permit continuous personnel comfort, access, equipment safety, and operation in conjunction with the normal HVAC system discussed in Section 9.4.2.1.

Codes and standards applicable to the auxiliary building ventilation unit are listed in Controlled Document 90034, "Q-List." The system is designed and constructed in accordance with the requirements of AMCA and SMACNA Standards, IEEE Standards 323 and 344, Regulatory Guides 1.26 and 1.52, and the Uniform Mechanical Code, 1970.

9.4.2.2.2 System Description

9.4.2.2.2.1 General Description

The Auxiliary Building Emergency VAC systems are shown in the following controlled drawings.

40095	40175A	40178A	40179E
40096	40175ASO3	40178ASO3	40180A
40098	40175B	40178B	40180B
40173A	40175BSO3	40178BSO3	40180BSO3
40173ASO3	40177A	40179A	40180C
40173B	40177ASO3	40179B	40180D
40173C	40177B	40179C	
40173D	40177BSO3	40179D	
40173DSO3	40177C	40179DSO3	

These drawings consist of the following:

- Emergency air conditioning systems for the following area:
  - Control Room / Command Center cabinet area
- Ventilation for the following area:
  - Control Room / Command Center complex

A. Control Room Complex

The Control Room / Command Center complex includes the Control Room / Command Center, cabinet area, computer rooms, turbine laboratory, and other facilities at the 30 ft elevation needed to support operations personnel in the permanently defueled plant condition. The mezzanine area, at elevation 39 ft-2 in., is also included as part of the Control Room / Command Center complex.

The Control Room / Command Center complex ventilation unit is common to both Units 2 and 3, and is arranged for ease of access, control, and monitoring. The ventilation unit is located at the 30 ft elevation.

The ventilation unit is initiated by manual action and maintained at positive pressure compared to ambient in conjunction with operation of the Normal HVAC system discussed in Section 9.4.2.1.

A duct heater upstream of the ventilation unit is provided for extreme cold weather.

Chilled water is provided to the Control Room / Command Center cabinet area air handling units by chiller E881. Chilled water is discussed in Section 9.4.2.1.

Table 9.4-6

EMERGENCY OPERATION – AUXILIARY BUILDING VAC

SPACE DESIGN CONDITIONS

System	Elevation		Type[a]	Temperature (°F)	
	ft	in		Summer (Dry Bulb)	Winter (Dry Bulb)
Control Room / Command Center cabinet area	30	0	VAC[b]	80	N/A

a) AC – Air conditioning
V – Ventilating

b) Duct heater provided upstream of ventilation unit for extreme cold weather.

Table 9.4-7

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS EMERGENCY OPERATION[a]

Item	Control Room / Command Center Complex	
	Cabinet Rooms	Emergency Ventilation
Type	E423 (Unit 2) E426 (Unit 3) Horizontal	A206 Horizontal draw-through floor mounted
Number	1 (Unit 2) 1 (Unit 3)	1
Nominal Flowrate, each, ft3/min	10,700 (Unit 2) 10,225 (Unit 3)	2,050
Total pressure, in. w.g.	2.56 (Unit 2) 2.39 (Unit 3)	10.60[b]
Motor hp, each	7-1/2	10.0
Drive	Direct	Direct
Cooling coil Capacity, Btu/hr	264,650 (Unit 2) 253,740 (Unit 3)	N/A
Heating coil capacity, kW	N/A	4.8 (E296)

a) See Controlled Document 90034, “Q-List” for equipment classification information.
b) Total static pressure

Table 9.4-7, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
EMERGENCY OPERATION

Item	Control Room / Command Center Complex Ventilation
Pre-filter	
Quantity	1
Size, in.	24 x 24 x 6
Pressure drop clean, in. w.g.	0.33
Efficiency, % (average dust spot atmospheric)	55
HEPA Filter	
Quantity	1
Size, in.	24 x 24 x 12
Pressure drop clean, in. w.g.	1.95

Table 9.4-7, cont.

AUXILIARY BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS
EMERGENCY OPERATION

Item	Control Room / Command Center Complex
	Ventilation
Quantity	1 set
Pressure drop, in. w.g.	3

9.4.2.2.2.2 System Operation

The Control Room / Command Center complex ventilation system is provided with a ventilation unit with an upstream duct heater. The subsystem consists of one ventilation supply unit and one electrical duct heater. The ventilation supply unit has HEPA filters through which fresh air is added to the recirculation circuit of the normal HVAC system discussed in Section 9.4.2.1. The ventilation unit is manually operated. The duct heater upstream of the ventilation unit is operated during extreme cold weather conditions.

The supply air is based on a constant-volume principle.

The supply air is cooled to the required design temperature by the normal HVAC system discussed in Section 9.4.2.1 and is discharged into a duct system that distributes the air to the following areas: computer rooms, Control Room / Command Center, mezzanine area, cabinet areas, work areas, Central Alarm Station, Supervisor office, NOA office, fan rooms, shift superintendent's office, foreman's office, instrument repair room, electric room, telecommunication room, offices, lobby, turbine laboratory, kitchen, lunch rooms, and hall, men's and women's locker rooms, man trap, and vestibules.

There is one fan-coil unit in each Unit 2 and Unit 3 cabinet area located at elevation 50 ft for additional cooling.

9.4.2.2.2.3 System Performance Parameters

The performance parameters for the auxiliary building ventilation system described in this subsection are shown in Table 9.4-7.

9.4.2.2.3 Safety Evaluation

In the permanently defueled plant condition the ventilation system (previously referred to as the emergency VAC system) has no safety function. Therefore, no safety evaluation is provided.

9.4.2.2.4 Inspection and Testing Requirements

Each component is inspected prior to installation. Components of each system are generally accessible for periodic inspection.

A system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program. Instruments are calibrated during testing. Automatic controls are tested for actuation at the proper setpoints. Alarm functions are checked for operability and limits during preoperational testing.

Each system is operated and tested initially with regard to flow paths, flow capacity, and mechanical operability. Ductwork is tested for leakage during installation. Fans are tested in accordance with standards of the AMCA. HEPA filters of emergency ventilation supply units are subjected to the following tests before installation:

A. Media tensile test.

B. Sequential test.

C. Efficiency penetration test, dioctylphthalate penetration (DOP), in accordance with MIL-STD-282. Penetration will not exceed 0.05% for 0.3-micron diameter homogeneous particles of DOP at rated air flow.

9.4.3 SUPPORT BUILDING VENTILATION SYSTEMS

This subsection provides system descriptions for ventilation systems for the fuel handling building, safety equipment building, turbine building, diesel generator building, penetration building, electric and piping tunnels, intake structure, auxiliary feedwater pump room, the safety equipment building elevator machine room and South Yard Facility. Following is the status of each of the ventilation systems in these areas.

System	Status
Fuel Handling Building Ventilation System	Partially Removed from Service
Safety Equipment Building HVAC System	Partially Removed from Service
Turbine Building HVAC System	Partially Removed from Service
Diesel Generator Building Ventilation System	Removed from Service
Penetration Building and Electric Piping Tunnels Ventilation System	Partially Removed from Service
Intake Structure Ventilation System	Removed from Service
Auxiliary Feedwater Pump Room Ventilation System	Removed from Service
Safety Equipment Building Elevator Machine Room	Removed from Service
Full Flow Condensate Polishing Demineralizer Building Control Room and Laboratory Room	Removed from Service
South Yard Facility Ventilation Systems	Available

9.4.3.1 Fuel Handling Building Ventilation System

The fuel handling building heating, ventilating, and air conditioning system described in this subsection includes those systems that function within the fuel handling building during normal fuel handling and storage operations and subsequent to a postulated fuel handling accident.

System	Status
Normal Ventilation Supply and Exhaust Subsystem	Partially Removed from Service
Fuel Handling Building Post-Accident Cleanup Subsystem	Removed from Service
Fuel Pool Pump Room Emergency Cooling Subsystem	Removed from Service

9.4.3.1.1 Design Bases

The fuel handling building HVAC system is designed to:

A. Maintain the ambient air temperature at a level that permits continuous personnel access and equipment operation.

B. Minimize the possibility of exfiltration during normal operations.

Protection of the fuel handling building ventilation system from wind, tsunami, and tide effects as well as flood design and missile protection is discussed in Chapter 3.

Codes and standards applicable to the fuel handling building HVAC system are listed in Controlled Document 90034, "Q-List." The system is designed and constructed in accordance with the requirements of ARI, AMCA, and SMACNA standards.

9.4.3.1.2 System Description

9.4.3.1.2.1 General Description

The fuel handling HVAC system is shown schematically in the following controlled drawings.

40090	40177A	40177ASO3
40180C	40179B	40179C

The Fuel Handling HVAC System consists of the Normal Ventilation Supply and Exhaust subsystem.

The system is located within the fuel handling building (elevation 45 ft) and penetration area (elevation 95 ft) and is arranged for ease of access, control, and monitoring as applicable. The exhaust fan removes more air than is supplied. The extra air is made up by infiltration from the outside and from adjoining areas of the auxiliary building, thus minimizing the possibility of exfiltration.

The fuel handling building doors are provided with self-closers to prevent an open door from disrupting fuel handling building ventilation.

9.4.3.1.2.2 Component Description

The normal ventilation supply subsystem includes outside air intake louvers, two manually operated isolation dampers, two 100% supply air units (one operating and one on standby) with moderate-efficiency pre-filters, two isolation dampers, air supply, ductwork, and associated controls.

The normal ventilation exhaust subsystem includes six manually operated dampers, exhaust ductwork, backdraft dampers and two 100% transfer air fans (one operating and one standby) discharging to the continuous exhaust plenum from where it is exhausted to the atmosphere through the plant vent stack.

Normal Ventilation Supply and Exhaust subsystem equipment classification is listed in Controlled Document 90034, "Q-List."

9.4.3.1.2.3 System Operation

The fuel handling building normal ventilation supply and exhaust subsystem operates during normal operation. The air handling unit draws outside air through the pre-filter and discharges into a duct system which distributes the air to fan rooms, pump rooms, and the new fuel storage area. Air is first delivered to clean spaces, from where it flows toward areas of progressively higher potential activity levels. The exhaust air from these spaces is discharged to the continuous exhaust plenum by the transfer air fan, from where it is exhausted to the atmosphere through the two plant vent stacks. Fuel handling building temperature at pool level is maintained between 45°F and 109.2°F during normal operation.

9.4.3.1.2.4 System Performance Parameters

The performance parameters for the fuel handling building HVAC systems described in this subsection are shown in Table 9.4-8.

9.4.3.1.3 Safety Evaluation

The fuel handling building normal ventilation subsystems do not have safety functions. Therefore, no safety evaluation is provided.

9.4.3.1.4 Inspection and Testing Requirements

Each component is inspected prior to installation. Components of each system are generally accessible for periodic inspection during normal plant operation. A system air balance test and adjustment to design conditions was conducted in the course of the plant preoperational test program. Instruments are calibrated during testing. A preoperational test was conducted to verify that a negative pressure exists in the spent fuel pool area when the normal ventilation system is in operation.

Table 9.4-8

FUEL HANDLING BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS

Item	Normal Ventilation Supply and Exhaust System	
	Supply Air Unit	Exhaust Air Unit
Type	A359, A360 Horizontal draw-through	A316, A317 Fan only
Number Flowrate each, ft^3/min.	2 (one standby) 21,280	2 (one standby) 22,628
Fan Type Drive No. of fans in each unit Total pressure, each, in. w.g. Motor hp, each	 Centrifugal Belt 1 2.75 20	 Vane-axial Direct 1 2.3 20
Nominal/Minimum Cooling coil capacity each, Btu/hr	N/A	N/A
Pre-filter Quantity and size, in Pressure drop, clean, in. w.g. Efficiency, % (Average dust spot atmospheric)	 15 - 24 x 24 x 6 3 - 24 x 12 x 6 0.33 55 	 N/A N/A N/A N/A

9.4.3.2 Safety Equipment Building Ventilation System

The safety equipment building ventilation system described in this subsection includes those subsystems that function during shutdown operating conditions to control the environment for equipment and operating personnel as applicable. There are no longer safety systems in these areas. These subsystems include the following:

1. The safety equipment building air conditioning equipment room normal ventilation subsystem
2. The safety equipment building lobby area ventilation subsystem

9.4.3.2.1 Design Bases

The safety equipment building ventilation system during normal plant operation is designed to maintain the following ambient temperatures:

Area	Summer Dry Bulb Temperature Maximum (°F)	Winter Dry Bulb Temperature (°F)
Lobby area	75	70
Air conditioning equipment room	104	N/A

Protection of the safety equipment building HVAC system from wind and tornado as well as missile protection is discussed in Chapter 3.

Codes and standards applicable to the safety equipment building HVAC system are listed in Controlled Document 90034, "Q-List." The system is designed and constructed in accordance with the requirements of AMCA and SMACNA standards and the Uniform Mechanical Code, 1970. The Seismic Category I portions of the system are also designed to IEEE 323 and 344.

9.4.3.2.2 System Description

9.4.3.2.2.1 General Description

The safety equipment building HVAC system is shown in the following controlled drawings.

40087	40175ASO3	40175BSO3
40175A	40175B	

The cooling systems are primarily required for heat removal function. The safety equipment building lobby area is in Unit 2 only, and the air conditioning subsystem for this area operates for personnel comfort.

9.4.3.2.2.2 Component Description

Design data for major components of the safety equipment building ventilation system are listed in Tables 9.4-9.

A. Safety Equipment Building Air Conditioning Equipment Room Normal Ventilation Subsystem

   This subsystem consists of one cooling unit located in the air conditioning room No. 017 at elevation 8 ft. The unit includes a moderate-efficiency pre-filter, a fan section, galvanized steel housing, ductwork, and associated controls.

B. Safety Equipment Building Lobby Area Ventilation Subsystem

This subsystem consists of one ventilation unit located in the safety equipment building lobby area at elevation 8 ft. The unit includes a moderate-efficiency pre-filter, a fan section, galvanized steel housing, and ductwork.

Table 9.4-9

SAFETY EQUIPMENT BUILDING VENTILATION SYSTEM PERFORMANCE PARAMETERS - NORMAL OPERATION

Item	A/C Room 017	Safety Equipment Bldg. Lobby Area
Ventilation Unit		
Type	E412 Horizontal draw-through ceiling mounted	E516 Horizontal draw-through ceiling mounted
Number	One (Unit 2) One (Unit 3)	One (Unit 2) Only
Flowrate, each ft^3/min	1,450	2,500
Total pressure, in. w.g.	2.4	2.24
Motor, hp each	1 ½	2
Drive	Belt	Belt
Pre-filter Quantity, each Units 2 and 3	Two	Two (Unit 2 only)
Size	16 x 20 x 2	25 x 20 x 2
Pressure drop clean, in. w.g.	0.17	0.12
Efficiency, % (Average dust spot atmospheric)	20	20

9.4.3.2.2.3 System Operation

A. Safety Equipment Building Air Conditioning Equipment Room Normal Ventilation Subsystem

This subsystem draws the outside air from the turbine building and delivers filtered air through ductwork to the A/C Equipment Room 017. The room air is exhausted to the continuous exhaust system through the penetration and safety equipment building exhaust system described in Section 9.4.3.4.

B. Safety Equipment Building Lobby Area Ventilation Subsystem

This subsystem is operated manually from the MCC 1A.

This subsystem mixes approximately 80% of room air with 20% outside air drawn from the turbine building. The ventilation unit delivers filtered air through ductwork to the safety equipment building lobby area, the clean clothing room, and the guard room.

9.4.3.2.2.4 System Performance Parameters

The performance parameters for the safety equipment building HVAC system described in this subsection are shown in Tables 9.4-9.

9.4.3.2.3 Safety Evaluation

In the permanently defueled condition, there are no safety functions performed by the Safety Equipment Building HVAC system. Therefore, no safety evaluation is provided.

9.4.3.3 Turbine Building HVAC System

The turbine building HVAC system described in this subsection operates as needed with SONGS in the permanently defueled condition. Following is a listing of the status of each subsystem.

Structures / Systems / Components	Status
Turbine Building General Area Ventilation Subsystem	Removed from Service
Switchgear Room and D6 Battery Room Ventilation Subsystem	Partially Removed from Service
Lube Oil Room Ventilation Subsystem	Removed from Service
Excitation-Automatic Voltage Regulator (AVR) Room Air Conditioning Subsystem	Removed from Service
Steam Air Ejector And Vacuum Pump Exhaust Subsystem	Removed from Service
D7 Battery Room And Battery Charger Room Ventilation Subsystem	Removed from Service
UPS (previously classified as non-Class 1E) Room Air Conditioning Subsystem	Partially Removed from Service

9.4.3.3.1 Design Bases

The turbine building HVAC system is designed to:

A. Maintain the following space design conditions

	Dry Bulb Temperature (°F)	
	Winter	Summer
Switchgear room	N/A	104
D6 Battery room (El. 7 ft)	77	95
UPS (previously classified as non- Class 1E) area	N/A	104

B. Maintain combustible concentration of hydrogen gas below the recommended limit of 4% of the battery room volume

Codes and standards applicable to the turbine building HVAC system are listed in Controlled Document 90034, "Q-List." The system is designed and constructed in accordance with the requirements of ARI, AMCA, SMACNA, and UL standards.

9.4.3.3.2 System Description

9.4.3.3.2.1 General Description

The turbine building HVAC system described in this subsection is shown in shown in the following controlled drawings:

40177B 40177BSO3 40152D 40152DSO3

The system is available for manual operation for the permanently defueled plant condition.

9.4.3.3.2.2 Component Description

Design data for major components of the turbine building HVAC system are listed in Table 9.4-11.

A. Switchgear Room and D6 Battery Room Ventilation Subsystem (Unit 2 Only)

This subsystem includes one ventilation supply air unit serving the switchgear and D6 battery room, one electric duct heater in the battery room supply air duct, and one battery room exhaust fan.

The ventilation supply air unit is located in the turbine building at elevation 56 ft and consists of an outside air louver, a moderate-efficiency pre-filter, a fan section, galvanized steel housing, ductwork, and associated controls.

No forced exhaust is required for the switchgear room in the permanently defueled plant condition.

The battery room exhaust unit is located on the battery room roof and consists of an in-line fan and associated ductwork.

B. UPS (previously classified as non-Class 1E) Air Conditioning Subsystem

This subsystem consists of two 100% redundant capacity heat pump units for Unit 2 only. These provide space cooling to the UPS area located on the 7 ft-0 in. elevation in the turbine building. (The UPS equipment located here is the battery charger, the inverter, the switchgear, and the control panel. The UPS battery is located in the existing battery room adjacent to the UPS area.) The heat pump units are located at elevation 7 ft-0 in. in the turbine building.

Table 9.4-11

TURBINE BUILDING HVAC SYSTEM PERFORMANCE PARAMETERS

Item	Switchgear and Battery Room Ventilation System			Previously classified Non-Class 1E UPS System Air-Cond. System
		Exhaust Air Units		
	Supply Air Unit	Switchgear Room	D6 Battery Room	
Type	A363 Build-up unit	N/A	A300 Fan only	E974, E975 Built-up unit
Number of units	1	N/A	1	2 (Unit 2)
Flowrate, Each, ft3/min	30,980	N/A	1,000	2,700 (Unit 2)
Fan				
Type	Vane-axial	N/A	Vane-axial	Centrifugal
Drive	Belt	N/A	Direct	Belt
Total pressure, in. w.g.	2.5	N/A	1.0	1.2 (Unit 2)
Motor hp	30	N/A	1	2.9 (Unit 2)
Cooling capacity, Btu/hr	N/A	N/A	N/A	70,000 (Unit 2)
Heating coil capacity, kW	N/A	N/A	21.5 (E506) (Duct heater in supply air duct)	25.5 (Unit 2)
Pre-filter				
Quality	15 -24 x 24 x 6	N/A	N/A	4-16x16x2 (Unit 2)
Pressure drop Clean, in. w.g.	0.33	N/A	N/A	0.40 (Unit 2)
Efficiency, % (average dust spot atmospheric)	55	N/A	N/A	90 (Unit 2)

9.4.3.3.2.3 System Operation

A. Switchgear and D6 Battery Room Ventilation Subsystem (Unit 2 Only)

This subsystem is manually operated from the local control panel.

The ventilation supply air unit operates continuously during normal operation and distributes the air through ducts to the switchgear room and the D6 battery room. During winter operation, the battery room space thermostat controls the electric duct heater located in the supply air duct and maintains a 77°F space temperature. The electric duct heater is turned off automatically to prevent burnout if the airflow switch, located in the battery room supply air duct, detects no airflow.

The air from the switchgear room is naturally exhausted to the surrounding environment. No forced exhaust is required for the switchgear room in the permanently defueled plant condition. Battery room air is exhausted to the atmosphere through an exhaust fan and associated ducts. The battery room exhaust fan operates continuously.

Combustible gas detectors are located in the battery room to detect a combustible gas (hydrogen) concentration (2%) which is well below its explosive limit. An alarm will be annunciated in the Control Room / Command Center upon detection of the combustible gas concentration.

B. UPS (Previously classified non-Class 1E) Air Conditioning System

(Unit 2) The UPS system (Previously classified non-Class 1E) heat pump units are automatically and manually controlled from an electrical panel located inside the UPS room. The two heat pump units are 100% redundant capacity, with recirculating air. Thermostats located on the electrical panel, controls the system's cooling capacity.

9.4.3.3.2.4 System Performance Parameters

The performance parameters for the turbine building HVAC system described in this subsection are shown in Table 9.4-11.

9.4.3.3.3 Safety Evaluation

Because the turbine building HVAC system has no safety design bases, no safety evaluation is provided.

9.4.3.3.4 Inspection and Testing Requirements

Fans are tested and rated in accordance with standards of the AMCA. Ductwork is tested for leakage during installation. A system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program.

9.4.3.4 Penetration Building Ventilation System

The ventilation system described in this subsection is for the penetration building at normal operating conditions.

9.4.3.4.1 Design Bases

The ventilation system for the penetration building is designed to maintain the space temperature at 104°F maximum dry bulb in summer and 36°F dry bulb in winter in the electrical penetration and piping penetration areas.

Protection of this VAC system from wind and tornado, flood, and missiles is discussed in Chapter 3.

Codes and Standards applicable to this ventilation system are listed in Controlled Document 90034, "Q-List." The system is designed and constructed in accordance with the requirements of AMCA, SMACMA, and ARI Standards.

9.4.3.4.2 System Description

9.4.3.4.2.1 General Description

The ventilation systems for the penetration building and electric piping tunnels are shown in Controlled Drawings 40086, 40087, 40175B, 40175BSO3, 40187A, and 40178SO3.

In the penetration building, the ventilation unit for the piping penetration area is located at elevation 30 ft and the ventilation unit for the electrical penetration area is located at elevation 45 ft. The exhaust fan is located at elevation 95 ft. The locations of supply and exhaust fans for electric and piping tunnels are shown in Controlled Drawings 40086 and 40087.

9.4.3.4.2.2 Component Description

Design data for major components of ventilation systems for the penetration building and the electric and piping tunnels are listed in Table 9.4-13.

Penetration Building

1. Piping and Penetration Area

   The air handling unit consists of a moderate-efficiency pre-filter and a fan section.

2. Electrical Penetration Area

   The air handling unit consists of a moderate-efficiency pre-filter and a fan section.

Table 9.4-13

PENETRATION BUILDING AND ELECTRIC AND PIPING TUNNELS VENTILATION

SYSTEM PERFORMANCE PARAMETERS

Item	Penetration Building	
	Electrical Area	Piping Area
Ventilating Supply Unit		
Type	E361 One horizontal draw-through	E360 Horizontal draw-through
Number	One (Unit 2) One (Unit 3)	One (Unit 2) One (Unit 3)
Flowrate, each ft^3/min	18,830	11,150
Total pressure, in. w.g.	4.14	4.48
Motor, hp each	25.0	15.0
Drive	Belt	Belt
Cooling coil capacity, Btu/h	N/A	N/A
Pre-filter		
Quantity, each	8 - 24 x 24 x 6 6 - 12 x 24 x 6	4 - 24 x 24 x 6 4 - 12 x 14 x 6
Pressure drop clean, in. w.g.	0.33	0.33
Eff % dust spot atmospheric	55	55

Table 9.4-13, cont.

PENETRATION BUILDING AND ELECTRIC AND PIPING TUNNELS VENTILATION

SYSTEM PERFORMANCE PARAMETERS

Item	Penetration Building
Transfer Fan	A037 (Penetration and safety equipment building)
Type	Vane axial
Number	One (Unit 2) One (Unit 3)
Flowrate, each ft^3/min	9,000
Total pressure, in. w.g.	2.4
Motor, hp each	7.5
Drive	Direct

9.4.3.4.2.3 System Operation

Penetration Building

1. Piping Penetration Area

   Outside air is mixed with recirculated air, is filtered through pre-filters, and is discharged into a duct system. The duct system distributes the air to the piping penetration areas on elevations 15 ft and 30 ft, the fan room at elevation 30 ft, and the piping tunnel and corridor on elevation 9 ft. Part of the room air is exhausted through the continuous exhaust system by the exhaust fan. Area supply fans are interlocked with the exhaust fan.

2. Electrical Penetration Area

   Outside air is mixed with recirculated air, is filtered through pre-filters, and is discharged into a duct system. The duct system distributes the air to the electrical penetration areas on elevations 45 ft and 63 ft-6 in., the fan room at elevation 45 ft, and personnel monitor area, monitor vestibule, emergency decontamination room, and electrical penetration room at elevation 63 ft-6 in.

   Part of the room air is exhausted through the continuous exhaust system by the exhaust fan. The electrical penetration area supply fans are interlocked with the exhaust fan.

9.4.3.4.2.4 System Performance Parameters

The performance parameters for the penetration building and electric and piping tunnels ventilation system described in this subsection are shown in Table 9.4-13.

9.4.3.4.3 Safety Evaluation

Because these systems have no safety design bases, no safety evaluation is provided.

9.4.3.4.4 Inspection and Testing Requirements

Fans are tested in accordance with the standards of the AMCA. Ductwork is tested for leakage during installation. A system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program.

Alarm functions are checked for operability and limits during preoperational testing. Instruments are calibrated during testing.

9.4.3.5 South Yard Facility Ventilation Systems

The normal and emergency operation systems for the South Yard Facility are discussed in this subsection.

9.4.3.5.1 Design Bases

The south yard facility normal HVAC system is designed to:

A. Maintain the ambient air temperature at a level which permits continuous personnel comfort and equipment operation.

B. Minimize the possibility of exfiltration from the hot machine shop, decontamination shop, and REMS work area during normal operation.

The system is designed and constructed in accordance with the requirements of AMCA and SMACNA Standards, Uniform Mechanical Code, and UL Standards for Seismic Class III, Quality Class IV.

9.4.3.5.2 System Description

9.4.3.5.2.1 General Description

The South Yard Facility HVAC System consists of the following subsystems:

A. Second floor air conditioning subsystem including HP access control
B. Hot machine shop, REMS rebuild area, hot tool room, REMS work area, decontamination shop, and Mixed Waste Room heating and ventilation subsystem
C. Refueling mock-up area heating and ventilation subsystem
D. Paint shop, carpentry shop, cold machine shop, rigging test room heating and ventilation subsystem
E. Restricted holding area heating and ventilation subsystem
F. Welding area heating and ventilation subsystem
G. REM holding area heating and ventilation subsystem
H. Electrical room ventilation subsystem
I. Telecommunication room air conditioning subsystem

All subsystems operate during normal operation. The subsystem listed in 9.4.3.5.2.1 B above, shuts down under emergency conditions.

9.4.3.5.2.2 Component Description

Design data for major component of the South Yard Facility HVAC subsystems are listed in Table 9.4-17.

A. Second floor Air Conditioning Subsystem

   An air conditioning unit, located outside in the mechanical room on the second floor, and four roof exhaust fans serve the office area on second floor and M&TE, cold tool room, and computer room on the first floor. The subsystem consists of an air handling unit with economizer, 30% efficiency filter, electric heating coil, refrigerant cooling coil, fan section, weatherproof steel housing, supply and return duct and associated control. The exhaust fans are centrifugal type and are connected to the exhaust ducts.

B. Hot Machine Shop REMS Rebuild Area, Hot Tool Room, Beta Booth corridor, Corridor #2, Counting Room, Supply Room, REMS Work Area, Decontamination Shop, and Mixed Waste Room HVAC Subsystem

   This subsystem consists of a heat pump unit located on the roof, two air handling units located in the hot machine shop and REMS work area and two exhaust fans located in the REMS holding area.

The heat pump consists of an economizer, 30% efficiency filter, additional electric heating coil, refrigerant cooling coil, fan section, weatherproof steel housing, supply duct, isolation dampers, and associated control.

The air handling unit located in hot machine shop consists of 30% efficiency filter, electric heating coil, fan section, steel housing, supply duct, isolation dampers, and associated control.

The air handling unit located in REMS work area consists of 30% efficiency filter, electric heating coil, fan section, steel housing, supply duct, isolation dampers, and associated control.

The exhaust subsystem, located in REM holding area, consists of two axial fans, exhaust duct, isolation damper, and associated controls.

C. Refueling, Heating and Ventilation Subsystem

This subsystem consists of one air handling unit located in the room and one exhaust fan located on the roof.

The subsystem consists of an air handling unit with 30% efficiency filter, electric heating coil, fan section, steel housing, supply duct, and associated control. The exhaust fan is centrifugal type. No duct required.

D. Paint Shop, Carpentry Shop, Cold Machine Shop, and Rigging Test Room, Heating and Ventilation Subsystem

This subsystem consists of two air handling units located in the cold machine shop. Five exhaust fans located on the roof and one exhaust fan for the rigging test room located on the wall.

The air handling units consist of a 30% efficiency filter, electric heating coil, fan section, steel housing, supply duct, and associated control.

The cold machine shop exhaust fans are centrifugal type. No duct work required.

The rigging test room exhaust fan is centrifugal type. No duct required.

The carpentry shop and paint shop exhaust fans are centrifugal type and connected to exhaust duct work.

E. Restricted Holding Area; Heating and Ventilation Subsystem

This subsystem consists of an electric room unit heater and an exhaust fan.

F. Welding Area; Heating and Ventilation Subsystem

This subsystem consists of an air handling unit located outside in the mechanical room on the second floor, one exhaust fan located on the roof, and a welding exhaust fan located in the cold machine with the exhaust duct to the roof.

The air handling unit consists of a 30% efficiency filter, electric heating coil, fan section, weatherproof steel housing, supply duct, and associated control. The exhaust fans are centrifugal type and are connected to the exhaust ductwork.

G. REMS Holding Area; Heating and Ventilation Subsystem

This subsystem consists of one air handling unit located in the REMS holding area and two roof exhaust fans. The air handling unit consists of 30% efficiency filter, electric heating coil, fan section, steel housing, supply duct, and associated control. The exhaust fans are centrifugal type. No duct required.

H. Electrical Room; Ventilation Subsystem

This subsystem consists of a wall intake louver and one wall centrifugal exhaust fan.

I. Telecommunication Room; Air Conditioning Subsystem

This subsystem consists of a wall heat pump unit with recirculation.

9.4.3.5.2.3 System Operation

A. Second Floor Air Conditioning Subsystem

The air conditioning unit and the exhaust fans (interlocked with air conditioning unit) are manually started from the local panel or from the computer. The room thermostats, discharge air sensor and dry bulb control modulate the return air damper, outside air damper, zone dampers, bypass damper on the unit, heating coil and compressor to satisfy the room demand. The unit can operate with 100% outside air. The unit is set back for night time. Actuation of the fire alarm will secure the air conditioning unit.

B. Hot Machine Shop, REMS Rebuilt Area, Hot Tool Room, Beta Booth corridor, Corridor #2, Instrumentation Storage, Supply Room, REMS Work Area, Decontamination Shop, Heating, and Mixed Waste Room Ventilation Subsystem

1. Normal Operation

The exhaust fans (one standby) and the air handling units are switched on from the local panel or from the computer (air handling units are interlocked with the exhaust fans). The room thermostats will actuate the heating coils if the temperature drops below 65°F.

The negative pressure (outside doors closed) is controlled by the static pressure sensors located in the hot machine shop, decontamination shop, REMS work area and outdoor reference pressure sensors. The air handling unit fan speed is modulated to maintain the building pressure ≤ - 0.1 in. W.G.

The outside door cannot be opened if the inside doors in the room are not closed. When the outside door opens, the air handling unit serving REMS work area is automatically turned off and vice versa.

2. Emergency Condition

   If one of the effluent radiation monitors alarms, the heat pump, the two air handling units, the exhaust fan are shut off and the associated dampers fail closed to isolate the subsystem from the outside. If the fire alarm is actuated, the unit supplying the area is turned off.

C. Refueling; Heating and Ventilation Subsystem

The air handling unit and the exhaust fan (interlocked with the air handling unit) is switched on locally or from the computer. The room thermostat, set at 65°F, controls the heating coil of the air handling unit. If the fire alarm is actuated, the unit is turned off.

D. Paint Shop, Carpentry Shop, Cold Machine Shop, Rigging Test Room; Heating and Ventilation Subsystem

The air handling units and the exhaust fans (interlocked with the air handling units) are switched on locally or from the computer. The room thermostats, set at 65°F, control the heating coils of the air handling units. When the heating coils are on, the supply fans of the air handling units and exhaust fans are turned on the low speed. If the fire alarm actuates, the units supplying the area are turned off.

E. Restricted Holding Area; Heating and Ventilation Subsystem

The unit heater is switched on locally or from the computer. The room thermostat set at 65°F controls the heater. The same room thermostat set at 80°F in the summer controls the exhaust fan.

F. Welding Area; Heating and Ventilation Subsystem

The air handling unit and the room exhaust fan are switched on locally or from the computer. The room thermostat set at 65°F controls the heating coil of the air handling unit. The welding exhaust fan is switched on when the welding hoods are operated. The welding exhaust fan is interlocked with the room exhaust fan which stops when the welding exhaust fan starts and vice versa. If the fire alarms actuates, the unit supplying the area is turned off.

G. REMS Holding Area; Heating and Ventilation Subsystem

The air handling unit and the exhaust fans (interlocked with the air handling unit) are turned on locally or from the computer. The room thermostat, set at 65°F, controls the heating coils of the air handling units. When the heating coils are on, the supply fan of the air handling unit and the exhaust fans are turned on the low speed. If the fire alarm actuates, the supply unit is turned off.

H. Electrical Room; Ventilation Subsystem

The exhaust fan is turned on locally or from the computer. The exhaust fan is controlled by the room thermostat set at 85°F.

I. Telecommunication Room; Air Conditioning Subsystem

The unit is turned on locally or from the computer.

9.4.3.5.2.4 System Performance Parameters

The performance parameters for the South Yard Facility HVAC described in this subsection are shown in the Table 9.4-17. The space design conditions are shown in the Table 9.4-18.

9.4.3.5.3 Safety Evaluation

Inasmuch as these systems have no safety design bases, no safety evaluation is provided.

9.4.3.5.4 Inspection and Testing Requirements

Each component is inspected prior to installation. Components of each system are accessible for periodic inspection during normal operation. A system air balance test and an adjustment to design conditions is conducted in the course of the plant preoperational test program. Instruments are calibrated during testing. Automatic controls are tested for actuation at the proper setpoints. Alarm functions are checked for operability and limits during preoperational testing.

Each system is operated and tested initially with regard to flow capacity and mechanical operability. Ductwork is tested for leakage during installation. Fans are tested in accordance with AMCA standards.

Table 9.4-17

SOUTH YARD FACILITY HVAC SYSTEM PERFORMANCE PARAMETERS

Item	2nd Floor Air Conditioning System				Hot Machine Shop, Hot Tool Room, Beta Booth Corridor, Corridor #2 REMS Work Area, Decontamination Shop HVAC System			
		Exhaust Air Units			Supply Air Units			
	Supply Air Unit	Break / Assembly	Toilets	Personnel Decon	Corridor #2 Supply Room, Counting Room A/C Unit	Hot Tool Room, Hot Machine Shop, Beta Booth Corridor, Decontamination Shop, and Mixed Waste Room Heating and Ventilation Unit	REMS Work Area Heating and Ventilation Units	Exhaust Air Units
Air Conditioning / Ventilation								
Type	Package Roof Top	Fan Only	Fan Only	Fan Only	Single Package Roof Top Heat Pump	Horizontal Draw-Thru	Horizontal Draw-Thru	Fan Only
No. of Units	1	1	1	1	1	1	1	2 (1 stand-by)
Flowrate, Each Ft^3/min	8,050	860	1,740	410	2,250	12,620	2,500	19,980
Fan								
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Tube-Axial
Drive	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Direct
Total Pressure, in. w.g.	1.8 (External)	5/8	5/8	3/8	0.6 (External)	2	2	3
Motor HP	7.5	1/3	0.5	1/4	1	7.5	2	20
Cooling Capacity, BTU/H	248,480*	N/A	N/A	N/A	100,520*	N/A	N/A	
Heating Capacity, kW	56	N/A	N/A	N/A	16.5	131	27	

* Values in this table are nominal rated values. Refer to calculation for design values.

Table 9.4-17, cont.

SOUTH YARD FACILITY HVAC SYSTEM PERFORMANCE PARAMETERS

Item	2nd Floor Air Conditioning System				Hot Machine Shop, Hot Tool Room, Beta Booth Corridor, Corridor #2 REMS Work Area, Decontamination Shop and Mixed Waste Room HVAC System			
	Supply Air Unit	Exhaust Air Units			Supply Air Units			Exhaust Air Units
		Break / Assembly	Toilets	Personnel Decon	Corridor #2 Supply Room, Counting Room A/C Unit	Hot Tool Room, Hot Machine Shop, Beta Booth Corridor, Decontamination Shop, and Mixed Waste Room Heating and Ventilation Unit	REMS Work Area Heating and Ventilation Units	
Air Conditioning / Ventilation		N/A	N/A	N/A				N/A
Pre-filter								
Quantity	2-18x24x2 4-24x24x2				16x25x1	4-16x25x2	2-20x20x2	
Pressure Drop Clean, in.w.g.	0.28					0.28	0.28	
Efficiency, % (Average Dust Spot Atmospheric)	30				30	30	30	
Air-Cooled Condensing Unit (for 2nd Floor Air Conditioning System) A. Compressor Type: Semi-hermetic Quantity: 2 Capacity: 248,480 BTU/H* Refrigerant: R-22			B. Condenser Coil Coil Face Area: 24.75 sq. ft. No. of Rows: 3 Fins/Inch: 15.7			C. Condenser Fan No. of Rows: 2 Flowrate: 10,000 CFM HP: 3/4 each		
Air-Cooled Condensing Unit (for Supply Room, Counting Room) A. Compressor Type: Hermetic Quantity: 2 Capacity: 100,520 BTU/H* Refrigerant: R-22			B. Condenser Coil Coil Face Area: 8 sq. ft. No. of Rows: 3 Fins/Inch: 15			C. Condenser Fan No. of Rows: 1 Flowrate: 6500 CFM HP: 3/4		

Table 9.4-17, cont.

SOUTH YARD FACILITY HVAC SYSTEM PERFORMANCE PARAMETERS

Item	Refueling Ventilation System		Paint Shop, Carpentry Shop, Cold Machine Shop, Rigging Test Room, Ventilation System					
	Supply Air Unit	Exhaust Unit	Supply Air Units		Exhaust Air Units			
					Cold Machine Shop	Paint Shop	Carpentry Shop	Rigging Test
Air Conditioning / Ventilation								
Type	Horizontal Draw-Thru	Fan Only	Horizontal Draw-Thru	Horizontal Draw-Thru	Fan Only	Fan Only	Fan Only	Fan Only
No. of Units	1	1	1	1	3 (One Stand-By)	1	1	1
Flowrate, Each Ft^3/min	3,300	3,200	14,400	14,000	13,400	1,200	500	1,765
Fan								
Type	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Drive	Belt	Belt	Belt	Belt	Belt	Belt	Belt	Belt
Total Pressure, in.w.g.	2	1/8	2.5	2.5	1/8	7/8	1/4	1/8
Motor HP	2	1/3	10	10	1-1/2	1/3	1/4	1/3
Cooling Capacity, BTU/H	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heating Capacity, kW	36	N/A	80	80	N/A	N/A	N/A	N/A
Pre-filter								
Quantity	2-20x25x2	N/A	4-16x20x2 4-16x25x2 1-20x20x2 1-20x25x2	4-16x20x2 4-16x25x2 1-20x20x2 1-20x25x2	N/A	N/A	N/A	N/A
Pressure Drop Clean, in.w.g.	0.28		0.28	0.28				
Efficiency, % (Average Dust Spot Atmospheric)	30		30	30				

Table 9.4-17, cont.

SOUTH YARD FACILITY HVAC SYSTEM PERFORMANCE PARAMETERS

Item	Restricted Holding Area Ventilation System		Welding Area Ventilation System			REMS Holding Area Ventilation System	
	Unit Heater	Exhaust Unit	Supply Air Unit	Exhaust Air Units		Supply Air Unit	Exhaust Air Unit
				Room	Welding		
Air Conditioning / Ventilation							
Type	Propeller Type Wall Mounted	Fan Only	Horizontal Draw-Thru	Fan Only	Fan Only	Horizontal Draw-Thru	Fan Only
No. of Units	1	1	1	1	1	1	1
Flowrate, Each Ft^3/min	620	3,500	4,700	4,900	4,900	4,800	2,400
Fan							
Type		Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal	Centrifugal
Drive		Belt	Belt	Belt	Belt	Belt	Belt
Total Pressure, in.w.g.		1/4	2	3/8	2-1/2	2	0.5
Motor HP	1/5	3/4	3	3/4	3	3	0.5
Cooling Capacity, BTU/H	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Heating Capacity, kW	7.0	N/A	50	N/A	N/A	27	N/A
Pre-filter	N/A	N/A		N/A	N/A		N/A
Quantity			3-20x25x2			3-20x25x2	
Pressure Drop Clean, in.w.g.			0.28			0.28	
Efficiency, % (Average Dust Spot Atmospheric)			30			30	

Table 9.4-17, cont.

SOUTH YARD FACILITY HVAC SYSTEM PERFORMANCE PARAMETERS

Item	Electrical Room Ventilation System		Telecommunication room Air Conditioning
	Outside Air Intake	Exhaust Air Unit	Recirculation Unit
Air Conditioning / Ventilation			
Type		Fan Only	Wall Air Conditioning
No. of Units		1	1
Flowrate, Each ft^3/min		1,400	175/125
Fan	Not Required (Outside air is drawn thru Louver)		
Type		Centrifugal	
Drive		Belt	
Total Pressure, in. w.g.		1/8	
Motor HP (watt)		1/4	(600)
Cooling Capacity, BTU/H		N/A	5400
Heating Capacity, kW		N/A	N/A
Pre-filter		N/A	N/A
Quantity			
Pressure Drop Clean, in. w.g.			
Efficiency, % (Average Dust Spot Atmospheric)			

TABLE 9.4-18

SOUTH YARD FACILITY SPACE DESIGN CONDITION

System	Type[(a)]	Temperature (°F)		Pressure in. w.g.
		Summer (Dry Bulb)	Winter (Dry Bulb)	
Second Floor Air Conditioning				
- Offices and Occupied Areas	HVAC	78 and 50% RH (max)	70	N/A
- Toilets, Lockers and Shower Areas	HVAC	78 and 50% RH (max)	70	N/A
Hot Machine Shop, Counting Room, Supply Room, REMS Work Area, Decontamination Shop, Beta Booth Corridor and Mixed Waste Room				
- Hot Machine Shop	HV	95	65	negative -0.1
- Counting Room, Supply Room	HVAC	78 and 50% RH (max)	70	negative
- REMS Work Area	HV	95	65	negative -0.1
- Decontamination Shop	HV	95	65	negative -0.1
- Beta Booth Corridor	HV	95	65	negative-0.1
- Mixed Waste Room	HV	95	65	negative-0.1
Refueling	HV	95	65	
Cold Machine Shop Rigging Test Room	HV	95	65	N/A
Restricted Hold Area	HV	95	55	N/A
Welding Area	HV	95	65	N/A
REMS Holding Area	HV	95	55	N/A
Electrical Room	V	104	50	N/A
Telecommunication	HVAC	78	N/A	N/A

a) HVAC - heating, ventilation, air conditioning
HV - heating and ventilation

9.5 OTHER AUXILIARY SYSTEMS

Not all subsystems of Other Auxiliary Systems are required to support permanent plant shutdown or defueled operations. The status of these subsystems is listed in the table below. Design Basis, Licensing Basis, and operational information contained in this section has been updated to reflect the current status. Although the subsystems removed or partially removed from service no longer support operation, they may still contain fluids, gases, or other hazards such as energized circuits, compressed air, radioactive material, etc. Equipment may not have been physically removed from the plant. See General Arrangement Drawings, P&IDs, and One Line diagrams for the current plant configuration.

System	Status
Fire Protection System	Partially Removed from Service
Communications Systems	Partially Available
Lighting Systems	Available
Diesel Generator Fuel Oil Storage and Transfer System	Removed from Service
Diesel Generator Cooling Water System	Removed from Service
Diesel Generator Starting System	Removed from Service
Diesel Generator Lubrication System	Removed from Service
Diesel Generator Combustion Air Intake and Exhaust System	Removed from Service

9.5.1 FIRE PROTECTION SYSTEM

The fire protection system (FPS) is designed to prevent, detect, contain, and manually extinguish fires in the plant.

The FPS, where referred to in this section, includes fire detection and extinguishing systems and equipment. It is exclusive of such design elements as physical separation, barrier separation, and burning characteristics of combustibles, which limit the propagation of fire but do not actively extinguish it. These design elements are considered, however, when analyzing the results of a fire in an area of the plant where a loss of in-service components and systems in that area would jeopardize spent fuel pool functions or an area with the potential for a radiological release due to a fire in the plant. The maximum postulated fire in an area is termed the credible fire, as opposed to the design basis fire which postulates the complete combustion of all fuel in an area regardless of available active or passive fire protection.

The FPS water supply and pumping equipment are shared by Units 2 and 3. Fire suppression and fire detection systems are being removed from service or physically removed as combustibles or other hazards are removed from the affected fire zones. Other fire protection equipment described below is provided for each plant individually.

The fire water supply system is also used to support other plant systems in the event of a design base fire in certain fire areas. See the Updated Fire Hazards Analysis, Section 3.0.

9.5.1.1 Design Bases

A. Structures, systems, and components important to safety are designed and located to minimize, consistent with other safety requirements, the fire hazard. Noncombustible and heat-resistant materials are used whenever practical throughout the units to minimize potential fires (including duration, severity, and intensity in any combustion zone) in accordance with 10CFR50 General Design Criterion 3, Fire Protection. In-Situ Combustible Loading, 90035CT, provides information on the combustible loading and fire severity in various areas of the plant.

B. The existing fire barriers provide "defense-in-depth" protection for the independent SFP cooling and SFP makeup functions.

C. The FPS is not a safety-related system. FPS components, however, are designed so that seismic loadings do not cause loss of function of plant structures, systems, or components important to safety, in compliance with 10CFR50 General Design Criterion 3, Fire Protection.

D. FPS components are designed so that their inadvertent operation does not result in loss of function of plant structures, systems, or components important to safety, in compliance with 10CFR50 General Design Criterion 3, Fire Protection.

E. The FPS is designed to minimize the effects of fires consistent with the postulated type, location, duration, severity, and fire loads in the Fuel Handling, Penetration, Auxiliary Radwaste, and Auxiliary Control Buildings. Other plant areas which are protected by means of manual fire protection (with use of adjacent fire hydrants and hoses) are accessible with respect to heat, smoke, toxic combustion products, and radiation.

F. The plant fire protection water supply system is capable of supplying rated flow with the largest pump out of service. The fire protection water supply system is rated to supply simultaneously the maximum flow for any automatic sprinkler system or water spray system and 750 gal/min for fire hoses, assuming the shortest fire main flow path is valved out of service.

G. The fire protection water supply yard main is arranged so that each branch line from the main may be supplied with water from the pumps by alternate flow paths. Two-way hydrants are installed at a maximum of 300-foot intervals along the main which will ensure adequate coverage of plant areas by fire truck hoses.

H. Hydraulically balanced automatic sprinkler systems, ordinary or extra-hazard automatic sprinkler systems, and hydraulically designed automatic water spray systems are installed in areas with a high fire potential which cannot otherwise be protected by separation or by limiting the quantities of combustibles. As combustible hazards are removed, water spray and wet-pipe sprinkler fire suppression systems are removed from service in accordance with SO123-FP-1. Criteria for determining the need for remaining systems are in compliance with the Nuclear Mutual Limited (NML) guide, Property Loss Prevention Standards for Nuclear Generating Stations (June 1974).

I. Standpipes, inside hose connections, and fire hose stations are provided in areas adjacent to and within stair towers and other points in accordance with applicable National Fire Protection Association (NFPA), and NEIL regulations and recommendations.

J. Portable fire extinguishers are provided throughout normally accessible areas of the plant in accordance with applicable NFPA, and NEIL regulations and recommendations.

K. Alarms are provided in the Control Room / Command Center upon activation of automatic fire protection systems. Fire and smoke monitoring and detection systems are installed in areas where a potential for fire exists to damage spent fuel pool function and / or radiological release due to a fire. These systems alarm in the Control Room / Command Center.

L. Two FPS water supply jockey pumps are provided to maintain system pressure and to minimize cycling of the main fire pumps.

M. Portions of standpipes and hose connections are designed to withstand a design basis earthquake. The water supply to these standpipes is from a seismically–qualified water tank via a hose connection and a seismically–qualified pump.

9.5.1.2 System Description

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.1.3 Safety Evaluation

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.1.4 Tests and Inspections

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.1.5 Component Description

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.1.6 System Operation

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.1.7 Personnel Organization, Qualification and Training

The specific content of this section is discussed in the Updated Fire Hazards Analysis.

9.5.2 COMMUNICATION SYSTEMS

The communication systems include internal (in-plant) and external (out-of-plant) communications designed to provide convenient and effective operational communications among various plant locations and between the plant and locations external to the plant.

9.5.2.1 Design Bases

Various communication systems are provided in the plant to ensure reliable communication during maintenance and under normal and emergency conditions. The design bases of these systems are:

A. A telephone system, two-way radio system, and a public address system (PA) are provided to accomplish onsite communication between the Control Room / Command Center and various plant locations.

B. Public and Private Telephone System Network and a radio system is provided to permit plant-to-offsite communication on a continuous basis. These systems are not required to operate subsequent to a design basis accident (DBA).

C. The plant has communication circuits to the SCE and SDG&E dispatching centers. Alternate systems are provided from the station to the SCE dispatcher.

D. The emergency evacuation alarm system is designed to warn personnel to evacuate the exclusion area in the event of a design basis accident. The emergency evacuation alarm system is designed to remain functional subsequent to a design basis earthquake in all seismically qualified buildings. The plant public address paging system speakers can also function as emergency evacuation alarms. The Units 2 & 3 emergency evacuation alarm system also actuates the Reservoir Thunderbolt siren. An isolation relay has been utilized to isolate it from the Units 2 & 3 QC II system.

E. The communication systems are provided with diverse power sources as listed in Table 9.5-2. The main equipment cabinets and power supplies are located in separate areas to minimize losses from fire.

F. The communication systems conform with applicable local codes, standards, ordinances, and Federal Communication Commission regulations. The emergency evacuation alarm system is designed to conform to the standards indicated in Controlled Document 90034, “Q-List.”

G. Functional communication tests will be performed between all operating stations to demonstrate system capabilities.

9.5.2.2 System Description

The plant communication systems are illustrated schematically in the following controlled drawings.

35980	35982	35984	35986
35981	35983	35985	

The locations of telephones and public address speakers are shown on the station lighting and communication plan drawings.

9.5.2.2.1 In-Plant Communication Systems

9.5.2.2.1.1 SCE PAX Telephone System

The primary means of communication within the plant is a distributed, multi-switch Private Branch Exchange (PBX). The switches are interconnected with a fiber optic transmission system. The switch locations are in the AWS building, SCE Microwave building, and Elevation 70 ft of the Units 2 and 3 Control Building.

This system, commonly referred to as Private Automatic Exchange (PAX), provides station-to-station private line communications with any PAX telephone onsite, including the command center, and between the plant and the external SCE PAX system. Interconnection to the Public Address (PA) System is also provided.

Cables between PAX node locations are routed underground in concrete-encased duct banks, conduits or covered cable trays to protect the cable from being severed accidentally. All communication cables within the plant have fire resistant insulation or are routed in conduit, in nonsafety-related cable trays or with an aluminum sheath to resist damage. Communication cabling entering plant communication rooms from outside the building are routed using SCE Communication System Practices which may include small amounts of non-flame resistant cable insulations.

The PAX exchange is powered by 48-volt battery supplies located near each telephone switch.

9.5.2.2.1.2 Public Address System

The Unit 2 and 3 paging system consists of a central rack of 48-volt amplifiers powered by the Unit 2 and 3 communication battery. Paging speakers utilize self-contained matching transformers and are distributed between amplifiers for increased reliability in the event a given amplifier or speaker fails. Access to the PA system may be obtained from select PAX telephone positions using a dedicated number or by a priority override from the Control Room / Command Center operator telephone and CAS. A tone generator is included to provide siren signals over the paging speakers throughout the plant.

9.5.2.2.1.3 Emergency Evacuation Alarm System

For buildings previously classified as quality class II, an emergency evacuation alarm system is provided consisting of electronic sirens installed throughout the buildings and one motor-driven roof-mounted siren. Also, an additional motor-driven Reservoir Thunderbolt siren has been provided near the bluff north of the plant. The sirens are actuated manually from the command center. The perimeter PA system is used for paging individuals within the exclusion area and to notify the general public along the plant perimeter in case of an emergency which would require evacuation of the area adjacent to the site. The perimeter paging system cabinet (2/3L-210) is located in the Auxiliary Control Building. The perimeter speakers are operated from microphones in the Unit 2 and 3 shift manager's office. They are driven from amplifiers in the Unit 2 and 3 communication room. For nonsafety-related buildings the tone generator connected to the public address amplifiers provides plant evacuation siren signals. In addition, the emergency sirens can be activated independently by pushbuttons located in its associated main Control Room / Command Center panel. Emergency Evacuation Alarm System equipment classifications are listed in Controlled Document 90034, “Q-List.”

9.5.2.2.1.4 Two-Way Radio

Portable, UHF two-way radios are available for voice communication among plant personnel.

The UHF radio system is a multi-channel trunked configuration in the 800 MHz band. Channels are assigned to functional organizations by a central controller on an as needed basis.

If the PAX is not available, hand-held portable transceivers and fixed radio consoles are available for communications. UHF repeater stations assure coverage virtually throughout the plant except for prohibited and dead zone areas noted in the security plan. Power sources for the radio system are as listed in Table 9.5-2.

9.5.2.2.2 Public Offsite Communication System

ATT’s Telephone Company commercial telephone system interfaces with the plant PAX system. Extensions are installed in the command center, supervision offices, and maintenance and administrative areas throughout the plant. The PAX system provides direct dialing to locations outside the plant, both local and long distance, and also between extensions within the plant.

9.5.2.2.3 Private Offsite Communication System

The private offsite communication system provides communication between the plant and offsite locations, including security forces and remote points in the power system.

9.5.2.2.3.1 Security Force Communication

Multiple communication methods to offsite security forces exist. The public offsite communication system described in Section 9.5.2.2.2 is used as one method. One other method consists of a radio communication system with Law Enforcement Agency (LEA).

Telephone lines are available in the SAS, CAS and in the command center's operator telephone turrets. The Law Enforcement Agency radio link may be accessed from radio consoles in the CAS and SAS.

9.5.2.2.3.2 Power System Communications

Communication with offsite locations in the power system is provided by means of a private communications network described below:

A. SCE PAX Dial Trunking

Forty-eight dial trunks connect the plant PAX system into the external SCE company PAX dial system via the Santa Ana Central Exchange, 24 dial trunks connect the plant PAX system directly to the central system in SCE (Rosemead), and seventy-two dial trunks connect the plant via the Alhambra Central Exchange. This interconnection uses a combination of multiplexed channels and routes.

B. San Diego Gas & Electric Communications

Four (4) direct tie lines from Santa Ana to SDG&E are available on SCE/SDG&E private network by means of multiplex microwave channels to the load dispatcher. Alternative channels and fiber optics to SDG&E are available via the SCE PAX system and the telephone company facilities.

C. U.S. Marine Corps Communications

There is a radio communication on a USMC frequency between the command center staff and the U.S. Marine Corps Headquarters Fire Station. Communications via the PTSN exists from the CAS and the SAS to offsite agencies.

Radio communication on a USMC talk group is provided between the command center staff and the U.S. Marine Corps Headquarters Fire Station. Also radio communications on a USMC talk group is provided between CAS and US Marine Corps Provost Marshall.

Table 9.5-2
COMMUNICATION SYSTEMS POWER SUPPLIES

System	Power Supply
SCE PAX telephone system at AWS building, SCE microwave building, control building, and elevation 70 ft.	Power source for same building as respective node
Units 2 and 3 -	
PA system	Communication battery, common to Units 2 and 3, control building, elevation 9 ft
SCE PAX dial trunking SDG&E circuits	Communication battery, common to Units 2 and 3, control building, elevation 70 ft 480VAC/48VDC backed by Diesel Generator
System radio repeaters, Control Room / Command Center radio consoles, and Central Alarm Station (CAS) radio consoles.	Redundant 48 VDC with local 30 minute battery backup. Battery chargers are powered from 480 VAC (Diesel Generator backup) Bus BQ.
Radio consoles at other locations	Local 110 VAC power
Portable radio (hand held units)	Self-contained battery packs
Emergency evacuation alarm system	A. AC power from either unit via manual transfer switch B. The Reservoir Thunderbolt siren receives power from MCC BQ.
Commercial Telephone Company	Telephone Company power
NRC emergency notification system (ENS)	EOF[2] Power source

D. NRC Emergency Notification Telephone System (ENS)

A dial line to the NRC Operations Center in Bethesda, Maryland is provided within the Control Room / Command Center.

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[2] The SONGS Permanently Defueled Emergency Plan (PDEP) no longer includes an Emergency Operations Facility (EOF); however, the legacy name for this building is still used.

E. Health Emergency System

Ambulance mobile units are equipped with cellular phones to communicate with SONGS and local hospitals.

9.5.2.3 System Operation

Diverse systems are provided to ensure means of in-plant and plant-to-offsite communications.

The in-plant communication systems are provided with reliable batteries and/or ac power supply sources to ensure constant communications between all areas of the plant. Table 9.5-2 lists the different communication systems and their corresponding sources of power. Table 9.5-3 summarizes onsite communication system capabilities during accidents.

Table 9.5-3

SUMMARY OF ONSITE COMMUNICATIONS SYSTEM CAPABILITIES AND NOISE CONSIDERATIONS DURING ACCIDENTS

Station	Max Anticipated Sound Levels[a] (dBA)	Communication Systems Available and Maximum Background Noise for Effective Communication[b]		
		PAX Telephone (dBA)	PAX Telephone Jack (dBA)	Paging Speaker (dBA)
Control Room / Command Center	70	92[b]		
ESF switchgear rooms	75	92[b]	92[b][d]	100[b][c]
Piping Penetration room				
Elevation 9 ft-0 in.	80	92[b]	92[b][d]	100[b][c]
Elevation 30 ft-0 in.	85	92[b]	118[e][c]	100[b][c]
Radwaste building				100[b][c]
Elevation 9 ft-0 in. and 24 ft-0 in.	80	92[b]	92[b][d]	

(a) Reference 3
(b) Reference 1
(c) Based on data supplied by vendors
(d) Telephone handset
(e) Ear-muff type headset

9.5.2.4 Safety Evaluation

Safety evaluation applies to equipment described in Section 9.5.2.1, item D.

A. The emergency evacuation alarm system has been designed to provide a signal that will be audible throughout the exclusion area.

   Power for the system is obtained from a common motor control center located in the auxiliary building, which is energized through an automatic transfer switch from load LDC02 or a dedicated communications diesel generator. An exception is the Reservoir Thunderbolt siren powered from MCC BQ.

B. The sirens, loudspeakers, microphones, amplifiers, power supplies, and circuits for the emergency evacuation alarm system, and their supports, are designed in accordance with Seismic Category I requirements as specified in Chapter 3. An exception is the Reservoir Thunderbolt siren which is Quality Class III Seismic Category II. New cables associated with repowering the 800 MHz system distributions panels are not seismically qualified.

9.5.2.5 Tests and Inspections

Systems of the types described above are conventional and have a history of successful operation at existing plants. Most of these systems are in routine use and this will ensure their availability. Those systems not frequently in use will be tested at periodic intervals to ensure operability when required.

9.5.3 LIGHTING SYSTEMS

The plant lighting systems and their components are not safety-related, although some are qualified to Seismic Category I standards, as described in Section 9.5.3.3. All lighting levels are designed to be equal to, or in excess of, the levels stipulated in IES Lighting Handbook (1972). Discussion and evaluation of the electric power systems are contained in Chapter 8.

9.5.3.1 Design Bases

The components of the lighting systems are protected from winds, floods, and missiles only to the extent that protection provided for specific equipment may also protect components of other systems physically within that protected area. These components require quality assurance documentation only on the seismic analysis of seismic supports. Protection from wind and tornado effects, flood design, and missile protection is discussed in Chapter 3.

The design basis of the lighting systems is that area lighting intensities provide the illumination required for comfort and worker efficiency in the performance of the visual activities required in that area.

The lighting systems conform with applicable local codes, standards, and ordinances. Generally, design of the plant lighting systems follows the guidance provided by the Handbook of the Illuminating Engineering Society.

9.5.3.2 System Description

Plant lighting is divided into three categories; normal, emergency, and essential. Normal and essential lighting have their power supplied from the SONGS Ring Bus distribution system described in Chapter 8.

Emergency lighting power is supplied from either repurposed station batteries, or from self-contained battery packs (fluorescent and sealed beam) that are energized from the Ring Bus distribution system.

9.5.3.2.1 Component Description

9.5.3.2.1.1 Normal Lighting

The normal lighting system provides plant illumination for the two units. Most of the normal lighting load is supplied from two double-ended load centers, each consisting of two 750 kVa, 4160-208Y/ 120-volt, indoor, dry-type transformers, low-voltage drawout main circuit breakers, and molded-case feeder circuit breakers. The load centers are common to both units.

Areas remote from the lighting load center are serviced by 480-208Y/120-volt dry--ype transformers, powered from the SONGS Ring Bus distribution system. All ac lighting transformers have grounded neutrals.

All fixtures and lamps are rated for 120V-ac service. Incandescent lamps are installed in the containment structure, safety equipment building, piping penetration rooms, radwaste building, and fuel handling building.

9.5.3.2.1.2 Emergency Lighting

Emergency lighting is installed in critical areas of the plant likely to be occupied by operating personnel (except in those areas noted in Section 9.5.3.2.1.3) and in exit corridors where minimum illumination is required for safety.

In the permanently defueled condition, Appendix-R Safe Shutdown and Appendix R 8-hour lighting is no longer required for San Onofre Units 2 and 3.

9.5.3.2.1.3 Essential Lighting

The essential lighting system provides a minimum amount of battery-backed lighting in several areas. The essential lighting system is served through battery backed AC power supplies or by self-contained battery powerpacks. The main Control Room / Command Center and associated corridors are served by 2 battery backed AC power supplies, each made up of batteries, a battery charger, an inverter, and a transfer switch. The other areas are served by the self-contained battery powerpacks, each consisting of a luminary with lamps and a power unit with batteries, battery charger, and inverter-ballast combination. The units are designed to provide continuous-rated illumination for a minimum of 90 minutes in the event of loss of input ac power. The supplies are wired such that, under normal conditions about half of the essential lights are supplied from one unit and the other half are supplied by the other unit.

9.5.3.3 Evaluation

The essential lighting system that serves the Control Room / Command Center and all supports of other lighting systems installed in Seismic Category I structures are designed in accordance with Seismic Category I requirements as specified in Chapter 3 and are consistent with paragraph c.1.n of Regulatory Guide 1.29. The components and supporting structures of any system, equipment, or structure that is not Seismic Category I, and whose collapse could result in the loss of a required function through either impact or flooding, are analytically checked to determine that they will not collapse when subjected to seismic loading.

9.5.3.4 Tests and Inspections

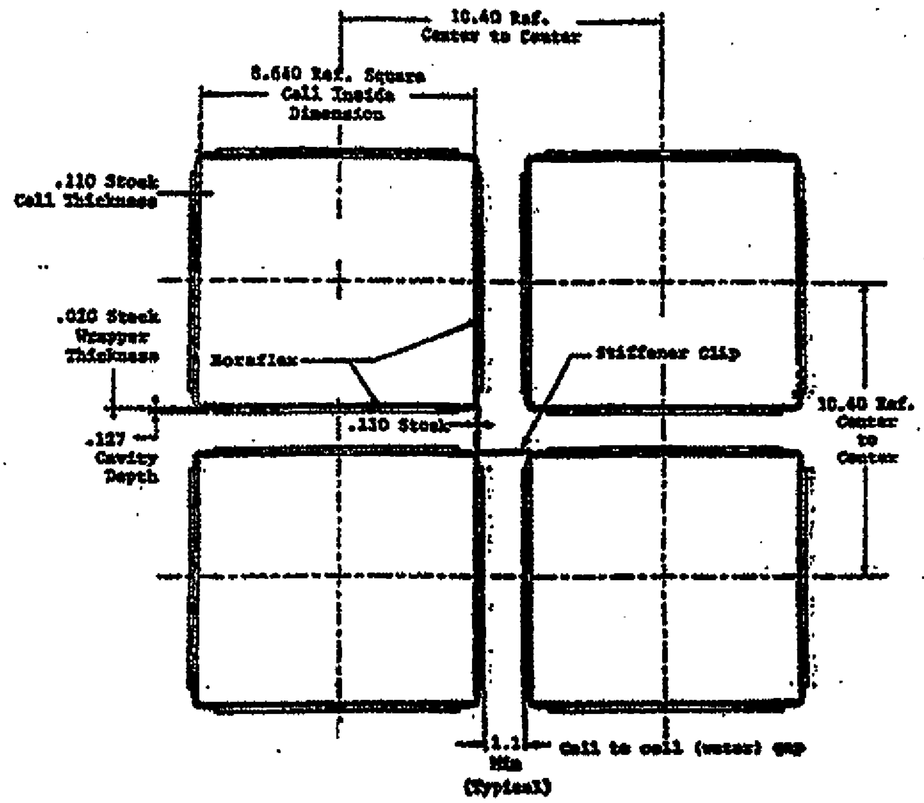
The ac lighting circuits and the essential lights are normally energized and require no periodic testing. The essential backup power supply which consists of battery charger, batteries, transfer switches, and inverter are inspected and tested periodically to ensure the operability of the automatic switches and other components in the system.

9.5.4 REFERENCES

1. "Updated Fire Hazards Analysis, San Onofre Nuclear Generating Station Units 1, 2 and 3," Southern California Edison Company.

2. Smith, A. J., "Considerations in the Design of Communications Systems for Power Plants," IEEE Power Engineering Society Transaction Paper No. T75 090-6, September 6, 1974.

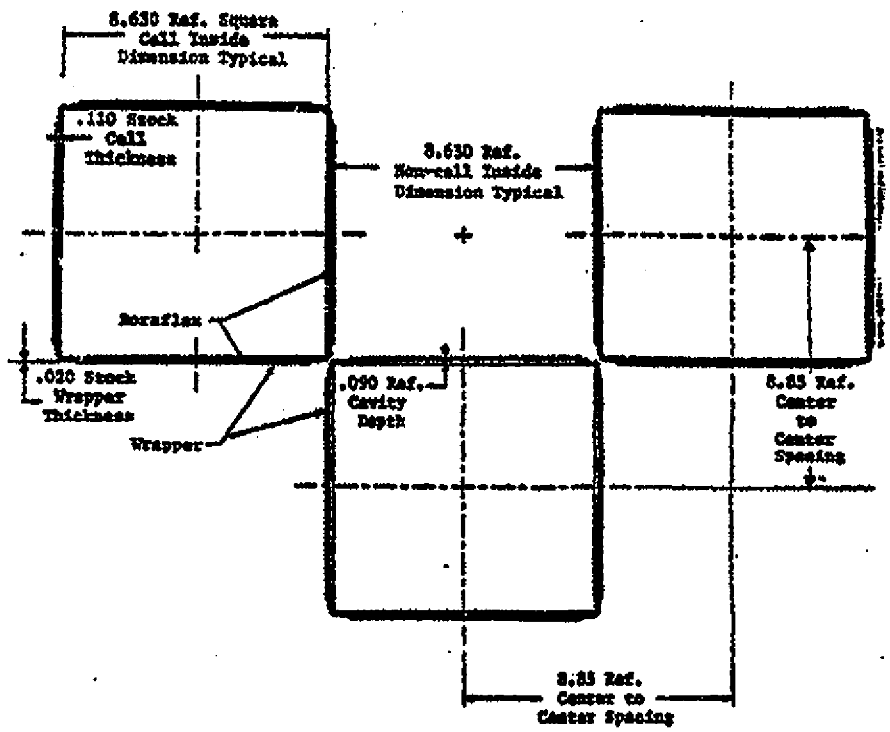
3. WR-83-30, "Ambient Noise Survey for San Onofre Nuclear Generating Station Units 2 and 3," Wyle Laboratories.



SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
Updated Final Safety Analysis Report

REGION I SPENT FUEL
STORAGE RACKS
NOMINAL CELL GEOMETRY

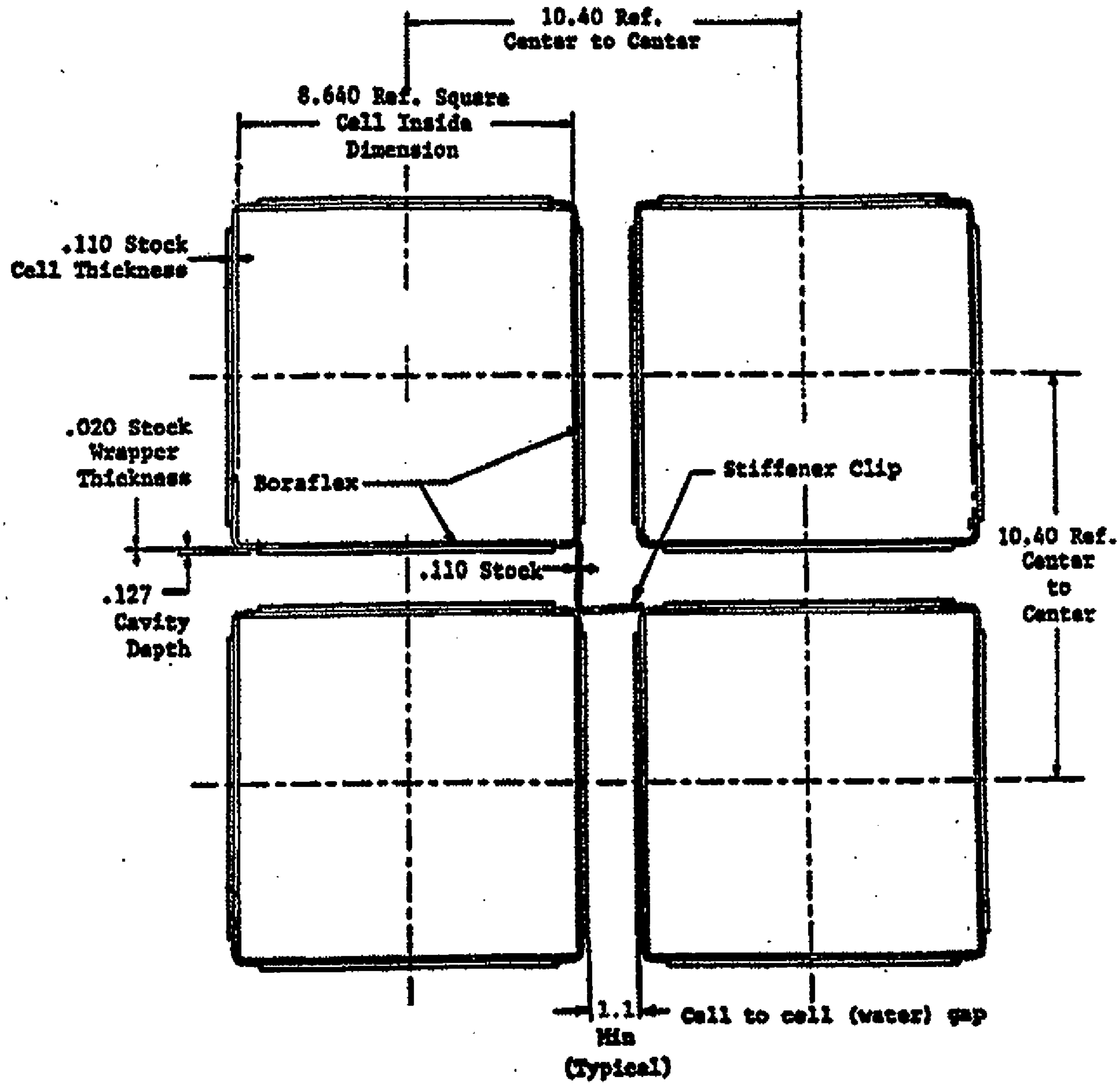
Figure 9.1-2 (Sheet 1 of 2)



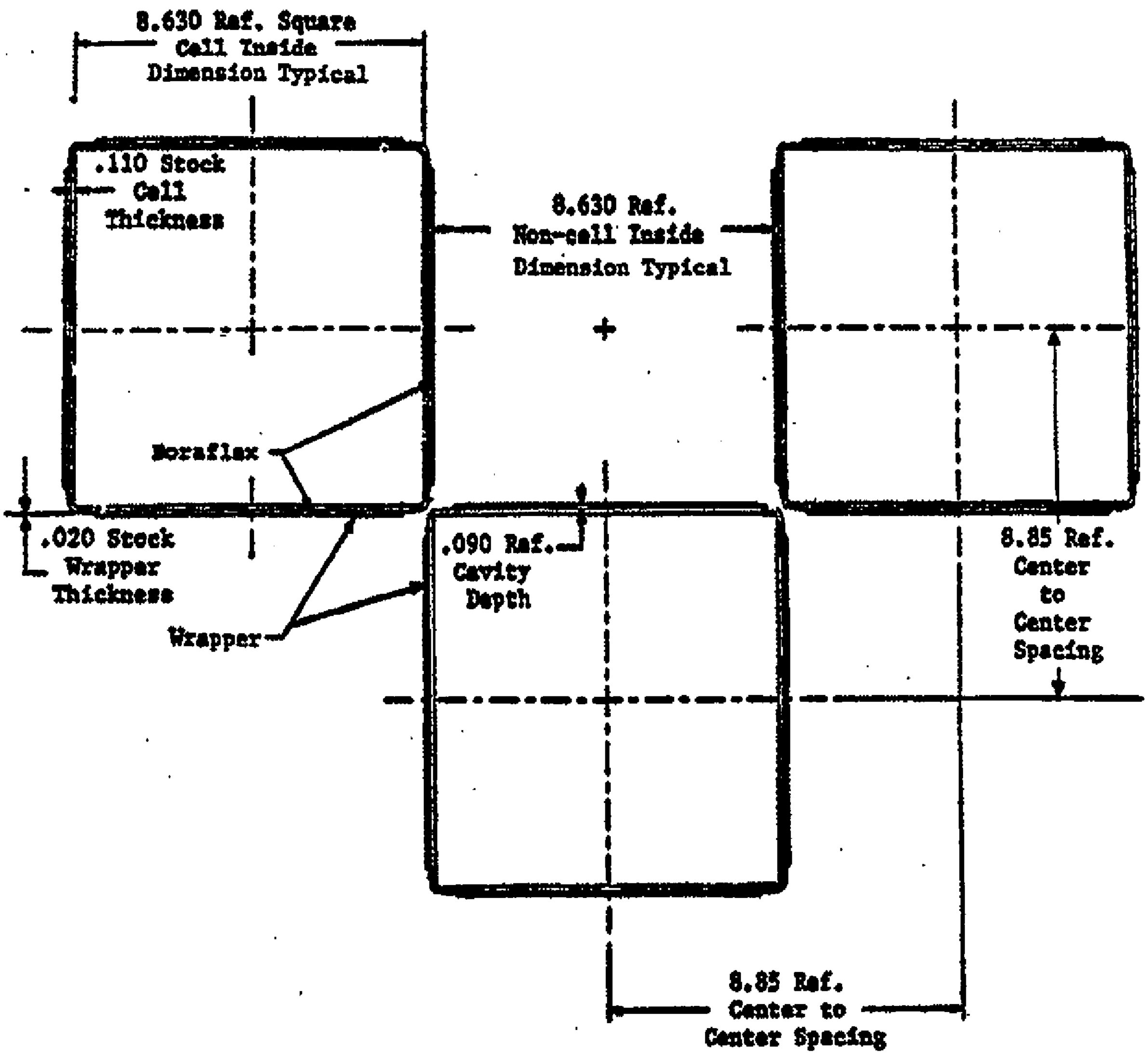
SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
Updated Final Safety Analysis Report

REGION II SPENT FUEL STORAGE RACKS NOMINAL CELL GEOMETRY

Figure 9.1-2 (Sheet 2 of 2)



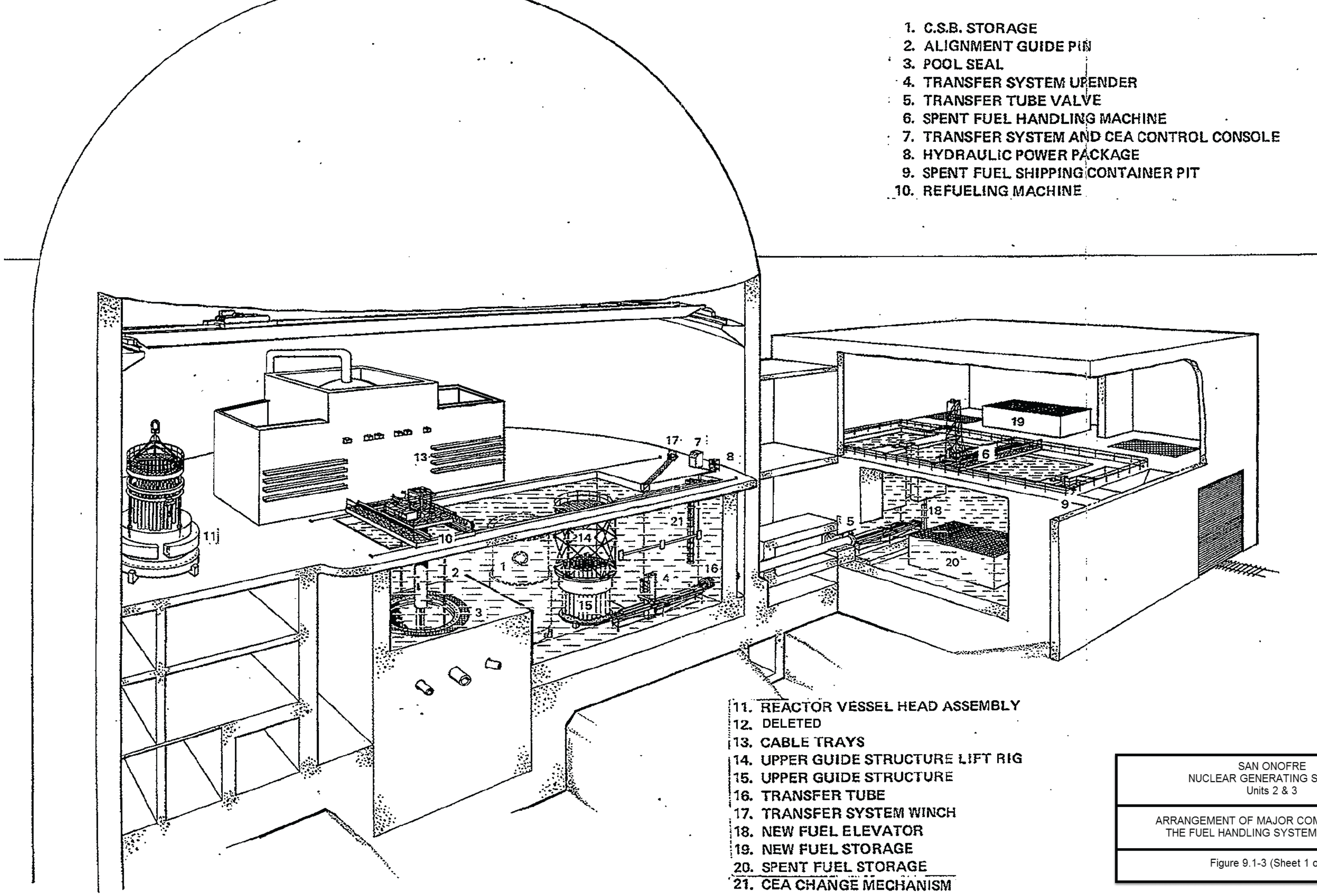
SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
REGION I SPENT FUEL STORAGE RACKS NOMINAL CELL GEOMETRY
Figure 9.1.2A (Sheet 1 of 2)



SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
Updated Final Safety Analysis Report

REGION II SPENT FUEL
STORAGE RACKS
NOMINAL CELL GEOMETRY

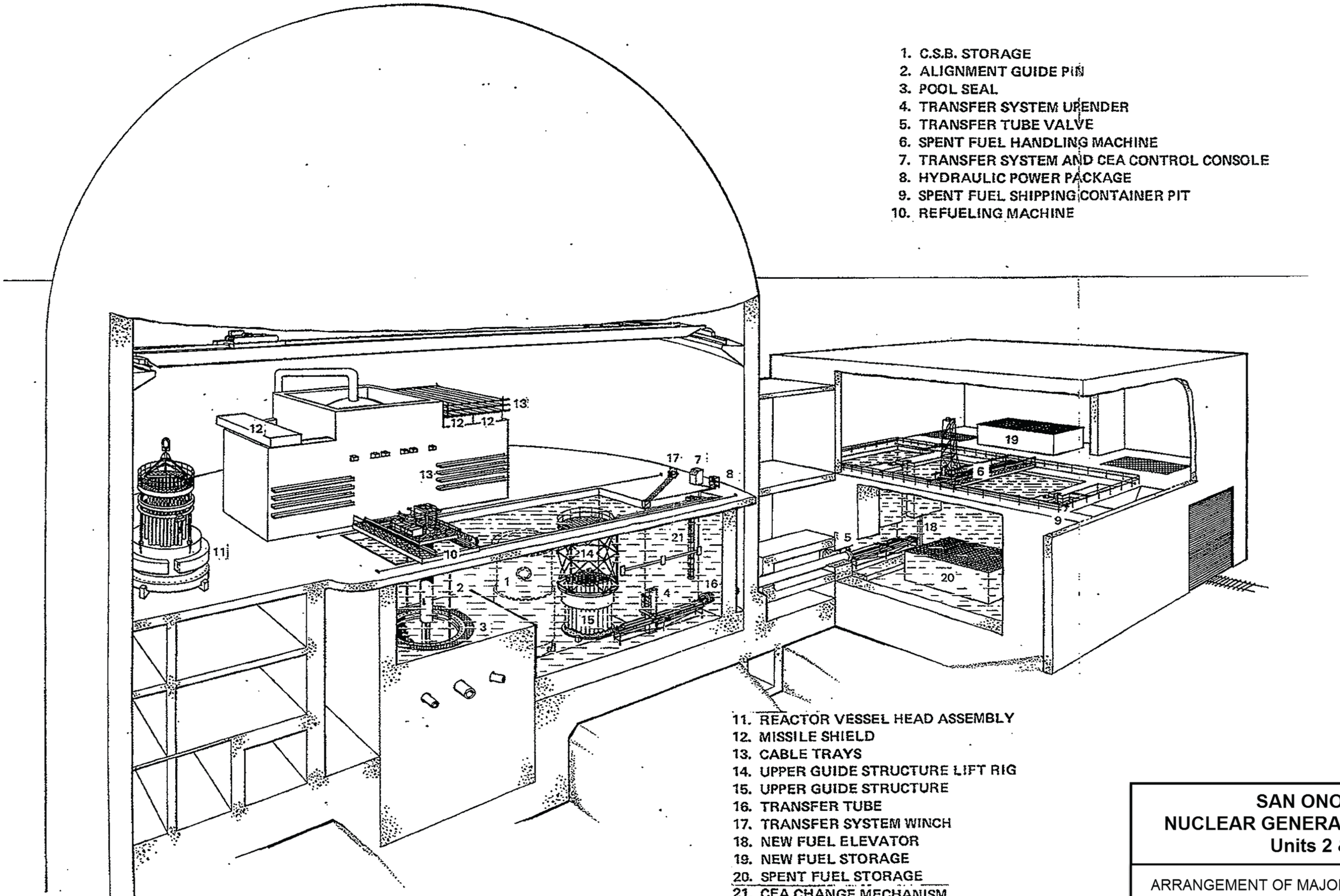
Figure 9.1.2A (Sheet 2 of 2)



SAN ONOFRE
NUCLEAR GENERATING STATION
Units 2 & 3

ARRANGEMENT OF MAJOR COMPONENTS OF THE FUEL HANDLING SYSTEM (Unit 2 Only)

Figure 9.1-3 (Sheet 1 of 2) REV 5

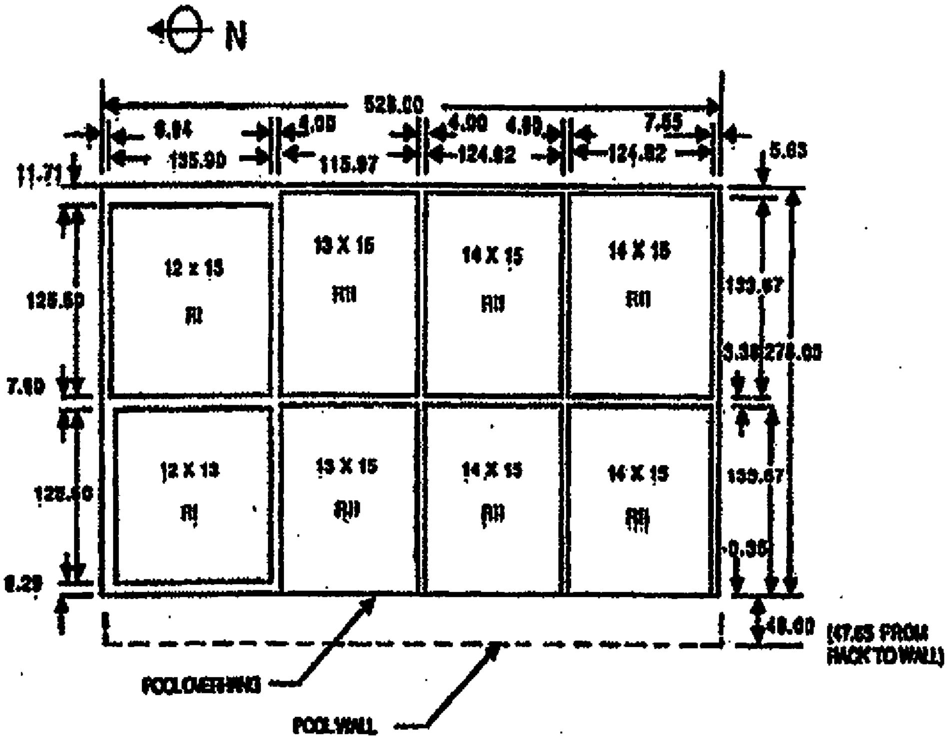


1. C.S.B. STORAGE
2. ALIGNMENT GUIDE PIN
3. POOL SEAL
4. TRANSFER SYSTEM UPENDER
5. TRANSFER TUBE VALVE
6. SPENT FUEL HANDLING MACHINE
7. TRANSFER SYSTEM AND CEA CONTROL CONSOLE
8. HYDRAULIC POWER PACKAGE
9. SPENT FUEL SHIPPING CONTAINER PIT
10. REFUELING MACHINE
11. REACTOR VESSEL HEAD ASSEMBLY
12. MISSILE SHIELD
13. CABLE TRAYS
14. UPPER GUIDE STRUCTURE LIFT RIG
15. UPPER GUIDE STRUCTURE
16. TRANSFER TUBE
17. TRANSFER SYSTEM WINCH
18. NEW FUEL ELEVATOR
19. NEW FUEL STORAGE
20. SPENT FUEL STORAGE
21. CEA CHANGE MECHANISM

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3

ARRANGEMENT OF MAJOR COMPONENTS OF THE FUEL HANDLING SYSTEM (Unit 3 Only)

Figure 9.1-3 (Sheet 2 of 2) REV 5



SAN ONOFRE UNIT 2
SPENT FUEL POOL LAYOUT
(Unit 3 Mirror Image)

REGION I: 312 Storage Locations at 10.40 inches CTC Spacing
REGION II: 1230 Storage Locations at 8.85 inches CTC Spacing
1542 Total Locations

NOTE: All dimensions are nominal and represent inches.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
SPENT FUEL STORAGE AREA FUEL RACK MODULE ARRANGEMENT
Figure 9.1-4

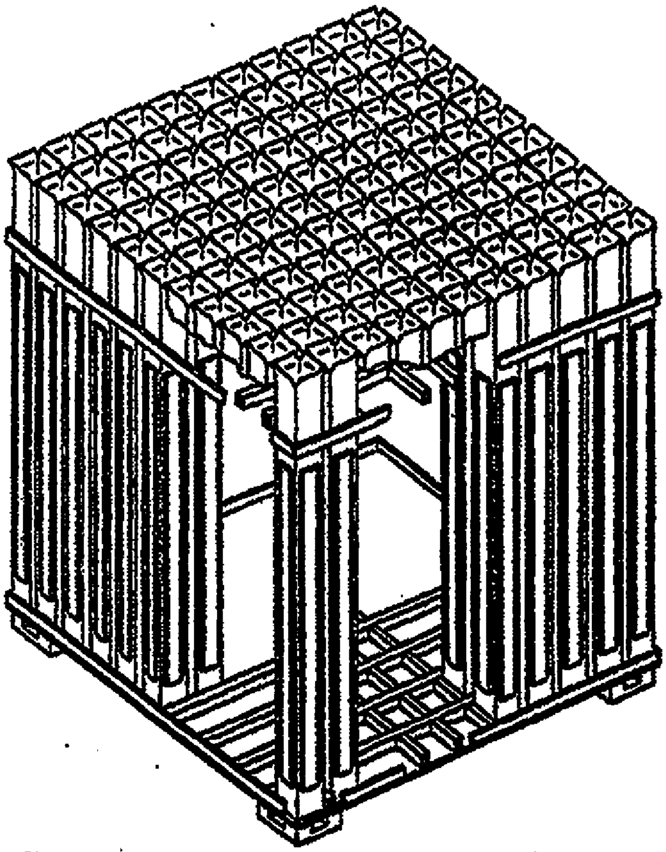


Figure shows 11 x 11 rack array. SONGS Region I racks are 12 x 13 arrays. Internal support pads are omitted. Boraflex is not required on rack sides that face the pool wall.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
SPENT FUEL STORAGE MODULE TYPICAL ELEVATION
Figure 9.1-5

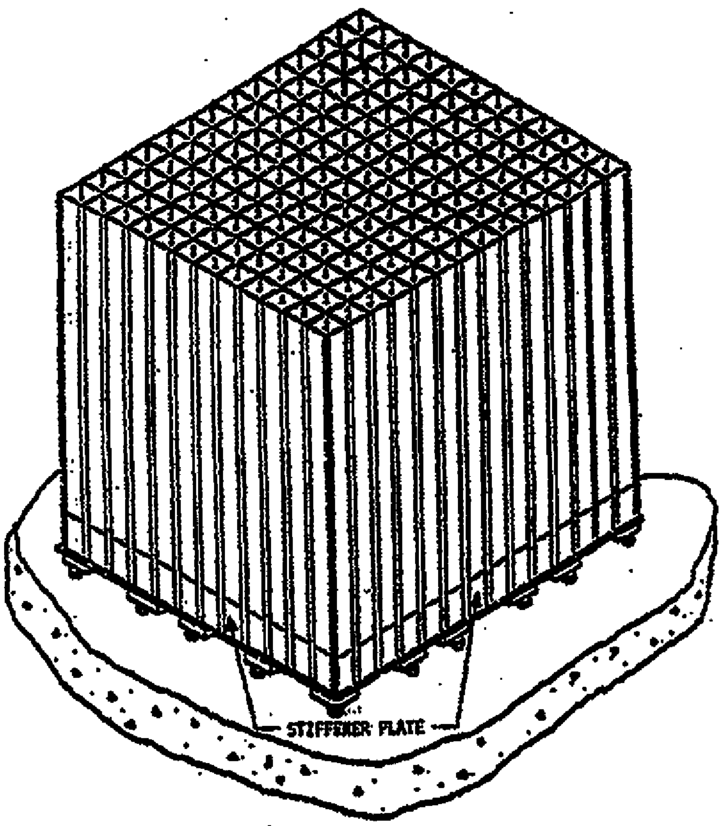
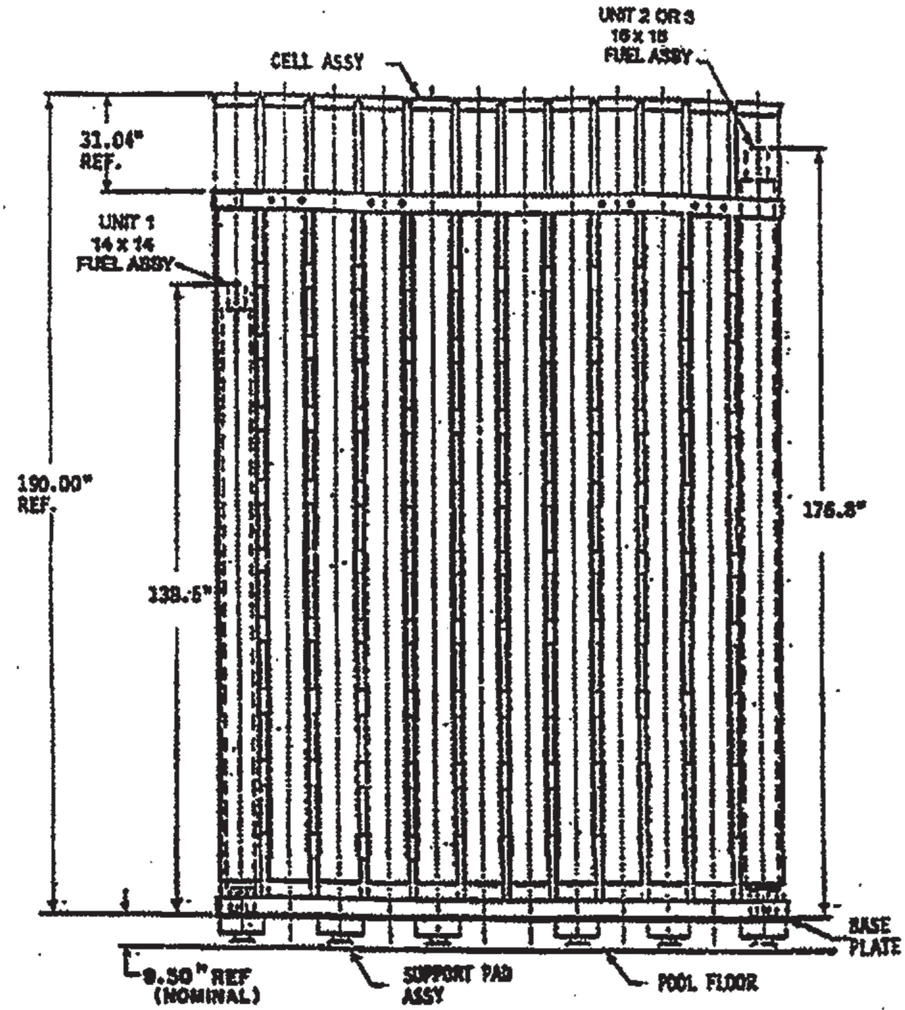


Figure shows 12 x 14 rack array. SONGS Region II racks are 14 x 13 and 13 x 15 arrays. Boraflex is not required on the periphery cell walls.

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
TYPICAL SECTIONS 4 X 8 AND 8 X 8 RACK MODULES
Figure 9.1-6



REGION I RACK SHOWN.

REGION II RACK HEIGHT IS SIMILAR.

NOTE: BRIDGE PLATES NOT SHOWN

SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
FUEL ASSEMBLIES IN HIGH DENSITY SPENT FUEL RACKS
Figure 9.1-9C

X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X		X		X		X	X	X
X	X		O		O		O		X	X
X	X	X		X		X		X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X

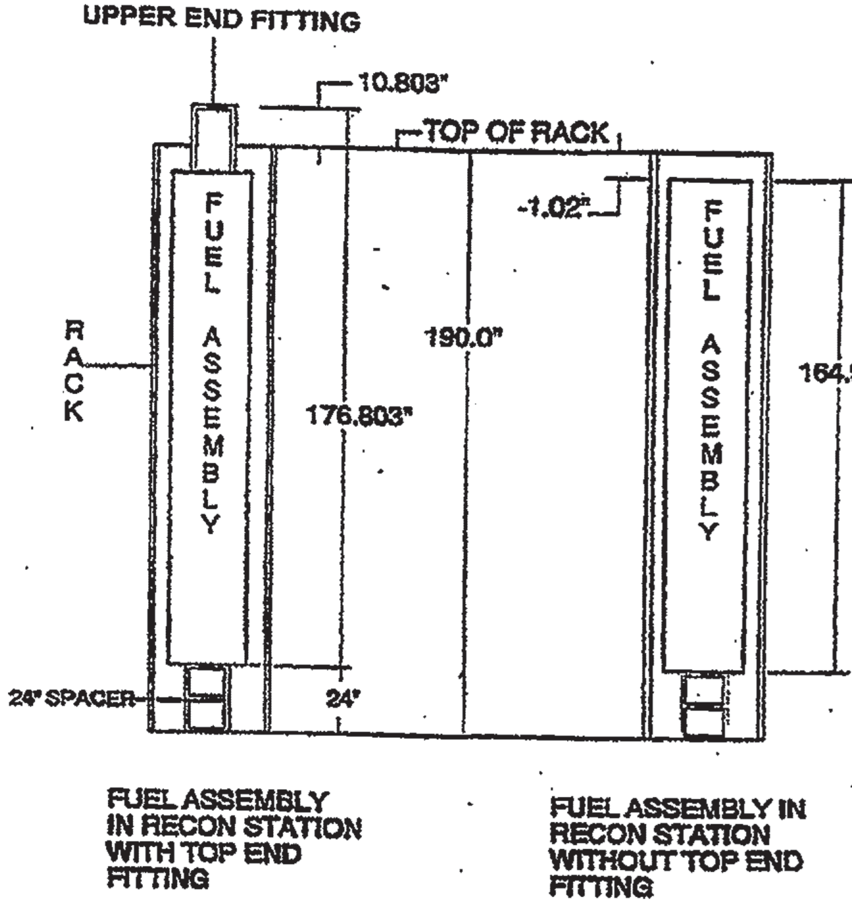
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X		X		X	X	X	X
X	X	X		O		O		X	X	X
X	X		O		O		O		X	X
X	X	X		X		X		X	X	X
X	X	X	X	X	X	X	X	X	X	X
X	X	X	X	X	X	X	X	X	X	X

O	= FUEL IN A RECONSTITUTION STATION
X	= FUEL NOT IN A RECONSTITUTION STATION
	= EMPTY (BLOCKED)

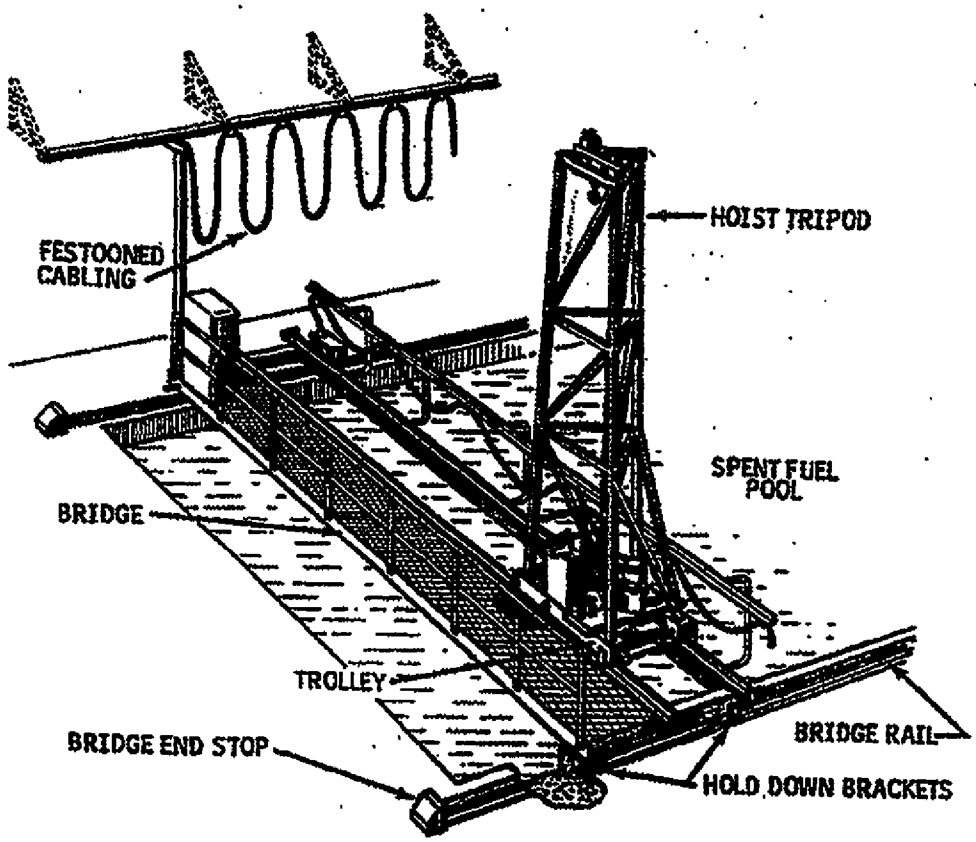
SAN ONOFRE NUCLEAR GENERATING STATION
UNITS 2 & 3
UPDATED FINAL SAFETY ANALYSIS REPORT

FUEL STORAGE PATTERNS
FOR REGION II RACKS
RECONSTITUTION STATION

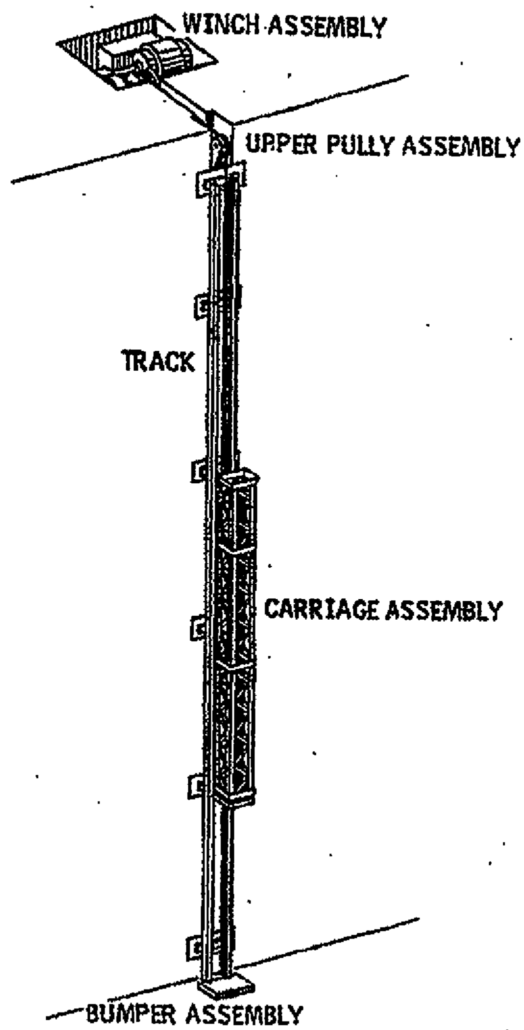
FIGURE 9.1-9D



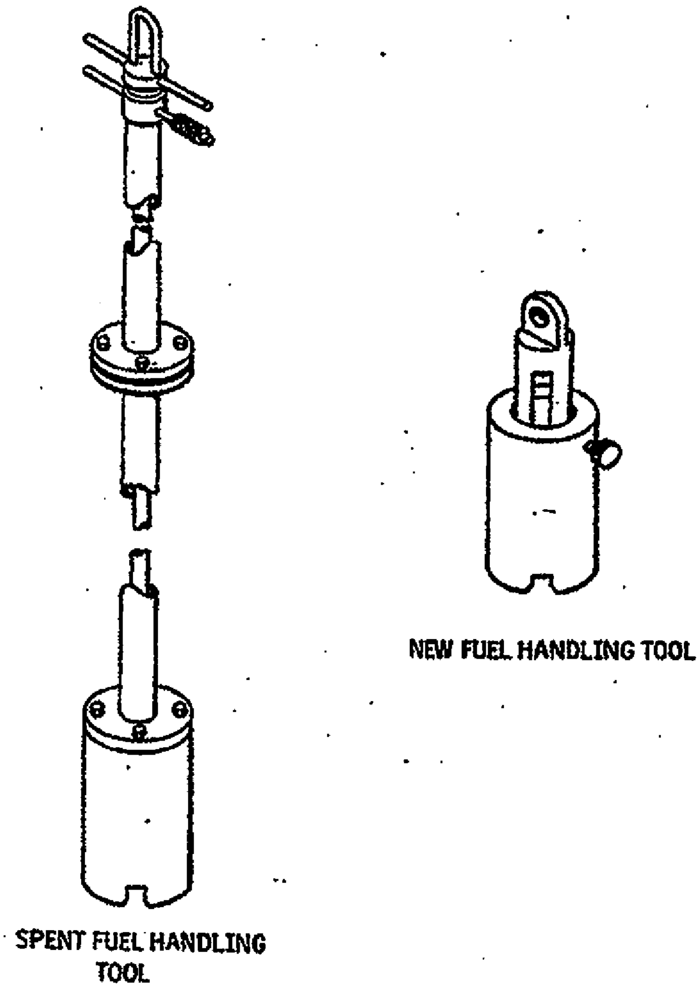
SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
SPENT FUEL ASSEMBLY INSIDE RECONSTITUTION STATION ATOP SPACER
Figure 9.1-9F



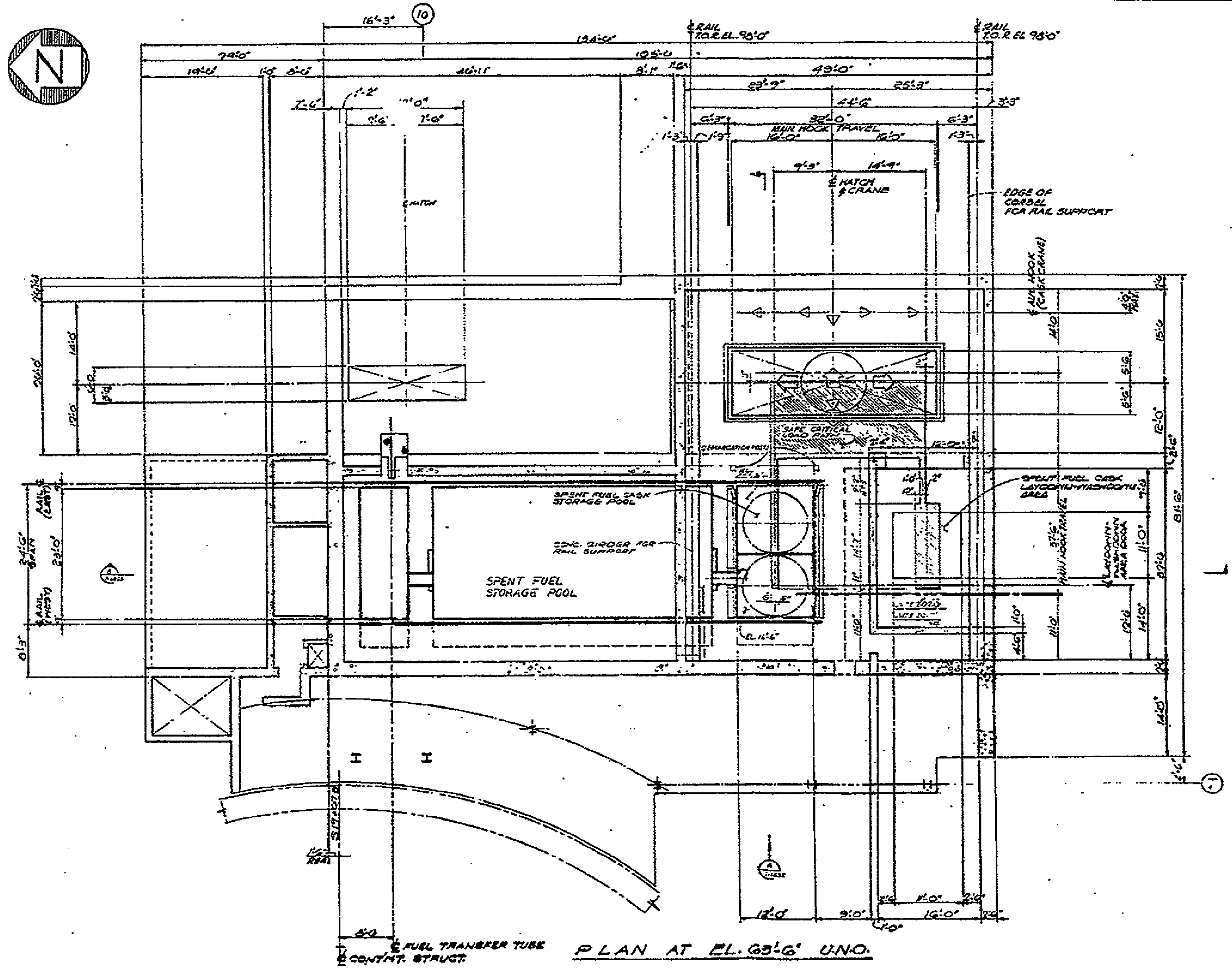
SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
SPENT FUEL HANDLING MACHINE
Figure 9.1-21



SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
NEW FUEL ELEVATOR
Figure 9.1-22



SAN ONOFRE NUCLEAR GENERATING STATION Units 2 & 3 Updated Final Safety Analysis Report
FUEL HANDLING TOOLS
Figure 9.1-23



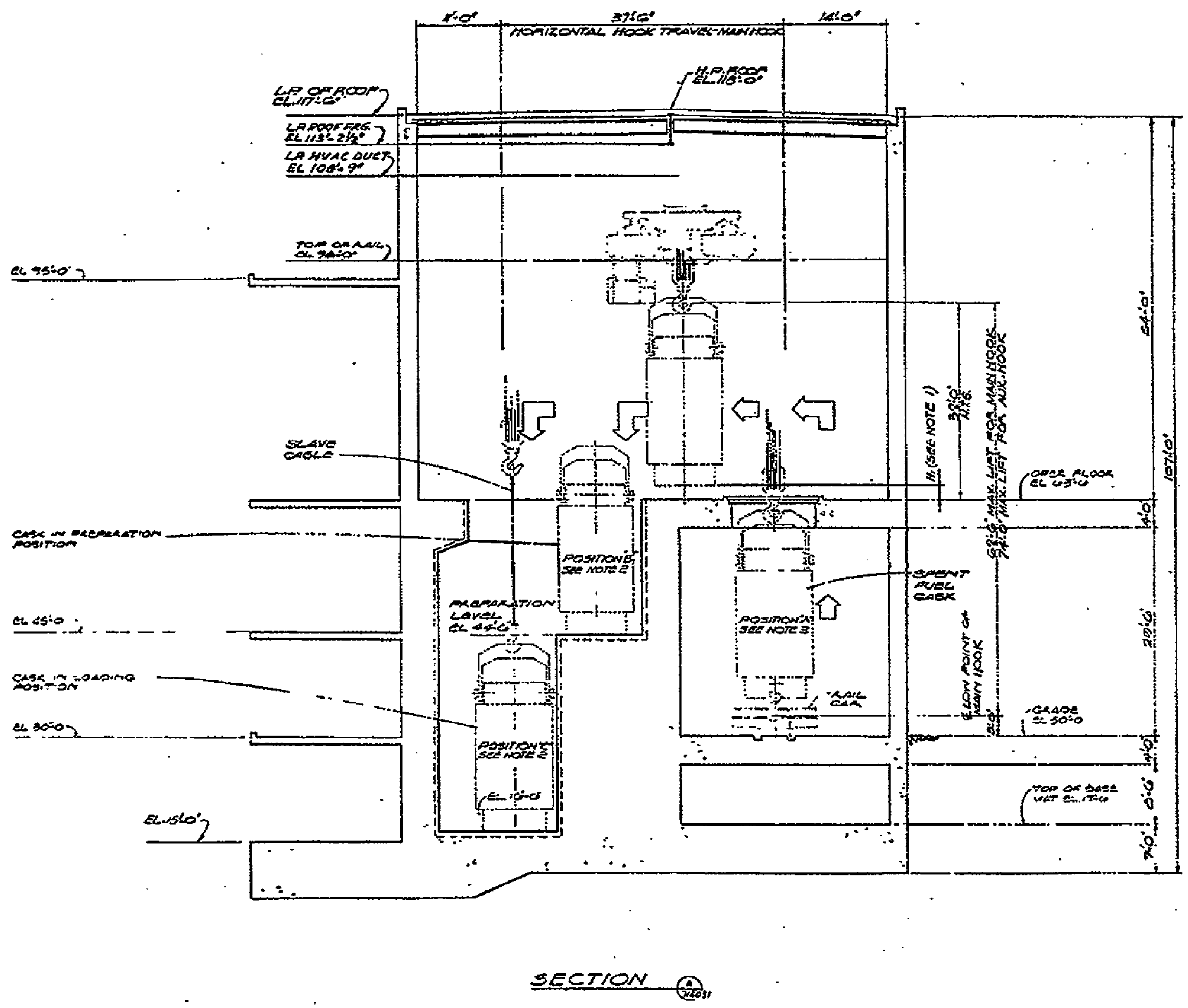
SAFE LOAD PATH

SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
Updated Final Safety Analysis Report

FUEL HANDLING BUILDING
CASK HANDLING CRANE TRAVEL PATH
REQUIREMENTS PLAN

FIGURE 9.1-24

716032



SAFE LOAD PATH

SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
Updated Final Safety Analysis Report

FUEL HANDLING BUILDING
CASK CRANE HOOK
HEIGHT REQUIREMENTS

FIGURE 9.1-25

Amended: April 2009 TL: E047999

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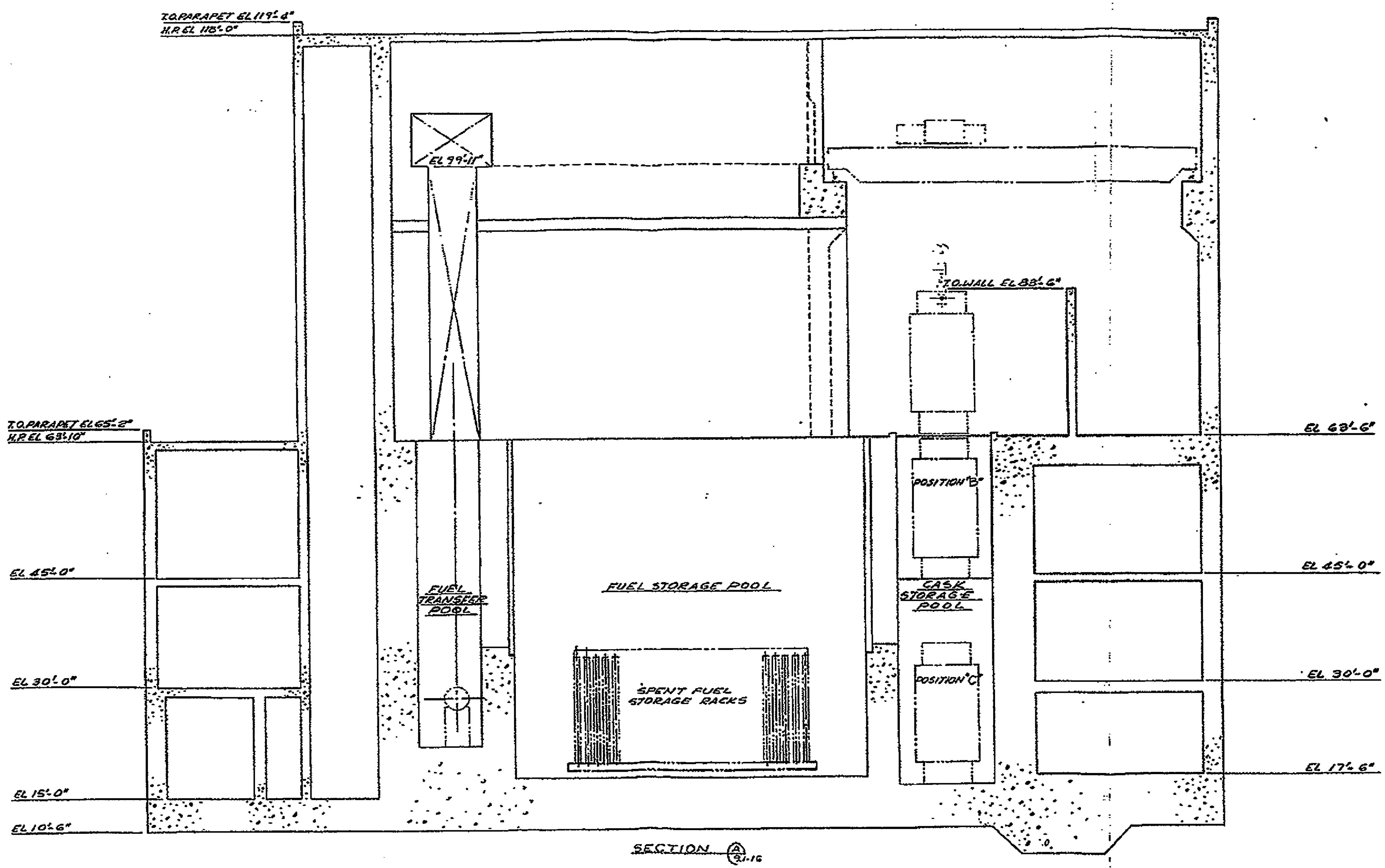

SAN ONOFRE NUCLEAR GENERATING STATION
Units 2 & 3
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FUEL HANDLING BUILDING
CASK LIFT AT STORAGE POOL

Figure 9.1-26