WOLF CREEK

CHAPTER 9.0

AUXILIARY SYSTEMS

This chapter provides information concerning the auxiliary systems included in the WCGS powerblock. Those systems that are essential for the safe shutdown of the plant or the protection of the health and safety of the public are identified. The description of each system, the design bases for the system and for critical components, a safety evaluation demonstrating how the system satisfies the design bases, the testing and inspection to be performed to verify system capability and reliability, and the required instrumentation and controls are provided. Those aspects of the auxiliary systems that have little or no relationship to protection of the public against exposure to radiation are described in enough detail to allow understanding of the auxiliary system design and function. Emphasis is placed on those aspects of design and operation that might affect the reactor and its safety features or contribute to the control of radioactivity.

The capability of the system to function without compromising the safe operation of the plant under both normal operating or transient situations is clearly shown by the information provided, i.e., a failure analysis.

9.1 FUEL STORAGE AND HANDLING

The power block has its own fuel storage and handling facility. The onsite fuel storage and handling facilities are designed to accommodate both new and spent fuel assemblies.

9.1.1 NEW FUEL STORAGE

A new fuel storage facility (NFSF) is located within the fuel building, and provides onsite dry storage for 66 new fuel elements (approximately one-third core).

9.1.1.1 Design Bases

The NFSF maintains the new fuel elements in a subcritical array during all postulated design basis events.

A/1

9.1.1.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The NFSF is protected from the effects of natural phenomena, including earthquakes, tornadoes, hurricanes, floods, and external missiles (GDC-2).

SAFETY DESIGN BASIS TWO - The NFSF will perform its intended function and maintain structural integrity after an SSE or following a postulated hazard, such as fire, internal missiles, or pipe break (GDC-3 and 4).

SAFETY DESIGN BASIS THREE - Components of the NFSF are not shared with other units (GDC-5).

SAFETY DESIGN BASIS FOUR - The NFSF is designed to store reactor core fuel assemblies in a subcritical array (GDC-62).

SAFETY DESIGN BASIS FIVE - The NFSF meets the requirements of 10 CFR 73.40, 10 CFR 73.55, and 10 CFR 73.60, which require physical protection of special nuclear material while in storage.

SAFETY DESIGN BASIS SIX - The NFSF, including the new fuel storage racks, precludes insertion of new fuel assemblies in other than prescribed locations within the NFSF.

SAFETY DESIGN BASIS SEVEN - The new fuel storage racks are designed for the following loads and combinations thereof:

a. Dead loads

b. Live loads (fuel assemblies)

c. Crane uplift load (maximum of 5,000 pounds)

d. Safe shutdown earthquake loads

e. Operating basis earthquake loads

(b)(4)

SAFETY DESIGN BASIS NINE - The capability to inspect the NFSF is provided (GDC-61).

9.1.1.1.2 Power Generation Design Basis

There are no power generation design bases associated with the NFSF.

9.1.1.2 Facility Description

The NFSF is a separate and protected area containing fuel storage racks, and is enclosed by a reinforced concrete structure with an associated steel plate top containing hinged openings covering each fuel assembly. The concrete vault is described in Section 3.8. Drainage is provided to prevent accumulation of water within the vault. The new fuel storage racks are carbon steel support structure with stainless steel guides where the rack comes into contact with the fuel assembly. New fuel assemblies are received, inspected, and stored in the new fuel storage racks in the NFSF or in the Fuel Storage Pool. (b)(4)
(b)(4)
(b)(4) The NFSF is shown in Figures 1.2-20 and 1.2-21. Figure 9.1-1 shows a typical new fuel storage rack module.

The new fuel storage rack modules are designed and fabricated as four vertical continuous cells for the storage of fuel assemblies. The cells are continuous stainless steel tubes to ensure good vertical alignment and stability for the fuel assemblies in storage position. Design, fabrication, and installation of the new fuel storage racks are based on the ASME Code specifications. Stresses in a fully loaded rack are below the design stress level defined in the ASME Code, Section III, Appendix XVII. The new fuel storage racks are designed to seismic Category I criteria, and are anchored to the seismic Category I floor and walls of the NFSF.

The criticality analysis (Reference 5) shows that the spacing between fuel assemblies in the storage racks is sufficient to maintain the array in a subcritical condition, even when fully loaded. (b)(4)
(b)(4)

In the analysis for the storage facilities, the fuel assemblies are assumed to be in their most reactive condition, namely fresh or undepleted, and with no control rods or removable neutron absorbers present. Credit is taken for the inherent neutron-absorbing effect of materials of construction for the racks.

Assemblies cannot be closer together than the design separation provided by the storage facility, except in special cases such as in fuel shipping containers where analyses are carried out to establish the acceptability of the design. The mechanical integrity of the fuel assembly is assumed.

Section 9.1.4 provides an evaluation to demonstrate that the new fuel storage racks can withstand a maximum crane uplift force of 5,000 pounds. A dropped fuel assembly cannot impact the racks, since a steel cover is provided over the new fuel storage area.

To further ensure that no fuel can be damaged, each storage cell is designed to prevent any portion of a fuel assembly or core component (e.g., control rods) from extending above support or guiding surfaces of the storage cell. See Table 9.1-1 for the design data for the NFSF.

9.1.1.3 <u>Safety Evaluation</u>

The safety evaluations given below correspond to the safety design bases in Section 9.1.1.1.1.

SAFETY EVALUATION ONE - The NFSF is located in the fuel building. The fuel building is designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7(B), and 3.8 provide the bases for the adequacy of the structural design of the building.

SAFETY EVALUATION TWO - The NFSF is designed to remain functional after an SSE. Sections 3.7(B).2 and 3.9(B) provide the design loading conditions that were considered. Sections 3.5, 3.6, and 9.5.1 provide the hazards analyses to assure that the facility is properly protected.

SAFETY EVALUATION THREE - The power block has an NFSF capable of storing one-third of a core. No sharing is necessary.

SAFETY EVALUATION FOUR - The criticality analysis (Reference 5) demonstrates that a (b)(4) center-to-center storage spacing of fuel assemblies in both horizontal directions ensures the subcriticality of new fuel assemblies within the NFSF.

(b)(4)

SAFETY EVALUATION SIX - A steel checker plate cover is provided over the entire new fuel storage concrete vault. Hinged covers are provided directly over each fuel storage position. The covers and fuel racks are sized to prevent insertion of a fuel assembly in other than its prescribed location.

SAFETY EVALUATION SEVEN - The new fuel storage racks, loaded with fuel, are designed to minimize the distortion or buckling of rack arrangements. Stresses in the fully loaded racks do not exceed stresses specified by the ASME Code, Section III, Appendix XVII. This condition ensures a $k_{eff} \leq 0.98$. The new fuel storage equipment is designed to meet seismic Category I requirements. The crane hookup to the new fuel assemblies is done manually and under administrative control. The new fuel storage racks are designed to withstand a maximum uplift force of 5,000 pounds. The impact load of a dropped fuel assembly is taken by the checker plate covering the new fuel assemblies. The checker plate has been analyzed and determined capable of sustaining the maximum fuel assembly drop.

The probability of a dropped mass accident occurring is remote since:

a. New fuel storage racks in the new fuel storage vault are protected from dropped objects by a steel protective cover.

b. Safe handling features, as described in Section 9.1.4, are incorporated into the new fuel assembly handling tools.

(b)(4)

SAFETY EVALUATION NINE - As described in Section 9.1.1.4, the NFSF is accessible for periodic inspection.

9.1.1.4 <u>Tests and Inspections</u>

The NFSF requires no shielding and is completely accessible to plant personnel. Prior to initial use, the new fuel storage racks and modules were inspected to ensure the absence of any binding using a dummy assembly. For each cell, the dummy assembly was inserted and removed. Thereafter, the cells are periodically inspected.

9.1.1.5 Instrumentation Application

As described in Section 12.3.4, two area radiation monitors are provided near the NFSF which will provide a distinct audible and visual alarm to alert personnel in the vicinity. (b)(4)
(b)(4)

Criticality is precluded from occurring, however, by design and proper operation of the fuel handling system, as described in Section 9.1.4.

9.1.2 SPENT FUEL STORAGE AND TRANSFER

(b)(4)
(b)(4) Fuel storage racks are located in the fuel storage pool, which is constructed of reinforced concrete with a stainless steel lining and is an integral part of the fuel building. The fuel storage pool consists of the spent fuel pool and the cask loading pool (with fuel storage racks installed). The fuel storage pool provides a cooling and shielding medium for the spent fuel. The facility provides protection for spent fuel assemblies under conditions such as tornadoes, hurricanes, earthquakes, and flooding and provides an efficient method for safe and reliable fuel handling operations within the fuel storage pool.

9.1.2.1 Design Bases

The FSF is safety related, and is required to ensure a subcritical array during all normal, abnormal, and accident conditions. It also provides a shielding and cooling medium for the spent fuel.

9.1.2.1.1 Safety Design Bases

SAFETY DESIGN BASIS ONE - The FSF is capable of withstanding the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and external missiles (GDC-2).

SAFETY DESIGN BASIS TWO - The FSF is designed to maintain structural integrity after an SSE to perform its intended function following a postulated hazard, such as fire, internal missiles, or pipe break. The FSF uses the design and fabrication codes commensurate with Category I structures and the seismic category assigned by Regulatory Guide 1.29 (GDC-3 and 4).

SAFETY DESIGN BASIS THREE - Components of this system are not shared with other units (GDC-5).

SAFETY DESIGN BASIS FOUR - The fuel storage pool is designed to maintain fuel assemblies in a subcritical array with $k_{eff} \leq 0.95$ when fuel assemblies are inserted into prescribed locations (GDC-62).

SAFETY DESIGN BASIS FIVE - The fuel handling area and equipment are designed to prevent a drop of an unacceptable object into the fuel storage pool. The FSF is designed to prevent the loss of cooling water within the pool that could uncover the stored fuel or prevent cooling capability. A redundant seismic Category I emergency makeup water supply is provided. The fuel building is a controlled air leakage facility.

SAFETY DESIGN BASIS SIX - The fuel storage racks are designed for the following loads and combinations thereof:

a. Dead loads

b. Live loads (fuel assemblies)

c. Crane uplift load (the spent fuel pool bridge crane - 2 tons)

d. Safe shutdown earthquake loads

e. Operational basis earthquake loads

f. Thermal loads

g. Fuel assembly drop load

(b)(4)

SAFETY DESIGN BASIS SEVEN - The FSF is designed to meet the requirements of 10 CFR 73.55 and 10 CFR 73.60, which require physical protection of special nuclear material while in storage.

SAFETY DESIGN BASIS EIGHT - The fuel storage racks are constructed so as to preclude insertion of spent fuel assemblies into other than prescribed storage locations. If a fuel assembly is accidentally lowered or dropped onto the top of the racks or into the annular space between the spent fuel racks and the pool wall, subcriticality is maintained in all cases with a shutdown margin of at least 0.05 ($k_{eff} \leq 0.95$).

SAFETY DESIGN BASIS NINE - The NRC issued an exemption to the requirements of 10CFR70.24 to WCNOC on June 24, 1997. On November 12, 1998 the NRC issued 10CFR50.68, which provides eight criteria that may be followed in lieu of criticality monitoring per 10CFR70.24. One of these criteria require that radiation monitors are provided in storage areas when fuel is present to detect excessive radiation levels. Monitors meeting the provisions of GDC-63 are provided in the FSF area to provide prompt warning of high radiation.

SAFETY DESIGN BASIS TEN - The capability to inspect the SFSF is provided (GDC-61).

9.1.2.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - Shielding for the FSF is sufficient to prevent exposure of the plant personnel to radiation levels greater than 2.5 mrem/hr during normal operations and 10 mrem/hr during fuel handling operations, except where appropriate access controls are implemented. Gaseous radioactivity above the spent fuel pool is maintained below the limits, as defined in Table 1, Column 1 of Appendix B to 10 CFR 20.

POWER GENERATION DESIGN BASIS TWO - A leak chase and collection system is provided for the detection of leaks in the spent fuel pool liner plate.

POWER GENERATION DESIGN BASIS THREE - Borated demineralized reactor makeup water may be used to fill and to supplement water inventory in the spent fuel pool. Boration is not essential for maintaining the subcriticality of the stored fuel assemblies. An alternate source of makeup water is supplied from the refueling water storage tank.

POWER GENERATION DESIGN BASIS FOUR - Fuel handling devices have provisions to avoid dropping or jamming of fuel assemblies and to avoid applying or carrying improper loads during the transfer operation.

POWER GENERATION DESIGN BASIS FIVE - Cranes and hoists which are used to lift spent fuel have a maximum lift height so that the minimum required depth of water is maintained for shielding. In addition to crane and hoist limitations, a long-handled tool is utilized when handling spent fuel.

9.1.2.2 <u>Facilities Description</u>

(b)(4)

(b)(4) Figures 1.2-20 through 1.2-22 depict the storage facility. Figure 9.1-2 is a possible fuel storage rack arrangement. See Table 9.1-2 for design data for the fuel storage pool.

When Wolf Creek received its low power operating license in September 1985, the spent fuel pool was authorized to store no more than (b)(4) to be located in (b)(4) in the spent fuel pool. With the NRC approval of the Wolf Creek storage pool rerack amendment in 1999, and with the completion of the rerack modification to the spent fuel pool, Wolf Creek's (b)(4) (b)(4) The modification replaced the original (b)(4) (b)(4) Additional capability to add three high density storage racks within the cask loading pool could be made available with supporting evaluations, during a future campaign. (b)(4) (b)(4)

Under the high density storage design, the fuel storage pool can be defined as a Mixed Zone Three Region (MZTR) storage configuration. Fuel Storage configuration patterns are setup using administrative controls to establish storage areas specifically designated for low burnup fuel, including fresh (unburned) fuel. Selected configurations ensure that a full core discharge can be accommodated with some allowance for other fuel assemblies that could also (b)(4) 4

cells have associated minimum burnup requirements for unrestricted fuel storage. The MZTR storage configurations are described in Appendix 9.1A. As an alternative to MZTR storage, (b)(4) storage may be accomplished in a checkerboard pattern without any enrichment/burnup restrictions.

(b)(4)

(b)(4) The rack modules are designed as cellular structures such that each fuel assembly has a square opening with conforming lateral support and a flat horizontal bearing surface. The design maximizes structural integrity while minimizing inertial mass. (b)(4)

(b)(4) 4

The rack modules are free-standing and self supporting. They are primarily made from Type 304L austenitic stainless steel in a prismatic array interconnected through longitudinal welds. They are separated by a gap of (b)(4) Along the pool walls, a nominal gap is provided which varies for each wall. The minimum allowable cell to wall dimension is (b)(4) 4

The racks contain Boral as an active neutron absorber. The Boral provides fixed neutron absorbtion for primary reactivity control in the high density racks. The Boral absorbers in the racks have been sized to sufficiently shadow the active fuel height of all fuel assembly designs stored in the pool.

The criticality analysis (including the associated assumptions and input parameters) given in Appendix 9.1A shows that the spacing between fuel assemblies in the storage racks is sufficient to maintain the array, when fully loaded and flooded with nonborated water, in a subcritical condition, i.e., k_{eff} of less than 0.95.

This is based upon fuel with an original enrichment of 5.00 weight percent U-235 with at least 16 IFBA rods or 4.6 percent U-235 without IFBA. Fresh unirradiated fuel assemblies are either stored in the (b)(4)
(b)(4)
Appendix 9.1A provides a discussion of the criticality analysis for the fresh unirradiated fuel stored wet in the fuel storage pool.

Burnable poison rod assemblies, unirradiated rod control clusters, and thimble plug devices are normally stored in the fuel assemblies in the spent fuel pool. (b)(4)

The fuel storage rack configuration does not prevent accidental lowering or dropping of a fuel assembly across the top of the racks or into the space between the racks and the pool wall. Criticality under these conditions is addressed in Safety Evaluation Eight. To further assure that no fuel can be damaged, each storage cell is designed to prevent any portion of a fuel assembly or core component from extending above the top of the rack. The fuel storage racks are also designed to withstand the impact resulting from a falling fuel assembly under normal loading and unloading conditions and are designed to meet seismic Category I requirements. Design, fabrication, and installation of the fuelstorage pool racks are based on applicable ASME Codes. Allowable stresses are expressed as percentages of yield stresses obtained from Section III of the ASME Code.

The structural, seismic, criticality, and thermal hydraulic analyses (including the associated assumptions and input parameters) given in Appendix 9.1A show that the racks are designed so that subcriticality is maintained during all normal, abnormal, or accident conditions.

The fuel storage racks installed in the fuel storage pool were designed and manufactured by Holtec International. The rack modules are freestanding on the floor liner plate of the spent fuel pool. Time-history seismic analyses have been performed and demonstrate that no lateral supports from the pool walls or fastenings to the pool floor are required. The supports for the racks are sufficiently large in area to prevent damage to the spent fuel pool liner and floor leakchase system from concentrated loads.

The rack modules are constructed from stainless steel square tubes arranged in an alternating pattern such that the connection of the tube corners from storage cells. A Boral (aluminum and boron carbide) panel centered on each side is attached to the walls of the stainless steel tubes by a stainless steel sheathing. Peripheral cells use a stainless steel sheathing on the outside wall to attach the Boral panel. The fuel assemblies are nominally located in the center of each storage cell on a nominal lattice spacing of approximately 8.99 inches. Each storage cell has a hole in or near the bottom and a rectangular opening on the top of the cell to allow cooling water to flow through the storage cell. The size of the openings precludes blockage by any crud accumulations.

Adjacent to the spent fuel pool are two small pools and a washdown pit. One pool (b)(4)

(b)(4)

(b)(4)

(b)(4) When fuel storage racks are installed in the cask loading pool, and the (b)(4)
(b)(4)
(b)(4) Since the cask loading pool is deeper than the spent fuel pool. Platforms will be installed beneath the cask loading pool racks to allow installation at the same elevation as the spent fuel pool racks.

The concrete structures for the refueling pool, spent fuel pool, cask loading pool, and fuel transfer canal are designed in accordance with the criteria for seismic Category I structures contained in Sections 3.7(B) and 3.8. As such, they are designed to maintain leaktight integrity to prevent the loss of cooling water from the pools. (b)(4)
(b)(4)
(b)(4) In addition, all piping penetrations into the pool are designed to preclude draining the pool down to an unacceptable limit, as described in Section 9.1.3.

For the purpose of providing an easily decontaminable surface and to provide a construction form for the concrete pour, a liner plate surface which serves no safety function is provided for these pools.

(b)(4)
(b)(4) The joint welds are provided with a leakchase system for initial testing and subsequent monitoring of weld integrity. Following installation and testing, a breach of the liner plate (which could result in any significant loss of water through the leakchase system) is not considered credible.

(b)(4) as described in Section 9.3.3. Any water collected is directed to the floor and equipment drain system and transferred to the liquid radwaste system for processing.

The liner plate is anchored to the concrete walls by welding to steel angles which are embedded in the concrete. An analysis has been performed which demonstrates that the liner plate will not, as a result of an SSE, break away from the walls and fall on top of the fuel storage racks. Consequently, the liner plate is prevented from either inflicting mechanical damage to the spent fuel or from blocking the flow of cooling water around the fuel. (b)(4)
(b)(4)
(b)(4)

If weld repair of the liner plate is made in the future, the repair will be in accordance with the following:

a. Materials used, including weld rod, will be verified in accordance with ASTM specifications or equivalent

b. Repair procedures will be in accordance with the original fabrication specifications or equivalent

c. Welders will be qualified in accordance with ASME Section IX or equivalent

d. Non-destructive examination of the weld repairs will be in accordance with the original fabrication specification or equivalent

Should repairs be necessary with water in the fuel pool, special procedures may be required and modifications to the above criteria may be required due to the particular circumstances.

(b)(4) 4

(b)(4) The above dose rates consider the contribution from spent fuel and the fuel storage pool water. No other radioactive equipment that would significantly contribute to the dose rate is stored in the pool. A description of the fuel storage pool cooling and cleanup system is provided in Section 9.1.3.

The fuel transfer tube is completely shielded with permanent shielding to within radiation zone limits. No special access control, radiation monitoring, or posting is required.

(b)(4) 4

(b)(4) The fuel transfer tube is completely surrounded by concrete or water, with the exception of the seismic gaps, so that no personnel access is possible.

(b)(4)

Therefore, there

is no unshielded portion of the fuel transfer tube. See Section 12.2.1.3.1 for additional information.

Section 9.1.4 discusses the load-bearing capability of all of the cranes serving the FSF. Section 9.1.4 also provides an evaluation which demonstrates that the maximum uplift force is due to the spent fuel pool bridge crane and the maximum impact load that is due to a dropped fuel assembly. The racks are designed to withstand these loads with no increase in k_{eff}.

9.1.2.3 Safety Evaluations

The safety evaluations given below correspond to the safety design bases in Section 9.1.2.1.1.

SAFETY EVALUATION ONE - The FSF is located in the fuel building. The fuel building is designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7(B), and 3.8 provide the bases for the adequacy of the structural design of these buildings.

SAFETY EVALUATION TWO - The FSF is designed to remain functional after an SSE. Appendix 9.1A provides the design loading conditions that were considered. Sections 3.5, 3.6, and 9.5.1 provide the hazards analyses to assure that the facility is properly protected.

SAFETY EVALUATION THREE - (b)(4)
(b)(4)
pending addition of storage racks in the Cask Loading Pool and the supporting evaluations, during a future campaign.

SAFETY EVALUATION FOUR - (b)(4)
(b)(4)

Procedures and precautions described in Appendix 9.1A (b)(4)
(b)(4)

SAFETY EVALUATION FIVE - (b)(4)
(b)(4)
(b)(4) As described in Section 9.1.3, a system provides cooling and emergency makeup water for the spent fuel pool. Section 9.4.6 describes the ventilation system provided for the fuel building. Table 9.1-3 indicates compliance with Regulatory Guide 1.13 positions.

SAFETY EVALUATION SIX - The structural, seismic, criticality, and thermal-hydraulic analyses provided in Appendix 9.1A demonstrate that the fuel storage racks are designed to withstand normal, abnormal, and accident conditions without causing a decrease in the degree of subcriticality. Section 9.1.4 evaluates the bases for external loads on the fuel storage racks. The probability of a dropped mass accident occurring is remote because of the safe handling features described in Section 9.1.4.

SAFETY EVALUATION SEVEN - (b)(4)
(b)(4) The security measures taken for the protection of the new and spent fuel against industrial sabotage and theft are discussed in the Physical Security Plan.

SAFETY EVALUATION EIGHT - Criticality analyses, described in Appendix 9.1A, show that if a fuel assembly is dropped on top of the racks or into the gap between the racks and the pool wall, the subcriticality criteria are maintained. (b)(4)
(b)(4)
(b)(4) If it is assumed that all fuel assemblies are new fuel and the pool water is unborated, $k_{eff} \leq 0.95$.

SAFETY EVALUATION NINE - (b)(4)
(b)(4)

SAFETY EVALUATION TEN - Access to the FSF is provided for periodic inspection as shown in Figures 1.2-20 through 1.2-22.

9.1.2.4 Tests and Inspections

The fuel storage racks were shop tested by insertion of a dummy assembly which is 0.17 inch minimum wider than an actual fuel assembly to ensure there is no significant resistance.

9.1.2.5 Instrumentation Application

(b)(4)

Criticality is precluded from occurring, however, by design and proper operation of the fuel handling system, as described in Section 9.1.4.

9.1.3 FUEL POOL COOLING AND CLEANUP SYSTEM

The fuel pool cooling and cleanup system (FPCCS) is designed to maintain the fuel storage pool water temperature below prescribed limits by removing decay heat generated by stored spent fuel assemblies and to remove impurities from the refueling pool water, the spent fuel pool water, the transfer canal water, and the water in the cask loading pool in order to ensure optical clarity and to limit the concentration of specific activity in the water. This section describes the FPCCS.

The FPCCS consists of three subsystems:

a. Fuel pool cooling system

b. Fuel pool cleanup system

c. Fuel pool surface skimmer system

Each of these subsystems has specific functions and design bases.

9.1.3.1 <u>Design Bases</u>

9.1.3.1.1 Safety Design Bases

The portion of the FPCCS associated with the cooling of spent fuel is safety-related.

SAFETY DESIGN BASIS ONE - The safety-related portion of the FPCCS is protected from the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and external missiles (GDC-2).

SAFETY DESIGN BASIS TWO - The FPCCS is designed to remain functional after an SSE and to perform its intended function following the postulated hazards of fire, internal missiles, or pipe break (GDC-3 and 4).

SAFETY DESIGN BASIS THREE - Safety functions can be performed, assuming a single active component failure coincident with the loss of offsite power. Components of this system are not shared with other units (GDC-5 and 44).

SAFETY DESIGN BASIS FOUR - The active components are capable of being tested during plant operation. Provisions are made to allow for inservice inspection of components at appropriate times specified in the ASME Boiler and Pressure Vessel Code, Section XI (GDC-45 and 46).

SAFETY DESIGN BASIS FIVE - The safety-related portions of the FPCCS use the design and fabrication codes consistent with the quality group classification assigned by Regulatory Guide 1.26 and the seismic category assigned by Regulatory Guide 1.29. The power supply and control functions are in accordance with Regulatory Guide 1.32.

SAFETY DESIGN BASIS SIX - The capability to isolate components or piping is provided so that the FPCCS's safety function is not compromised. This includes isolation of components to deal with leakage or malfunctions and to isolate nonsafety-related portions of the FPCCS (GDC-44).

SAFETY DESIGN BASIS SEVEN - The containment isolation valves in the system are selected, tested, and located in accordance with the requirements of GDC-54 and 56 and 10 CFR 50, Appendix J, Type C testing.

SAFETY DESIGN BASIS EIGHT - (b)(4)
(b)(4)

maximum decay heat generation rate resulting from the maximum anticipated spent fuel inventory with the maximum anticipated fuel burnup (GDC-44 and 61 and Regulatory Guide 1.13).

SAFETY DESIGN BASIS NINE - System piping is arranged so that loss of piping integrity or operator error does not result in draining of the fuel storage pool below a minimum depth above the stored fuel to ensure sufficient cooling media for cooling the stored spent fuel (Regulatory Guide 1.13).

SAFETY DESIGN BASIS TEN - Redundant seismic Category I makeup water supplies from the essential service water system are provided to ensure adequate makeup capability.

SAFETY DESIGN BASIS ELEVEN - A monitoring system is provided for the FPCCS to detect conditions that could result in the loss of decay heat removal capabilities (GDC-63).

9.1.3.1.2 Power Generation Design Bases

POWER GENERATION DESIGN BASIS ONE - (b)(4) (b)(4) (b)(4) Assumptions and heat loads for both design conditions are given in Table 9.1-4.

POWER GENERATION DESIGN BASIS TWO - The fuel pool cleanup and surface skimmer systems maintain the optical clarity of the pool water so that fuel handling operations are not hampered by limited visibility.

POWER GENERATION DESIGN BASIS THREE - The fuel pool cleanup system limits the fission and corrosion product concentrations in the refueling pool water, the transfer canal water, and the fuel storage pool water to permit operator access to the fuel storage area and for fuel handling operations.

POWER GENERATION DESIGN BASIS FOUR - The fuel pool cleanup system contains two pumps and two filters to allow for continuous system operation at a reduced capacity during filter cartridge changing and pump maintenance.

POWER GENERATION DESIGN BASIS FIVE - The fuel pool cleanup system provides the means for filtering and demineralizing the contents in the refueling water storage tank (RWST).

9.1.3.2 <u>System Description</u>

9.1.3.2.1 General Description

The FPCCS shown in Figure 9.1-3 consists of two cooling trains, a cleanup loop, and a surface skimmer loop. The system design parameters are given in Table 9.1-4.

9.1.3.2.1.1 Fuel Pool Cooling System

(b)(4)

(b)(4) The fuel pool cooling heat exchangers are serviced by the component cooling water system on the shell side with motor-operated isolation valves provided.

Spent fuel is placed in the fuel storage during a refueling sequence, and is stored there until it is shipped offsite. (b)(4) (b)(4) (b)(4) The decay heat generated is transferred from the fuel pool cooling system through the fuel pool cooling heat exchangers to the component cooling water system.

During normal system operation, one fuel pool cooling pump takes suction from the fuel storage pool and transfers the pool water through a fuel pool cooling heat exchanger back to the fuel storage pool. The fuel pool cooling pump suction is protected by a permanent strainer located at the terminal end of the suction piping within the fuel storage pool. The pump suction line penetrates the spent fuel pool wall, near the normal fuel storage pool water level. (b)(4) (b)(4) (b)(4) In order to prevent the draining of the fuel storage pool by siphoning action, an antisiphon hole is located in each return line, near the surface of the pool water.

Normal makeup water to the fuel storage pool is supplied by the reactor makeup water system. An alternate source of makeup water is the RWST via the fuel pool cleanup pumps. Boron addition to the fuel storage pool is normally accomplished by supplying borated water from the boric acid tanks via the boric acid blender. Boron may also be added by using the RWST as the source of makeup water to the fuel storage pool. All makeup and boron addition operations require manual action. Isolation of nonsafety-related portions of the FPCCS is a manual action.

Whenever irradiated fuel assemblies are in the fuel storage pool, at least 23 feet of water is maintained over the top of irradiated fuel assemblies seated in the storage racks. The water level in the fuel storage pool is determined to be above the minimum required depth once per 7 days. With water level less than 23 feet, suspend crane operations with loads in the fuel storage areas. Technical Specification 3.7.15 (b)(4) (b)(4)

An FPCCS leak is detected when an abnormally high amount of makeup water is required for the fuel storage pool. Leakage is also detected by the floor drain system, as described in Section 9.3.3. Once a significant leak is found, the affected item is isolated and repaired.

9.1.3.2.1.2 Fuel Pool Cleanup System

(b)(4) 4

(b)(4) The demineralizer removes ionic corrosion impurities and fission products. The filters are provided to remove particulate matter which would have otherwise entered the demineralizer, and the wye strainer downstream of the demineralizer removes resin fines which may be released from the resin bed.

The fuel pool cleanup system provides the capability for purification of the water in the fuel storage pool, the transfer canal, the refueling pool, and the RWST. The water chemistry specifications are given in Table 9.2-16.

The fuel pool cleanup pump design is based upon both fuel pool cleanup pumps running. (b)(4) 4
(b)(4)

9.1.3.2.1.3 Fuel Pool Surface Skimmer System

Surface debris is removed from the fuel storge pool, the fuel transfer canal, and refueling pool by a surface skimmer system. This system is comprised of surface intakes containing float-type strainers positioned just below the water surface. Lines from both pools and the fuel transfer canal are tied into a common header containing a pump and filter which discharges back into the fuel storage pool or refueling pool.

9.1.3.2.2 Component Description

FPCCS component design parameters are given in Table 9.1-5. Codes and standards applicable to the FPCCS are listed in Tables 3.2-1 and 9.1-5. The FPCCS is designed and constructed in accordance with the following quality group requirements: containment penetrations are quality group B, the separate and redundant cooling loops are quality group C, and the cleanup and skimmer loops are quality group D. The quality group B and C portions are designed to seismic Category I criteria.

Fuel Pool Cooling Pumps - (b)(4) (b)(4) wetted surfaces are austenitic stainless steel. Each pump takes suction from the fuel storage pool via separate suction lines. (b)(4) (b)(4)

Fuel Pool Skimmer Pump - The inline centrifugal pump takes suction from movable surface skimmers, circulates the water through a pool surface strainer and a high efficiency filter, and returns it to the spent fuel pool. All wetted surfaces of the pump are austenitic stainless steel.

Fuel Pool Cleanup Pumps - These inline centrifugal pumps are used to circulate fuel storage pool and refueling pool water through the fuel pool cleanup filters, demineralizer, and wye strainer for removal of particulate and ionic impurities. (b)(4) (b)(4) All wetted parts of the pumps are austenitic stainless steel. The contents of the RWST may also be circulated through the cleanup loop, using these pumps.

Fuel Pool Cooling Heat Exchangers - The heat exchangers are the shell and U-tube type. Fuel pool water circulates through the tubes while component cooling water circulates through the shell. (b)(4) (b)(4)

Fuel Pool Cleanup Demineralizer - A flushable, mixed bed demineralizer is used to provide adequate fuel pool water purity for Zone B access of plant personnel to the pool working areas. This demineralizer is also used to purify the contents of the RWST.

Fuel Pool Cleanup Filters - (b)(4) (b)(4)

Fuel Pool Skimmer Filter - The fuel pool skimmer filter is used to remove particles which are swept from the fuel pool water surface and not removed by the basket strainer in the floating skimmer.

Fuel Pool Strainers - A strainer is located in each fuel pool cooling pump suction line to prevent the introduction of relatively large particles which might otherwise foul the fuel pool cooling heat exchangers or damage the fuel pool cooling pumps.

Fuel Pool Skimmer Strainer - A strainer is located in the floating skimmer inlet to remove relatively large debris from the skimmer process flow.

Fuel Pool Cleanup Strainer - A (b)(4) strainer is provided downstream of the fuel pool cleanup demineralizer to prevent the entry of resin fines into the fuel pool and to trap any resin beads released in the event of retention element failure.

Refueling Pool Drain Inlet Strainer - a strainer is located in the inlet of refueling pool drain line to the suction of the reactor coolant drain tank pumps to prevent the introduction of relatively large particles which might otherwise restrict the refueling pool drain flow and/or damage the reactor coolant drain tank pumps.

Valves - Manual stop valves are used to isolate equipment and manual throttle valves to provide flow control. Valves in contact with fuel pool water are austenitic stainless steel. Motor-operated isolation valves are provided in the CCW line from each fuel pool cooling heat exchanger.

Piping - All piping in contact with the fuel pool water is austenitic stainless steel. The piping is welded, except where flanged connections are used to facilitate maintenance.

9.1.3.2.3 System Operation

9.1.3.2.3.1 Fuel Pool Cooling System

Normal operations of the fuel pool cooling system are manual and intermittent. The system is started, operated, and secured locally as required to maintain the water temperature below the established temperature limit for the fuel storage pool and to minimize the starting and stopping of a fuel pool cooling pump. During refueling, the refueling pool and the reactor core are cooled by the RHR system, as described in Section 5.4.7. The fuel pool cooling system is used only for removal of the decay heat generated by the irradiated fuel in the fuel storage pool.

(b)(4)

Boron addition to the fuel storage pool is normally supplied from the boric acid tanks via the boric acid transfer pumps and the boric acid mixing tee, using a feed-and-bleed process. Boron may also be added to the pool water by supplying borated water from the RWST via the fuel pool cleanup pumps. These operations require manual action by the operator.

Makeup water to the fuel storage pool is normally provided by the reactor makeup water system via a manually operated valve. Makeup water may also be supplied from the RWST via the fuel pool cleanup pumps if the reactor makeup water system is unavailable. These makeup supplies compensate for normal evaporative losses from the fuel storage pool. The flow rate to the fuel storage pool is locally controlled by a manually operated valve.

When a complete irradiated core is unloaded from the reactor and stored in the fuel storage pool, the fuel pool cooling system has the capability to maintain the fuel storage pool water temperature below 170 F with only one cooling train operating in the normal mode (see Table 9.1-4).

Following a loss of normal power, without a loss-of-coolant accident (LOCA), 4
(b)(4)

Following a LOCA with loss of offsite power, the fuel pool cooling pumps trip, and cooling of the fuel storage pool is interrupted. The fuel storage pool water temperature is increased from the initial temperature, indicated in Table 9.1-4, Item 5c. Post-LOCA, at the start of the recirculation phase, component cooling water (CCW) flow to the fuel pool heat exchangers will be automatically isolated and CCW flow to the RHR heat exchangers will be automatically started.
(b)(4) 4

When the FPCCS is reestablished, the fuel pool cooling pumps are manually loaded to the Class 1E power source, and CCW flow is established to at least one of the fuel pool cooling heat exchangers.

The heat load contribution from the fuel storage pool for determination of the maximum total heat load to the UHS, as described in Section 9.2.5, is based on the decay heat rate shown in Table 9.1-4, item 5C. (b)(4)
(b)(4) 4

The bulk fuel storge pool and in-cell thermal hydraulic analysis (including the associated assumptions and input parameters) given in Appendix 9.1A supports the data provided in Table 9.1-4.

Redundant, safety-related sources of makeup water are supplied to the fuel storage pool by the ESW system, via manually operated valves. This source of makeup is to be used only when nonsafety-related makeup sources are not available.

During normal shutdown of the reactor, the RHR system is utilized to remove core decay heat, as described in Section 5.4.7. At approximately 4 hours after shutdown, the RHR heat exchanger represents sufficient available CCW duty to require reducing or terminating CCW flow to the FPCCS heat exchangers. (b)(4)

(b)(4)

(b)(4)

9.1.3.2.3.2 Fuel Pool Cleanup System

Normal fuel pool cleanup system operation is manual and intermittent. The system is started, operated, and secured locally, as required, to maintain optical clarity and to limit ionic corrosion and fission product concentration in the fuel storage pool and the refueling pool. (b)(4)

(b)(4)

(b)(4) Samples are periodically taken from the cleanup loop to determine the quality of the water.

During a refueling, after the refueling pool is filled with borated water from the RWST, the fuel pool cleanup pump(s) take suction from the refueling pool and transfer the water through the fuel pool cleanup filter(s) and the fuel pool cleanup demineralizer and back to the refueling pool. The cleanup of the refueling pool by the fuel pool cleanup system is augmented by the CVCS via the RHR system to expedite the cleanup process. These operations are continued during the entire refueling process to maintain water clarity for refueling and to minimize the radiation dose to operators. Following transfer of the irradiated fuel to the fuel storage pool, the cleanup lines to the refueling pool are manually isolated and drained, and fuel storage pool cleanup is initiated as required.

After the refueling pool is drained to the RWST, the fuel pool cleanup system is isolated from the fuel storage pool, and the RWST is manually aligned for cleanup by the fuel pool cleanup filter(s) and demineralizer, via the fuel pool cleanup pump(s).

Upon high differential pressure or indication by manual sampling that the demineralizer resins are spent, the demineralizer resins are transferred to the solid radwaste system, as described in Section 11.4. Upon high differential pressure across the fuel pool cleanup or skimmer filters, that filter is isolated, and the cartridge is replaced by the filter handling system of the solid radwaste system, as described in Section 11.4.

However, if the system is unable to maintain sufficient clarity of the pool water and radiation levels adjacent to the pool when operated continuously, the filter and/or resin is replaced. No set radiation sampling frequency has been established for the pool water. In general, sampling is more frequent during and immediately after a refueling or if pool water radiation levels are higher than at other times.

Design parameters for the fuel pool cleanup system are as follows:

	Filter	Demineralizer
1. Decontamination factor	(b)(4)	
Iodine		
Cesium and rubidium		
Other nuclides		
2. Radiation level (See Section 12.2.1.3.2)		

(b)(4)

9.1.3.2.3.3 Fuel Pool Surface Skimmer System

The fuel pool surface skimmer system is aligned and operated, as required, to clean the refueling pool water surface and/or the fuel storage pool water surface. All operations require manual operator action.

9.1.3.3 Safety Evaluation

The safety evaluations given below correspond to the safety design bases in Section 9.1.3.1.1.

SAFETY EVALUATION ONE - (b)(4) (b)(4) These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7(B), and 3.8 provide the bases for the adequacy of the structural design of these buildings.

SAFETY EVALUATION TWO - The safety-related portions of the FPCCS are designed to remain functional after a safe shutdown earthquake. Sections 3.7(B).2 and 3.9(B) provide the design loading conditions that were considered. Sections 3.5 and 3.6 provide hazards analyses to assure that safe shutdown, as outlined in Section 7.4, can be achieved and maintained.

SAFETY EVALUATION THREE - Complete redundancy is provided and, as indicated by Table 9.1-6, no single failure will compromise the system's safety functions. All vital power can be supplied from either onsite or offsite power systems, as described in Chapter 8.0.

SAFETY EVALUATION FOUR - The FPCCS was initially tested with the program given in Chapter 14.0. Periodic inservice functional testing is done in accordance with Section 9.1.3.4.

Section 6.6 provides the ASME Boiler and Pressure Vessel Code Section XI requirements that are appropriate for the FPCCS.

SAFETY EVALUATION FIVE - Section 3.2 delineates the quality group classification and seismic category applicable to the safety-related portion of this system and supporting system. Section 9.1.3.2.2 shows that the components meet the design and fabrication codes given in Section 3.2. All the power supplies and the control functions necessary for safe function of the FPCCS are Class 1E, as described in Chapters 7.0 and 8.0.

SAFETY EVALUATION SIX - Section 9.1.3.2.1.1 describes provisions made to identify and isolate leakage or malfunction and to isolate the affected portion of the system.

SAFETY EVALUATION SEVEN - Sections 6.2.4 and 6.2.6 provide the safety evaluation for the system containment isolation arrangement and testability.

SAFETY EVALUATION EIGHT - The maximum decay heat generation rate that can be removed is governed by the capabilities of the fuel pool cooling system. The maximum decay heat loading was determined to be 63.41 MBtu/hr as discussed in appendix 9.1A.5.5 (see also Table 9.1-4). (b)(4)
(b)(4)
(b)(4) Cycle-specific decay heat analysis and administrative controls ensure that the maximum pool thermal loading limit is not exceeded.

(b)(4)

The fuel pool cooling system is controlled manually. Assuming that one fuel pool cooling train fails, the fuel storage pool is large enough that an extended period of time is required for the water to heat up significantly, if cooling were interrupted. Therefore, there is sufficient time for the operator to manually switch to the backup cooling train. Table 9.1-4 contains the heatup rates for the design basis conditions. Table 9.1-3 indicates compliance with the Regulatory Guide 1.13 position.

SAFETY EVALUATION NINE - (b)(4)
(b)(4)

SAFETY EVALUATION TEN - The redundant seismic Category I essential service water system intertie with the fuel storage pool ensures adequate fuel storage pool makeup water, considering the maximum anticipated evaporation rates of the fuel storage pool water, as given in Table 9.1-4.

SAFETY EVALUATION ELEVEN - As described in Section 9.1.3.5, (b)(4)
(b)(4)

9.1.3.4 Tests and Inspections

Preoperational testing is discussed in Chapter 14.0.

Provisions are incorporated in the design to allow for periodic starting of the nonoperating pump for verification of the required cooling flowpath. These operations demonstrate the operability, performance, and structural and leaktight integrity of all FPCCS components.

The safety-related components of the system, i.e., pumps, valves, heat exchangers, and piping (to the extent practicable), are designed and located to permit preservice and inservice inspections.

9.1.3.5 Instrumentation Applications

The instrumentation provided for the fuel pool cooling and cleanup system is discussed below. Alarms and indications are provided as noted.

a. Temperature

Instrumentation is provided to measure the temperature of the water in the spent fuel pool and give main control room indication as well as annunciation when normal temperatures are exceeded. Instrumentation is also provided to indicate the temperature of the fuel pool water as it leaves each heat exchanger.

b. Pressure

Instrumentation is provided to measure and give local indication of the pressures in the suction and discharge lines of the fuel pool cooling pumps. Local pressure indication is provided on the discharge of the fuel pool cleanup pumps and fuel pool skimmer pump. Differential pressure instrumentation is also provided at the fuel pool cleanup demineralizer and filters and the fuel pool skimmer filter so that the pressure differential across these components can be determined.

c. Flow

Instrumentation is provided to measure and give local and main control room indication of the flow in the outlet line of the fuel pool cleanup pumps. A low-flow alarm is located in the main control room, in addition to a local low-flow alarm.

Instrumentation is also provided to measure and give local and main control room indication of the flow in the discharge lines of the fuel pool cooling pumps.

d. Level

A Class 1E level switch is provided to protect each fuel pool cooling pump from loss of suction on low water level in the fuel storage pool. Instrumentation is also provided to measure the water level of the fuel storage pool and give local and main control room indication and annunciation of high or low pool levels.

9.1.4 FUEL HANDLING SYSTEM

The fuel handling system (FHS) provides a safe means for handling fuel assemblies and control components from the time of receipt of new fuel assemblies to shipment of spent fuel. This includes equipment necessary for reactor vessel servicing.

Design considerations include maintaining occupational radiation exposures ALARA during transportation and handling.

The fuel handling system is composed of cranes, equipment, special fuel handling devices, and a fuel transfer system that are designed to meet the seismic and safety classifications shown in Section 3.2.

9.1.4.1 Design Bases

9.1.4.1.1 Safety Design Bases

The portions of the FHS that are safety related are the containment isolation features of the fuel transfer tube and the crane structural components which prevent the falling of major crane components onto fuel assemblies or safe shutdown equipment.

SAFETY DESIGN BASIS ONE - The FHS is protected from the effects of natural phenomena, such as earthquakes, tornadoes, hurricanes, floods, and external missiles (GDC-2).

SAFETY DESIGN BASIS TWO - The FHS is designed to remain intact after an SSE or following the postulated hazards of fire, internal missiles, or pipe breaks (GDC-3 and 4).

SAFETY DESIGN BASIS THREE - The FHS components are capable of being tested during plant operation. Provisions are made to allow for inservice inspection and testing of components at appropriate times.

SAFETY DESIGN BASIS FOUR - The FHS is designed and fabricated to codes consistent with the seismic category assigned by Regulatory Guide 1.29 and industry standard specifications.

SAFETY DESIGN BASIS FIVE - The containment isolation provisions for the system are selected, tested, and located in accordance with the requirements of GDC-54 and 10 CFR 50, Appendix J, Type B testing.

SAFETY DESIGN BASIS SIX - The FHS is designed and arranged so that there are no loads which, if dropped, could result in damage, leading to the release of radioactivity in excess of 10 CFR 100 guidelines, or impair the capability to safely shut down the plant.

This meets the requirements of Regulatory Guide 1.13 and excludes the system from the requirements of Regulatory Guide 1.104.

9.1.4.2 System Description

9.1.4.2.1 General Description

The fuel handling system consists of the equipment needed to refuel the reactor core. Basically, this equipment is composed of cranes, handling equipment, and a fuel transfer system.

The associated fuel handling structures are divided into seven areas. In general, these areas are:

a. The refueling pool

b. The fuel transfer canal

c. The spent fuel pool

d. The shipping cask loading pool

e. The cask washdown pit

f. The new fuel storage vault

g. The new fuel receiving and inspection area

Figures 9.1-4 through 9.1-17 show equipment configurations and the areas of movement of the spent fuel and cask handling cranes.

The new fuel assemblies are removed one at a time from the shipping container utilizing a new fuel handling tool suspended from the monorail on the cask handling crane, inspected in the new fuel inspection area, and stored in the new fuel storage racks within the new fuel storage facility or moved to the new fuel elevator where it is lowered and transferred to a fuel storage pool storage location.

The new fuel is moved from its storage rack or inspection area, utilizing the new fuel handling tool suspended on the monorail hoist on the cask handling crane, and transferred to the new fuel elevator. The new fuel elevator is used to lower the new fuel assemblies into the cask loading pool. The new fuel is moved from the new fuel elevator, utilizing the spent fuel handling tool with the spent fuel bridge crane, and either placed in the fuel storage pool or transferred to the upended fuel containers located in the transfer canal, and then moved through the fuel transfer tube to the refueling pool where it is handled by the refueling machine.

The fuel transfer system includes a rod cluster control (RCC) storage rack and refueling machine. These facilitate the exchange of control rods between spent fuel and new fuel. The RCC storage rack may be used for temporary storage of new fuel during the refueling operations.

Spent fuel is removed from the reactor with the refueling machine, transferred to the fuel storage pool by the fuel transfer system and the spent fuel pool bridge crane, and deposited in a fuel storage pool rack.

In the fuel storage pool, fuel assemblies are moved by the spent fuel bridge crane. When lifting spent fuel assemblies, a long-handled tool is used to ensure that sufficient radiation shielding is maintained.

After a sufficient decay period in the fuel storage pool (b)(4), the spent fuel may be removed from the storage racks and transferred to the spent fuel shipping cask within the cask loading pool. The cask is sealed in the loading pool and then is decontaminated in the washdown pit to meet applicable transportation regulations and shipped off site.

In order to meet Department of Transportation regulations, dose rates below the maximum of 200 mrem/hr at the surface of the transporting vehicle and 10 mrem/hr at 6 feet from the surface must be attained prior to shipping.

Reactor servicing consists of those operations necessary to support refueling, maintenance, and inservice inspection.

9.1.4.2.2 Component Description

Principal codes and standards applicable to the FHS are listed in Tables 3.2-1 and 9.1-7 (Sheet 2).

REFUELING MACHINE - The refueling machine is a rectilinear bridge and trolley crane with a vertical mast extending down into the refueling pool. The bridge spans the refueling pool and runs on rails set into the pool edges. The bridge and trolley motions are used to position the vertical mast over a fuel assembly in the core. The bridge, trolley, main hoist, and hoist controls are interlocked through the use of the same control panel. A long tube with a pneumatic gripper on the end is lowered from the mast to grip the fuel assembly. The gripper tube is long enough so that the upper end is contained in the mast when the gripper end contacts the fuel assembly. A winch mounted on the trolley raises the gripper tube and fuel assembly up into the mast tube. The fuel is transported to its new position while inside the mast tube.

All controls for the refueling machine are mounted on a removable console on the trolley. The bridge and trolley are positioned in relation to a grid pattern referenced to the core. Bridge and trolley positions are indicated by a pointer-ruler system, and "absolute" encoders.

The outer mast is mounted on the trolley structure on a support bearing that allows rotation of the mast to allow a fuel assembly that is not properly oriented with the core position to be picked up and rotated into proper alignment. In the event a fuel assembly must be turned, the stops can be disconnected and the mast turned manually. With the mast rotated from normal operating position, the hoist is run at slow speed.

Fuel assemblies can be placed in the core in only one way relative to the core centerlines. Orientation of the fuel is maintained by the gripper which can engage the fuel only when the relative orientation is correct.

Indications are observed by the operator at the console. The drives for the bridge and trolley are variable speed. The maximum speed for the bridge is approximately 60 feet per minute. The trolley and hoist maximum speeds are both approximately 40 feet per minute. The auxiliary monorail hoist on the refueling machine has a variable speed controller to give hoisting speeds of 0 to 20 feet per minute.

Electrical interlocks, Programmable Logic Controller, and resolvers on the bridge and trolley drives prevent damage to the fuel assemblies. The winch is also provided with limit switches plus a mechanical stop to prevent a fuel assembly from being raised above a safe shielding depth should the limit switch fail. In an emergency, the bridge, trolley, and winch can be operated manually, using a handwheel on the motor shaft. Suitable restraints are provided between the bridge and trolley structures and their respective rails to prevent derailing.

A conservative design approach is used for all load-bearing parts. The static design load for the crane structure and all lifting components is normal dead and live loads plus three times the fuel weight with a RCC assembly inserted. The design load on the wire rope hoisting cables does not exceed 0.20 times the average breaking strength. Where two cables are used, each is assumed to carry one-half the load.

A single finger on the fuel gripper can support the weight of a fuel assembly and RCC assembly without exceeding the requirements given in Table 9.1-7.

All components critical to the operation of the equipment or located so that parts can fall into the reactor are assembled with the fasteners positively restrained from loosening under vibration.

The refueling machine design includes the following provisions to ensure safe handling of fuel assemblies:

a. Safety interlocks

Operations which could endanger the operator or damage the fuel are prohibited by mechanical or fail-safe electrical interlocks, or by redundant electrical interlocks. All other interlocks are intended to provide equipment protection and may be implemented either mechanically or by electrical interlock, not necessarily fail-safe. The following interlocks are provided on the refueling machine:

1. When the gripper is engaged, the machine cannot move outside the core region unless the guide tube is in its full up position.

2. When the gripper is disengaged, the machine cannot traverse unless the gripper is withdrawn into the mast.

3. Vertical motion of the guide tube is permitted only in a controlled area over the reactor (avoiding the vessel guide studs), fuel transfer system, rod cluster control change fixture, gripper disengage plate or load testing fixture.

4. Traverse of the trolley and bridge is limited to the areas of item 3 and a clear path connecting those areas.

5. A key-operated interlock bypass switch is provided to defeat interlocks 1 through 4. That switch also operates a flashing red light to indicate that the interlocks are bypassed.

6. The gripper is monitored by limit switches to confirm operation to the fully engaged or fully disengaged position. An audible and a visual alarm are actuated if both engaged and disengaged switches are actuated at the same time or if neither is actuated. A time delay may be used to allow for recycle time of normal operation.

7. The loaded fuel gripper will not release unless it is in its down position in the core, or in the fuel transfer system or rod cluster control change fixture, and the weight of the fuel is off the mast.

8. Raising of the guide tube is not permitted if the gripper is disengaged and the load monitor indicates that it is still attached to the fuel assembly.

9. Raising of the guide tube is not allowed by two overload interlocks if the hoist loading exceeds specified values. The setpoints for the two interlocks are specified as the force in lbs. above the total weight of guide tube plus fuel assembly plus rod cluster control assembly. For wet conditions the setpoint for the overload interlock is less than or equal to (b)(4) and the setpoint for the master overload is less than or equal to (b)(4) above the overload setting. At (b)(4) above the full down position in the core, upender, RCCA change fixture, overload interlock will be bypassed. 4

10. Lowering of the guide tube is not allowed by an underload interlock if the hoist loading falls below a specified value. The setpoint for the interlock is specified as the force in lbs. below the total weight of the guide tube plus fuel assembly plus lightest component. The setpoint for the underload is less than or equal to (b)(4). At (b)(4) above the full down position in the core, upender, and RCCA change fixture, the underload interlock will be bypassed. 4

11. The guide tube is prevented from rising to a height where there is less than (b)(4) of nominal water coverage over the fuel.

12. The guide tube is prevented from lowering completely out of the mast.

13. The guide tube travels only at a controlled speed of about (b)(4) when: a) the bottom of the fuel begins to enter the core, and b) the gripper approaches the top of the core. In addition, just above those points, the guide tube automatically stops lowering, and requires acknowledgment from the operator before proceeding. If the guide tube is in open water (greater than (b)(4) in both X and Y directions, or greater than the width of a fuel assembly plus two inches in one direction from any fuel assembly), the guide tube may operate at maximum speed.

14. The fuel transfer system lifting arm is prevented from moving unless the loaded gripper is in the full up position or the unloaded gripper is withdrawn into the mast, or unless the refueling machine is out of the upender zone. An interlock is provided from the refueling machine to the fuel transfer system to accomplish this.

b. Bridge and trolley holddown devices

The refueling machine bridge and trolley are both horizontally restrained on the rails by two pairs of guide rollers, one pair at each wheel location on one truck only. The rollers are attached to the bridge truck and contact the vertical faces on either side of the rail to prevent horizontal movement. Vertical restraint is accomplished by antirotation bars located at each of the four wheels for both the bridge and trolley. The antirotation bars are bolted to the trucks and extend under the rail flange. Horizontal and vertical restraints are both adequately designed to withstand the forces and overturning moments resulting from the SSE.

c. Main hoist braking system

The main hoists are equipped with two independent braking systems. A solenoid-release, spring-set electric brake is mounted on the motor shaft. This brake operates in the normal manner to release upon application of current to the motor and set when current is interrupted. The second brake is a mechanically actuated load brake internal to the hoist gear box that engages if the load starts to overload the hoist. It is necessary to apply torque from the motor to raise or lower the load. In raising, this motor cams the brake open; in lowering, the motor slips the brake, allowing the load to lower. This brake actuates upon loss of torque from the motor for any reason and is not dependent on any electrical circuits. Both brakes are rated at (b)(4) of the hoist design load.

d. Fuel assembly support system

The main hoist system is supplied with redundant paths of load support so that failure of any component will not result in free-fall of the fuel assembly. (b)(4) are anchored to the winch drum and carried to a load-equalizing mechanism on the top of the gripper tube. In addition, supports for the equalizing mechanism are backed up by passive restraints to pick up the load in the event of the failure of this primary support.

During each refueling outage and prior to removing fuel, the gripper and hoist system are load tested to 125 percent of the maximum setting on the secondary hoist load limit.

CASK HANDLING CRANE - The cask handling crane is a Crane Manufacturers Association of America (CMAA) No. 70, Class A, indoor electrical overhead traveling bridge crane with a single trolley and all the necessary motors, controls, and brakes, and a festooned pendant control station. The crane hoist is rated at (b)(4) The crane and accessories are used to handle spent fuel shipping casks between the railroad cars or trucks, the loading pool, and the washdown pit.

The main hoist and the main bridge trolley have an inching feature for positioning of the crane at desired locations.

The cask handling crane is equipped with a monorail and hoist which is used to transfer new fuel from the new fuel storage vault to the new fuel elevator. The monorail is also used for moving new fuel shipping containers. The monorail hoist is rated at (b)(4) . The festooned pendant control station or radio control unit is utilized for controlling the cask handling crane and the monorail hoist.

The handling tool of the cask handling crane is designed to prevent a shipping cask from dropping into the spent fuel pool.

Under normal use, limit switches and mechanical stops are located to prevent any crane (other than the spent fuel pool bridge crane) from traveling over the spent fuel pool. During scheduled maintenance periods, the cask handling crane is used to provide access over the spent fuel pool, for example, for servicing of light bulbs and fire detectors. During these periods, the rail stops are removed to allow crane travel. These rail stops, which are not heavy loads, are hinged such that they can be rotated out of the path of the cask handling crane. The hinged connections are outside the crane rails and the stops rotate away from the center of the fuel building to allow crane travel. These stops do not require lifting to clear the cask handling crane, but are permanently attached to the crane rail support girder, thus precluding a drop. Administrative procedures are used to control removal and replacement of the interlock and stops and to position the hoist and hook so as not to travel above the pool during use of the cask handling crane above the pool.

Geared-type upper and lower limit switches are used in the control circuit of each hoist system of the fuel building cask handling crane. In addition to the geared-type limit switches, a weight-operated hoist upper limit switch is used in each hoist system of the cask handling crane. The two types of hoist upper limit switches are redundant and independent. If the geared-type limit switch were to fail, the weight-operated limit switch would cut off power to the hoist, thus preventing vertical motion of the lifting block and the occurrence of a two-blocking event.

Specific data for the cask handling crane travel speeds and lifting capacities are shown on Table 9.1-7.

SPENT FUEL POOL BRIDGE CRANE - The spent fuel bridge crane is a CMAA No. 70, Class B type. The crane is designed to maintain its integrity during an SSE.

The crane consists of a 5-ton-capacity wheeled bridge structure with steel deck walkway, a (b)(4) motorized monorail trolley, and a (b)(4) manual push-type trolley. The crane has interlocking capabilities with the new fuel elevator, fuel storage pool transfer gate, and cask loading gate. The crane also has a (b)(4) 4

The spent fuel bridge crane is used to transport new and spent fuel to and from various locations inside the fuel building. These locations include the new fuel elevator, fuel storage racks, spent fuel shipping cask, upending device of the fuel transfer car, and fuel storage pool transfer gates. The handling tools for the new and spent fuel are different to prevent interchanging of the same. The hoist travel and tool length are designed to limit the maximum lift of a fuel assembly to a safe shielding depth.

The (b)(4) electric hoist of the crane is primarily used to transfer spent fuel and new fuel assemblies. (b)(4) 4
(b)(4) manual chain hoist and trolley are used to move the fuel storage pool transfer gates to and from their normal storage positions. The hoists share the same monorail. (b)(4) 4
(b)(4)

The spent fuel pool bridge crane has a limited maximum lift height so that the minimum required depth of the water shielding is maintained when the spent fuel is handled. This is accomplished by the use of limit switches.

Geared-type upper and lower limit switches are used in the control circuit of the electric hoist system of the spent fuel pool bridge crane. In addition to the geared-type limit switches, a weight-operated hoist upper limit switch is used in the electric hoist system of the spent fuel pool bridge crane. The two types of hoist upper limit switches are redundant and independent. If the geared-type limit switch were to fail, the weight-operated limit switch would cut off power to the hoist, thus preventing vertical motion of the lifting block and the occurrence of a two-blocking event.

Specific data pertaining to the travel speeds are shown on Table 9.1-7.

CONTAINMENT BUILDING POLAR CRANE - The polar crane is a CMAA No. 70, Class C type.

The containment has a (b)(4) polar crane which is used, in conjunction with the various lifting rigs, to remove the Simplfied Head Assembly (SHA), the reactor vessel upper internals, and the lower internals. The (b)(4) auxiliary (b)(4 on the polar crane, in conjunction with strategically located (b)(4) capacity jib cranes, is used for routine maintenance and inservice inspection. The crane is controlled from its bridge-mounted cab or a portable radio control unit. The polar crane is used during plant outages for maintenance activities, in plant modes 3 to 6. The heaviest load lifted is the SHA. The polar crane is designed to maintain its structural integrity under operating basis earthquake (OBE) and safe shutdown earthquake (SSE) conditions. An analysis has been performed to show that the polar crane will not derail under an OBE during plant operation. It is also designed to carry (b)(4) under an SSE, generally during outages.

The polar crane bridge is equipped with seismic restraints (snubbers), one in each corner of the crane girders G1 and G2 (corner #1 is snubber #1,corner #2 is snubber #2, etc), refer to Figures 9.1-24 to 9.1-26. Girder G1 is between corner #1 and corner #2 and Girder G2 is between corner #3 and corner #4. Each snubber consists of two wheels, each wheel contained in a frame. The two frames are pinned into a holding frame and thus are able to move with respect to each other. The wheels are pushed toward each other by a spring loaded hydraulic snubber. Thus, the wheels rest against the face of the girder flange on which the crane rests. In case of a seismic event (OBE or SSE), the wheels will stay in contact with the girder flange face, while the shock absorbers prevent the crane from moving more than 1/4 of an inch in the horizontal plane. The snubber wheels will be in contact with the face of the girder flange during plant modes 1 and 2. The snubbers in corners #1 to #4 may be retracted ¾" in all plant modes. Structural integrity during an SSE with the snubbers retracted to 3/4" has been analyzed in all plant modes. Vertical motion of the polar crane is restrained through the use of upkick lugs on the snubber frame, which project under the girder flange face, during seismic events.

Positive means are also provided to limit motion of the polar crane trolley during a seismic event. Trolley earthquake restraints are provided to limit vertical motion of the trolley. These restraints are attached to both sides of the trolley girders (G1 and G2) and project under the flanges supporting the rails on which the trolley runs. To help limit horizontal motion of the trolley during a seismic event, rail capture bars are provided.

The main hoist of the polar crane has a micro-drive, which enables the operator to move the main hoist hook at a speed of 3 inches per minute. The auxiliary hoist of the polar crane has an "inching" feature, which allows the operator to raise or lower the load at approximately 1/16 of an inch increments.

Geared-type upper and lower limit switches are used in each hoist system of the containment building polar crane. The geared-type limit switch is driven off the hoist drum shaft through an eccentric pin and crank arrangement. As the switch drive shaft rotates, it rotates two cam gears. Cam screws lock the cam wheels to their respective cam gears. Snap switches are actuated when the lobes on their associated cam wheels contact the switch pushers. Snap switches open or close the contacts, thereby breaking or completing the electrical circuit to the hoist motor and holding brake.

In addition to the geared-type limit switches, a weight-operated hoist upper limit switch is used in each hoist system of the containment building polar crane. This assembly is used as a safety-type limit switch or final upper stop to prevent over-travel of the hook block as it approaches its upper limit. Thus, the block and load are prevented from coming into contact with any portion of the trolley, and an unsafe condition is avoided (two blocking event).

The two types of hoist upper limit switches, geared and weight-operated, are redundant and independent. This is to say that if the geared-type limit switch were to fail, the weight-operated limit switch would stop the load block from rising higher and would prevent the occurrence of a two-blocking event.

The polar crane main and auxiliary hooks are administratively controlled by procedure to prevent travel over the reactor vessel in all modes except cold shutdown and refueling. Once the upper internals have been removed and fuel is in the reactor vessel, crane hook travel will be prohibited over the open vessel except for the occasional need for reversing the orientation of the main/auxiliary hoists and for required vessel servicing activities such as irradiation sample removal. When there is fuel in the vessel, administrative procedures will not allow raising or lowering the hook while traveling over the open vessel to reverse the hoist orientation and the only item attached to either hook may be the load cell linkage attacked to the main hook. Note that during irradiation sample removal, the loads on the hoist hook, which are carried over the vessel are light (b)(4)

Specific data pertaining to the crane travel speeds and lifting capacity are shown on Table 9.1-7.

FUEL TRANSFER TUBE AND ASSOCIATED COMPONENTS - The fuel transfer system permits the safe underwater transfer of new and spent fuel assemblies between the fuel transfer canal in the fuel building and the refueling pool in the reactor building. Connecting these two areas is the fuel transfer tube which is a steel pipe (b)(4) outside diameter and approximately (b)(4) The pipe is inserted in a sleeve which is embedded in the concrete walls separating the two areas.

Angle rails forming a track and extending from the refueling canal through the transfer tube and into the transfer canal permit the controlled travel of the fuel car. During the fuel transfer operations, the fuel assemblies are supported by the fuel car. Attached to the car is the transfer car container which holds the fuel assembly. This container is a tube and is equipped with a centrally located pivot which allows the fuel assembly to be rotated from a vertical to a horizontal orientation for easier transfer. The fuel transfer car and container assembly travel through the transfer tube as one unit.

Positioned at the fuel bldg side of the transfer tube are mechanical stops. Water-activated hydraulic lifting arms which are the mechanisms that allow the fuel assembly to be pivoted are provided at both ends of the transfer tube. Each hydraulic drive is operated by a hydraulic pump.

The travel of the fuel assembly, transfer car, and container is achieved by the use of a pusher arm. This arm is connected to two stainless steel cables near the floor of the fuel transfer canal. These cables are driven by a motor-winch assembly and directed by a series of sheaves so that the cables will push the transfer car in one direction and pull in the other direction to move the container from the fuel building to the reactor building and vice versa. (b)(4 (b)(4)

The fuel transfer car is equipped with an emergency pullout cable to withdraw the car from the transfer tube should a system breakdown occur.

During reactor operation, the transfer car is stored in the fuel storage area. A blind flange is bolted on the reactor building cavity end of the transfer tube to seal the reactor containment. The terminus of the tube outside the containment is closed by a gate valve in the fuel building.

The following safety features are provided in the fuel transfer system during operation with NO bypass funcitons in effect:

a. Transfer car permissive switch

   The transfer car controls are located in the fuel storage area, and conditions in the containment are, therefore, not visible to the operator. The transfer car permissive switch allows a second operator in the containment to stop the car movement if conditions visible to him warrant such control.

   Transfer car operation is possible only when both lifting arms are in the down position, as indicated by the limit switches. The permissive switch is a backup for the transfer car lifting arm interlock. Assuming that the fuel container is in the upright position in the containment and the lifting arm interlock circuit fails in the permissive condition, the operator in the fuel storage area still cannot operate the car because of the permissive switch interlock. The interlock, therefore, can withstand a single failure.

b. Lifting arm (transfer car position)

Two redundant interlocks allow a lifting arm operation only when the transfer car is at the respective end of its travel and, therefore, can withstand a single failure.

Of the two redundant interlocks which allow a lifting arm operation only when the transfer car is at the end of its travel, one interlock is a position limit switch in the control circuit. The backup interlock is a mechanical latch device on the transfer car that is opened by the car moving into position.

c. Transfer car (valve open)

An interlock on the transfer tube valve permits transfer car operation only when the transfer tube valve position switch indicates that the valve is fully open.

d. Transfer car (lifting arm)

The transfer car lifting arm is primarily designed to protect the equipment from overload and possible damage if an attempt is made to move the car when the fuel container is in the vertical position. This interlock is redundant and can withstand a single failure. The basic interlock is a position limit switch in the control circuit. The backup interlock is a mechanical latch device that is opened by the weight of the fuel container when it is in the horizontal position.

e. Lifting arm (refueling machine)

The refueling canal lifting arm is interlocked with the refueling machine. The fuel transfer system lifting arm is prevented from moving unless the loaded gripper is in the full up position or the unloaded gripper is withdrawn into the mast, or unless the refueling machine is out of the upender zone.

f. Lifting arm (spent fuel pool bridge crane (SFPBC))

The lifting arm is interlocked with the SFPBC. The lifting arm cannot be operated unless the spent fuel pool bridge crane (b)(4) electric hoist is not over the lifting arm area.

ROD CLUSTER CONTROL CHANGING FIXTURE - The RCC changing fixture is used for periodic RCC element inspections and for the transfer of RCC elements from one fuel assembly to another. The major subassemblies which comprise the changing fixture are the frame and track structure, the carriage, the guide tube, the gripper, and the drive mechanism. The carriage is a movable container supported by the frame and track structure. The tracks provide a guide for the four flanged carriage wheels and allow horizontal movement of the carriage during the changing operation. The positioning stops on the carriage and frame locate each of the three carriage compartments directly below the guide tube. Two of these compartments are designed to hold individual fuel assemblies while the third is made to support a single RCC element.

The guide tube is situated above the carriage and is mounted on the refueling canal wall. The guide tube provides for the guidance and proper orientation of the gripper and RCC element as they are being raised and lowered. The gripper is a pneumatically actuated mechanism responsible for engaging the RCC element. It has two flexure fingers which can be inserted into the top of the RCC element when air pressure is applied to the gripper piston. Normally, the fingers are locked in the radially extended position. Mounted on the operating deck is the drive mechanism assembly which is composed of the manual carriage drive mechanism, the revolving stop operating handle, the pneumatic selector valve for actuating the gripper piston, and the electric hoist for elevation control of the gripper.

NEW FUEL ELEVATOR - The new fuel elevator consists of a box-shaped assembly with its top end open. The elevator is sized to house only one fuel assembly. It is located on the wall of the cask loading pool and is used primarily to lower a new fuel assembly to the pool bottom. It is also used to support other activities and may contain an irradiated fuel assembly, fuel rodlet container, or other equipment or components weighing less than the design value for the elevator. When it is at the bottom of the pool, the fuel assembly is transported to either the fuel storage pool storage racks or to the container of the fuel transfer car by the use of the spent fuel pool bridge crane.

SPENT FUEL ASSEMBLY HANDLING TOOL - The spent fuel assembly handling tool, also referred to as the long-handling tool, is used to manually handle the new and spent fuel in the fuel storage pool. (b)(4) (b)(4) The tool is designed to maintain its integrity during an SSE.

The tool employs four cam-actuated latching fingers which grip the underside of the fuel assembly top nozzle. When the fingers are latched, a lock pin is inserted into the operating handle to prevent the fingers from being accidentally unlatched during fuel handling operations.

The tool weighs approximately 376 pounds and is preoperationally tested at (b)(percent the weight of one fuel assembly with control assembly inserted (b)(4) (b)(4)

NEW FUEL ASSEMBLY HANDLING TOOL - The new fuel assembly handling tool is a short-handled device located on the cask handling crane monorail. It is used to handle new fuel on the operating deck of the fuel building, to remove the new fuel from the shipping container, and to facilitate inspection and storage of the new fuel and loading of fuel into the new fuel storage racks and the new fuel elevator.

The new fuel assembly handling fixture employs four cam-actuated latching fingers which grip the underside of the fuel assembly top nozzle. When the fingers are latched, the safety mechanism on the side of the tool is turned in to prevent accidental unlatching of the fingers.

The tool weighs approximately (b) pounds and is preoperationally tested at (b)(percent the weight of one fuel assembly with control rod inserted (b)(4) (b)(4)

REACTOR CAVITY SEAL RING - A permanent, watertight reactor cavity seal ring is mounted between the reactor vessel flange and the cavity liner at the bottom of the refueling pool. The permanent cavity seal ring (PCSR) covers the annulus around the vessel permitting the cavity to be flooded for refueling. The PCSR is designed to remain in place during all plant operations as well as during refueling. Access covers are provided to allow a ventilation flow path during reactor operation. The PCSR is not an ASME Code class item and it is classified as a non-nuclear safety class item in accordance with ANSI N18.2 (1973).

9.1.4.2.3 System Operation

The fuel handling equipment is designed to handle the spent fuel assembly under water from the time it leaves the reactor vessel until it is placed in a container for shipment from the site. Underwater transfer of spent fuel assemblies provides an effective, economic, and transparent radiation shield, as well as a reliable cooling medium for the removal of decay heat.

Fuel is moved between the reactor vessel and the refueling canal by the refueling machine. A RCC changing fixture is located in the refueling canal for transferring control elements from one fuel assembly to another. The fuel transfer system is used to move fuel assemblies between the containment building and the fuel storage building. After a fuel assembly is placed in the fuel container, the lifting arm pivots the fuel assembly to the horizontal position for passage through the fuel transfer tube.

The fuel transfer tube is fitted with a blind flange on the refueling pool end and a gate valve on the fuel transfer canal end.

After the transfer car transports the fuel assembly through the transfer tube, the lifting arm at that end of the tube pivots the assembly to a vertical position so that the assembly can be lifted out of the fuel container.

During nonrefueling operations, (b)(4)
(b)(4)

In the fuel storage building, fuel assemblies are moved about by the fuel handling machine. When lifting fuel assemblies, the hoist uses a long-handled tool to assure that sufficient radiation shielding is maintained. A shorter tool is used to handle new fuel assemblies initially, but the new fuel elevator must be used to lower the assembly to a depth at which the fuel handling machine, using the long-handled tool, can place the new fuel assemblies into or out of the fuel storage racks.

In MODES 5, 6, and defueled, during spent fuel pool bridge crane operations,
(b)(4)
(b)(4) The suspension of movement of the spent fuel pool bridge crane shall not preclude completion of movement of the component to a safe position.

Decay heat, generated by the spent fuel assemblies in the fuel storage area, is removed by the fuel pool cooling and cleanup system. After a sufficient decay period, the spent fuel assemblies may be removed from the fuel racks and loaded into shipping containers for removal from the site.

9.1.4.2.3.1 Fuel Handling System Operations

NEW FUEL RECEIVING AND STORAGE - New fuel assemblies are delivered to the site by truck or rail in approved containers. New fuel containers are removed from the truck or railcar in the fuel shipping and unloading area of the fuel building and then, with the use of the new fuel handling tool suspended on the monorail hoist on the cask handling crane, are moved to the new fuel inspection area (a strongback is used initially to upend and prevent the bowing of the new fuel assembly). While the new fuel assembly is in this area, any shipping spacers present are removed, the cleanliness is verified, and the assembly is visually inspected for any damage.

Following inspection, the new fuel is transferred by means of the new fuel handling tool suspended from the monorail hoist on the cask handling crane to the new fuel storage racks in the new fuel storage vault, or moved to the new fuel elevator where it is lowered and transferred to a fuel storage pool location.

REFUELING PROCEDURE - The refueling operation follows a detailed procedure which provides a safe, efficient, refueling operation. The following significant points are assured by the refueling procedures:

a. The refueling water and the reactor coolant are maintained at no less than the boron concentration specified in the COLR. (b)(4) (b)(4) (b)(4) It is also sufficient to maintain the core subcritical in the unlikely event that all of the RCC assemblies were removed from the core.

b. The water level in the refueling pool is high enough to keep the radiation levels within acceptable limits when the fuel assemblies are being removed from the core.

The refueling operation is divided into five major phases:

Phase I - Preparation

Phase II - Reactor disassembly

Phase III - Fuel handling

Phase IV - Reactor reassembly

Phase V - Preoperational checks and startup

Phase I - Preparation

The reactor is shut down, borated, and cooled to cold shutdown conditions (b)(4) (b)(4) Following a radiation survey, the containment is cleared for entry. The reactor coolant system level is lowered to a point slightly below the reactor vessel flange. The fuel transfer equipment, refueling machine and polar crane are checked for proper operation.

Phase II - Reactor Disassembly

Prior to reactor vessel head disassembly, several items must be disconnected and removed. The tie rods which anchor the control rod drive mechanism (CRDM) seismic support platform to the refueling pool walls are disconnected. All cables connected to the reactor vessel head (rod position indication, CRDM power cables, upper instrumentation thermocouple leads, upper head loose parts monitoring leads, and head vent valves) are disconnected. The power cables to the CRDM fans are disconnected. RVLIS is disconnected. The reactor vessel head shield doors are closed for shielding.

The insulation is removed from the vessel head and studs detensioned and removed, guide studs installed and stud holes plugged. The refueling cavity is prepared for flooding by installing blind flanges on the refueling pool drain holes, checking underwater lights, tools and the fuel transfer system with the fuel transfer system blind flange removed. The shield plugs and cover plates on the permanent cavity seal ring are installed.

With the refueling cavity prepared for flooding, the reactor vessel head is lifted slightly and lift rig inspections completed. The reactor vessel head is gradually raised to clear CRDM drive shafts and core exit thermocouple bullet noses, cavity flood up is commenced and the reactor vessel head is moved to storage area. The remainder of the refueling cavity is flooded to the normal refueling level specified in Technical Specifications. The control rod drive shafts are disconnected from the RCC assemblies, and the upper internals are removed from the vessel and stored in the refueling cavity. The fuel assemblies and RCC assemblies are now free of obstructions and the core is ready for refueling.

Phase III - Fuel Handling

(b)(4)

(b)(4) This requirement is consistent with the assumptions of Section 15.7.4.5.1.2.

Prior to initiation of the refueling sequence, the refueling pool water level is raised to the same level as the fuel storage pool, and the gate valve, which normally isolates the fuel building side of the transfer tube is opened. In this condition, there is communication between the fuel building pools and the refueling pool; therefore, level monitoring, including a low level alarm, is provided by the fuel pool cooling and cleanup system.

The refueling sequence is started with the refueling machine. Spent fuel assemblies are removed from the core in the sequence prepared by plant personnel before each refueling.

During those activities that are defined as core alterations in the Technical Specifications, direct communications between the Control Room and refueling station are demonstrated. Communications is verified within 1 hour prior to the start of core alterations and at least once per 12 hours during core alterations. Without direct communications between the Control Room and the refueling station, core alterations are suspended.

The general fuel handling sequence is:

a. The refueling machine is positioned over a fuel assembly in the core.

b. The fuel assembly is lifted by the refueling machine to a predetermined height sufficient to clear the reactor vessel and still leave sufficient water covering to eliminate any radiation hazard to the operating personnel.

c. The fuel transfer car is moved into the refueling pool from the fuel transfer canal.

d. The spent fuel assembly is moved by the refueling machine to the fuel transfer car.

e. The fuel assembly container on the transfer system is pivoted to the vertical position by the upender.

f. The refueling machine is moved to line up the spent fuel assembly with the fuel assembly container, and the spent fuel assembly is loaded into the assembly container on the transfer system.

g. The container is pivoted to the horizontal position by the upender.

h. The fuel and container are moved through the fuel transfer tube to the fuel transfer canal by the transfer car.

i. The fuel assembly and container are pivoted to the vertical position. The spent fuel assembly is unloaded by the spent fuel handling tool attached to the spent fuel pool bridge crane.

j. The spent fuel assembly is transferred through the spent fuel storage pool transfer gate, and placed in a designated location in the spent fuel storage racks.

k. This sequence continues until the core is off-loaded. The core may be either partially or fully off-loaded.

l. Fuel is reloaded into the reactor vessel by reversing the steps necessary for fuel removal.

The reactor is now ready for the reassembly phase.

Phase IV - Reactor Reassembly

The reactor reassembly, following refueling, is essentially achieved by reversing the operations given in Phase II - Reactor Disassembly.

During those activities that are defined as core alterations in Technical Specifications, direct communications between the Control Room and refueling station are demonstrated. (b)(4)

(b)(4)

Phase V - Preoperational Checks and Startup

After the refueling pool has been drained, the reactor assembled, and the fuel transfer tube has been isolated, cleanup of the fuel handling areas within the containment building is performed in accordance with the established station housekeeping procedures.

The blind flanges covering the refueling pool drain holes are removed and stored in designated locations, and the refueling pool strainers are replaced. Any maintenance which is required on fuel handling equipment inside the containment is done during this general cleanup phase of refueling.

SPENT FUEL SHIPMENT - The spent fuel assemblies are stored on site, in the fuel storage pool, until fission product inventory and the decay heat is low enough to permit shipment. A spent fuel shipping cask (either by rail or truck) is brought into the shipping/receiving area. The (b)(4) cask handling crane upends the cask and places it in the cask washdown pit where it is thoroughly cleaned. The cask head is then disengaged from the top of the cask and stored in its designated storage area.

The cask is then lowered into the cask loading pool. The cask loading pool is normally flooded and considered part of the fuel storage pool. The removable gate is used to isolate the spent fuel pool from the cask loading pool, if a leak should occur in the cask loading pool.

The spent fuel handling tool on the spent fuel bridge crane transfers the spent fuel from the fuel storage racks to the cask loading pool and places it into the shipping cask.

After the cask is loaded, it is capped in the pool and then carried to the cask washdown pit for decontamination. The cask is then placed on the railcar or truck bed. The cask is monitored for radioactivity and verification made to ensure that the provisions of state and federal regulations are met.

Spent Fuel Casks (used to remove fuel from the plant) shall not be immersed in, or carried over, the Cask Loading Pool while spent fuel is stored in storage racks within this pool, unless one of the following is performed prior to the load lift:

1. The Cask Handling Crane is upgraded to single failure proof.
2. An evaluation is performed to demonstrate the acceptability of damage to the stored fuel, rack modules, pool liner, and structure.
3. Effective means (such as crane stops, limits, barriers or impact limiters, etc.) are implemented to preclude damage to the stored fuel, rack modules, and structure.

9.1.4.3 Safety Evaluation

Safety evaluations are numbered to correspond to the safety design bases in Section 9.1.4.1.1.

SAFETY EVALUATION ONE - (b)(4) (b)(4) These buildings are designed to withstand the effects of earthquakes, tornadoes, hurricanes, floods, external missiles, and other appropriate natural phenomena. Sections 3.3, 3.4, 3.5, 3.7(B), and 3.8 provide the bases for the adequacy of the structural design of these buildings.

SAFETY EVALUATION TWO - The safety-related portions of the FHS are designed to remain intact after an SSE. Section 3.7(B) provides the design loading conditions that were considered. Sections 3.5, 3.6, and 9.5.1 provide the required hazards analysis.

SAFETY EVALUATION THREE - The FHS is initially tested with the program given in Chapter 14.0. Periodic inservice functional testing is done in accordance with Section 9.1.4.4. The fuel transfer tube is inspected in accordance with the technical requirements of ASME Section XI.

SAFETY EVALUATION FOUR - Section 3.2 delineates the seismic category applicable to the safety-related portions of this system. Table 9.1-7 shows that the components meet the design and fabrication codes given in Section 3.2.

SAFETY EVALUATION FIVE - Sections 6.2.4 and 6.2.6 provide the safety evaluation for the system containment isolation arrangement and testability.

SAFETY EVALUATION SIX - In the event of a fuel handling accident in the fuel building, the radiological consequences analyzed in Chapter 15.0 demonstrate that the 10 CFR Part 100 guideline values are not exceeded. The circumstances resulting in a handling accident are limited to the following conditions.

a. Fuel drop from a lifting device

b. Improper operation of the transfer equipment and cranes

c. Drop of the fuel shipping cask

d. Drop of the RV head

The fuel handling equipment is designed to prevent a fuel assembly drop by providing special gripping devices which are locked in a manner which will not allow the release of the fuel assembly during transfer. The special features are described in Section 9.1.4.2.2.

Improper operation of the fuel transfer system (b)(4) (b)(4) (b)(4) Further description of these devices is given in Section 9.1.4.2.2.

(b)(4)

(b)(4)

The cask handling crane is restricted from moving the spent fuel cask over the spent fuel pool, the new fuel vault, the fuel pool cooling system, or engineered safety features systems which could be damaged by dropping the cask, and is limited to moving in such a manner as to avoid the possibility of falling or tipping into the spent fuel pool, in accordance with the regulatory position of Regulatory Guide 1.13 and General Design Criterion 61 of Appendix A to 10 CFR 50.

(b)(4)

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(b)(4)

(b)(4)

(b)(4)

(b)(4)

(b)(4)

(b)(4)

(b)(4)

9.1.5 REFERENCES

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2. Hunsaker, J. C. and Rightnire, B. G., Engineering Applications of Fluid Mechanics, page 183.

3. Hoemer, J. F., Fluid-Dynamic Drag, page 317.

4. Roark, R. J., Formulas For Stress and Strain - Fourth Edition, pages 340, 370, and 371.

5. Holtec Documentation No. 981968, Rev. 2, "Criticality Analysis of the Wolf Creek New Fuel Vault with 5% Enriched Fuel (calculation)" DCN C-175A-00088-W03

6. Letter from J. C. Stone, USNRC, to O. L. Maynard, WCNOC dated June 24, 1997, Request For Exemption From 10 CFR 70.24 Criticality Monitoring Requirements - Wolf Creek Generating Station (TAC NO. M89161).

7. Holtec Documentation No. HI-971768, Rev. 5, "Thermal-Hydraulic Evaluation of the Reracked Callaway and Wolf Creek Spent Fuel Pool" DCN c-175A-00052-W06.

8. Calculation No. AN-99-032, Rev. 0, "The Heat Rejection Rate from the Spent Fuel Pool to the Ultimate Heat Sink following a LOCA"

9. Letter ET 98-0103, dated December 8, 1998, from R. A. Muench, WCNOC, to USNRC, Docket No. 50-482: Follow-up To December 3, 1998, NRC/Wolf Creek Nuclear Operating Corporation/AmerenUE Meeting on Spent Fuel Pool Rerack

10. Holtec Documentation No. HI-971754, Rev. 3, "Analysis of the Mechanical Accidents for Callaway and Wolf Creek Nuclear Plants" (C-175A-00053)

11. Calculation 0720517.01-C-001: "WCNOC Reactor Vessel Head Drop Analysis"

12. Westinghouse calculation CN-CSE-02-40: "Simplified Head Assembly (SHA) loads".

TABLE 9.1-1

NEW FUEL STORAGE DESIGN DATA

Component Requirements	(b)(4)
New fuel storage vault capacity	
New fuel storage vault size	
Module array	

TABLE 9.1-2

SPENT FUEL STORAGE DESIGN DATA

(b)(4)

TABLE 9.1-3

DESIGN COMPARISON TO REGULATORY POSITIONS OF REGULATORY GUIDE 1.13 REVISION 1, DATED DECEMBER 1975, TITLED "SPENT FUEL STORAGE FACILITY DESIGN BASIS"

Regulatory Guide 1.13 Position	WCGS
1. The spent fuel storage facility (including its structures and equipment, except as noted in Paragraph 6 below) should be designed to Category I seismic requirements.	1. Complies as described in Section 9.1.2.1.1.
2. The facility should be designed (a) to keep tornadic winds and missiles generated by these winds from the fuel storage pool and (b) to keep missiles generated by tornadic winds from contacting fuel within the pool.	2. Complies as described in Section 3.5, and 3.8.
3. Interlocks should be provided to prevent cranes from passing over stored fuel (or near stored fuel in a manner such that if a crane failed the load could tip over on stored fuel) when fuel handling is not in progress. During fuel handling operations, the interlocks may be bypassed and administrative control used to prevent the crane from carrying loads that are not necessary for fuel handling over the stored fuel or other prohibited areas. The facility should be designed to minimize the need for bypassing such interlocks.	3. Complies as described in Section 9.1.4.
4. A controlled leakage building should enclose the fuel pool. The building should be equipped with an appropriate ventilation and filtration system to limit the potential release of radioactive iodine and other radioactive materials. The building need not be designed to withstand extremely high winds, but leakage should be suitably controlled during refueling operations. The design of the ventilation and filtration system should be based on the assumption that the cladding of all of the fuel rods in one fuel bundle might be breached. The inventory of radioactive materials available for leakage from the building should be based on the assumptions given in Regulatory Guide 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors" (Safety Guide 25).	4. Complies as described in Section 9.4.2 and 15.7.4.

TABLE 9.1-3 (Sheet 2)

Regulatory Guide 1.13 Position	WCGS
5. The spent fuel storage facility should have at least one of the following provisions with respect to the handling of heavy loads, including the refueling cask: a. Cranes capable of carrying heavy loads should be prevented, preferably by design rather than by interlocks, from moving into the vicinity of the pool; or b. Cranes should be designed to provide single-failure-proof handling of heavy loads, so that a single failure will not result in loss of capability of the crane-handling system to perform its safety function; or c. The fuel pool should be designed to withstand, without leakage that could uncover the fuel, the impact of the heaviest load to be carried by the crane from the maximum height to which it can be lifted. If this approach is used, design provisions should be made to prevent the crane, when carrying heavy loads, from moving in the vicinity of stored fuel.	5. Complies as described in Section 9.1.4.
6. Drains, permanently connected mechanical or hydraulic systems, and other features that by maloperation or failure could cause loss of coolant that would uncover fuel should not be installed or included in the design. Systems for maintaining water quality and quantity should be designed so that any maloperation or failure of such systems (including failures resulting from the safe shutdown earthquake) will not cause fuel to be uncovered. These systems need not otherwise meet Category I seismic requirements.	6. Complies as described in Section 9.1.2 and 9.1.3.
7. Reliable and frequently tested monitoring equipment should be provided to alarm both locally and in a continuously manned location if the water level in the fuel storage pool fails below a predetermined level or if high local-radiation levels are experienced. The high-radiation-level instrumentation should also actuate the filtration system.	7. Complies as described in Section 9.1.3.

TABLE 9.1-3 (Sheet 3)

Regulatory Guide 1.13 Position	WCGS
8. A seismic Category I makeup system should be provided to add coolant to the pool. Appropriate redundancy or a backup system for filling the pool from a reliable source, such as a lake, river, or onsite seismic Category I water-storage facility, should be provided. If a backup system is used, it need not be a permanently installed system. The capacity of the makeup systems should be such that water can be supplied at a rate determined by consideration of the leakage rate that would be expected as the result of damage to the fuel storage pool from the dropping of loads, from earthquakes, or from missiles originating in high winds.	8. Complies as described in Section 9.1.3.

TABLE 9.1-4

FUEL POOL COOLING AND CLEANUP SYSTEM
DESIGN PARAMETERS

(b)(4)

TABLE 9.1-4 (Sheet 2)

NOTES:

(b)(4)

TABLE 9.1-5

FUEL POOL COOLING AND CLEANUP SYSTEM
COMPONENT DESIGN PARAMETERS

(b)(4)

TABLE 9.1-5 (Sheet 2)

(b)(4)

TABLE 9.1-5 (Sheet 3)

(b)(4)

TABLE 9.1-5 (Sheet 4)

(b)(4)

TABLE 9.1-6

(b)(4)

WOLF CREEK

TABLE 9.1-7

FUEL HANDLING CRANE DATA (1)

Name of Crane

(b)(4)

TABLE 9.1-7 (Sheet 2)

(b)(4)

[TABLE 9.1-8 HAS BEEN DELETED]

TABLE 9.1-9

(b)(4)

TABLE 9.1-10

(b)(4)

Table 9.1-11

(b)(4)

(b)(4)

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4

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