June 6, 2000

MEMORANDUM TO: Richard P. Correia, Chief
Section 2
Project Directorate II
Division of Licensing Project Management

FROM: George H. Hubbard, Chief **/RA/**
Balance of Plant and Containment Systems Section
Plant Systems Branch
Division of Systems Safety and Analysis

SUBJECT: REVIEW OF LICENSE AMENDMENT REQUEST TO MODIFY THE TECHNICAL SPECIFICATIONS FOR THE SHEARON HARRIS NUCLEAR POWER PLANT TO SUPPORT AN INCREASE IN THE SPENT FUEL POOL STORAGE CAPACITY (TAC NO. MA4432)

By letter dated December 23, 1998, the Carolina Power and Light Company (CP&L), the licensee, submitted a License Amendment Request to modify the current Technical Specifications (TS) for the Shearon Harris Nuclear Power Plant (SHNPP) License No. NPF -63. Specifically, the licensee proposes to modify TS 5.6, “Fuel Storage,” to support an increase in the spent fuel storage capacity of SHNPP’s spent fuel pools (SFPs) by placing SFPs C and D into service. The storage capacity of pools ‘C’ and ‘D’ will be 3690 and 1025 fuel assemblies, respectively.

The Balance of Plant and Containment Systems Section in the Plant Systems Branch (SPLB) reviewed the proposed changes to TS.5.6. Specifically, we reviewed the considerations given to the heavy loads handling operations during the proposed increase in the spent fuel pool storage capacity. Based on our review, we find that the proposed changes to the TS and spent fuel pool storage capacity are acceptable.

Our evaluation is contained in the attached Safety Evaluation Report. This evaluation completes our effort associated with review of heavy loads under the above TAC Number. Other areas of review within the SPLB scope have been provided under separate cover.

Docket No.: 50-400

Attachment: As stated

CONTACT: Brian E. Thomas, SPLB/DSSA/NRR
(301) 415-1210

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ATTACHMENT

SAFETY EVALUATION INPUT BY THE PLANT SYSTEMS BRANCH

DIVISION OF SYSTEMS SAFETY AND ANALYSIS
OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO LICENSE AMENDMENT REQUEST
TO FACILITY OPERATING LICENSE NO. DPR-63
CAROLINA POWER AND LIGHT COMPANY
SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400

1. INTRODUCTION

By letter dated December 23, 1998, the Carolina Power and Light Company (CP&L), the licensee, submitted a License Amendment Request to modify the current Technical Specifications (TS) for the Shearon Harris Nuclear Power Plant (SHNPP), License No. NPF-63. Specifically, the licensee proposes to modify TS 5.6, "Fuel Storage," to: (1) activate SFPs C and D; (2) increase the spent fuel storage capacity of SFPs C and D to 3690 and 1025 spent fuel assemblies, respectively; (3) install high density stainless steel spent fuel storage racks; and (4) activate the cooling and cleanup systems associated with SFPs C and D.

The Balance of Plant and Containment Systems Section in the Plant Systems Branch reviewed the proposed changes to TS 5.6. Specifically, we reviewed the considerations given to the heavy loads handling operation during the proposed increase in the spent fuel pool storage capacity. Review of the thermal hydraulics aspects of the proposed SFP expansion was provided separately.

2. BACKGROUND

NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," dated July 1980, provides regulatory guidelines for licensees to assure safe handling of heavy loads in areas where a load drop could impact on stored spent fuel, fuel in the reactor core, or equipment that may be required to achieve safe shutdown or permit continued decay heat removal. The objectives of the guidelines are to assure that either: (1) the potential for a load drop is extremely small, or (2) the potential hazards of load drops do not exceed acceptable limits. The NUREG provides guidelines that are implemented in two phases. Phase I guidelines address measures for reducing the likelihood of dropping heavy loads and provide criteria for establishing safe load paths, procedures for load handling operations, training of crane operators, design, testing, inspection, and maintenance of cranes and lifting devices, and analyses of the impact of heavy load drops.

Phase II guidelines address alternatives for mitigating the consequences of heavy load drops, including using either (1) a single-failure-proof crane for increased handling system reliability, or (2) electrical interlocks and mechanical stops for restricting crane travel, or (3) load drops and consequence analyses for assessing the impact of dropped loads on plant safety and operations.

Generic Letter (GL) 85-11, “Completion of Phase II of Control of Heavy Loads at Nuclear Power Plants, NUREG-0612,” dated June 28, 1985, dismissed the need for licensees to implement the requirements of NUREG-0612, Phase II. However, GL 85-11 encouraged licensees to implement actions they perceive to be appropriate to provide adequate safety.

SHNPP has four SFPs - A, B, C, and D. SHNPP, Unit 1 began operation in 1987 with SFPs A and B in service. At that time, with construction approximately 80% complete, construction on SFPs C and D spent fuel pool cooling and cleanup systems were discontinued.

TS 5.6.3 is modified to reflect the following: TS 5.6.3.a limits SHNPP’s fuel storage capacity to 723 and 2946 fuel assemblies in SFPs A and B, respectively, for a total of 3669 fuel assemblies. TS 5.6.3.b adds 927 PWR and 2763 BWR fuel assemblies to SFP C for a total of 3690 additional spent fuel assemblies. TS 5.6.3.c adds 1025 PWR spent fuel assemblies to SFP D. According to the licensee, shipment of spent fuel to SHNPP for storage is necessary to maintain full core-off-load capability at Brunswick and Robinson. Activation of SFPs C and D and the associated cooling and cleanup systems will provide storage of spent fuel for four CP&L units - Harris (PWR), Brunswick 1 and 2 (BWRs), and Robinson (PWR) - through the end of their current licenses.

NRC Safety Evaluation Report related to the operation of SHNPP, Unit 1, (NUREG-1038, Supplement No. 4) dated October 1986 approved CP&L’s NUREG-0612, Phase I heavy loads program. In the proposed amendment, the licensee addresses heavy load issues, including the installation of spent fuel storage racks at SFPs C and D, fuel movement, movement of the gates that isolate the pools from the transfer canal, and movement of spent fuel dry storage casks. Considerations are given to the design and operation of the hoisting systems, safe load paths, procedures, crane operator training, and postulated load drop accidents and consequences on fuel and on the SFP.

3. EVALUATION

3.1 Hoisting Systems

The Fuel Handling Building (FHB) auxiliary crane which is rated at 10 tons will be used to lift and move the new racks, the gates that isolate the pools from the transfer canal, and new fuel assemblies. The racks will be lifted up through the equipment hatch then transported along the safe load path to spent fuel pools C and D. The same crane will be used to lower the racks into SFPs C and D. A 20-ton hoist will be suspended from the bridge of the FHB auxiliary crane and used in conjunction with the spent fuel rack lifting rig (special lifting device) to lift and move the racks into the pools. The use of the 20-ton hoist will allow the licensee to avoid contamination of the main hook during SFP rack movement in the pools. The 150-ton Spent Fuel Cask Handling Crane will be used to lift and move shipping casks containing offsite spent fuel between the railroad car in the equipment hatch and the cask loading pool.

In NUREG-1038, Supplement No. 4, we approved the load handling systems, including the FHB auxiliary crane and the spent fuel cask handling crane. We found that the load handling system provided adequate protection against heavy load drops and was consistent with NUREG-0612. However, the spent fuel storage rack lifting rig is specifically designed to lift the new rack modules, therefore, it was not addressed in NUREG-1038.

Both the FHB Auxiliary Crane and the Spent Fuel Cask Handling Crane are designed, fabricated, installed, inspected, tested, and operated in accordance with requirements of the Crane Manufacturers Association of America (CMAA) Specification No. 70, "Specifications for Electric Overhead Traveling Cranes," and ANSI B30.2-1976, "Safety Standards for Overhead and Gantry Cranes (Top Running Bridge and Multiple Girder)." The FHB auxiliary crane is single-failure-proof and although it has a rated capacity of 10 tons in the auxiliary hook, it can be used to handle items that weigh more than 10 tons but less than 12 tons provided that they are evaluated and administratively controlled. The single failure proof design of the crane enables the licensee to retain and hold the load in a stable and immobile safe position during an event. The crane is equipped with a means to safely move the load manually to a lay down area for emergency manual lowering of the load. Also, all the components in the load path of the crane hoist such as the hook, hoist rope, reeving, and braking mechanisms, either are redundant or have a large factor of safety. In addition, the crane is designed to maintain its structural integrity and hold the load under the dynamic loading conditions of a safe shutdown event (SSE). The maximum lifted weight during rack installation includes the rack, lifting rig (special lifting device), rigging, and the 20-ton hoist for a total weight of 18,820 lbs.

The licensee states that the rack modules will be lifted using a remotely engaged spent fuel rack lifting rig that is specifically designed to lift both PWR and BWR spent fuel rack modules. The lifting rig is designed and tested in accordance with the guidelines in NUREG-0612, Sections 5.1.6(1) and 5.1.6(3a), and the requirements in ANSI N14.6 (1978), "Standard for Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More for Nuclear Materials." Accordingly, in accordance with NUREG-0612, the lifting rig has twice the design safety factor with respect to the yield and ultimate strength (six (6) times and ten (10) times the combined concurrent static and dynamic loads for the yield and ultimate strength, respectively) of its material of construction. The lifting rig also is redundantly designed with four independently loaded lift rods that are configured such that failure of a single rod will not result in uncontrolled lowering of the rack. Therefore, the lift rods and lift points of the lifting rig are designed and tested as follows: (1) with a stress design factor of five times the lifted weight without exceeding the ultimate strength of the material; and (2) load tested to 300% of the maximum weight to be lifted, and hoisted and suspended for a minimum of 10 minutes. After load testing, examination of the critical weld joints using a liquid penetrant is performed.

We find that the lifting capacity of the 10-ton single-failure proof FHB auxiliary crane coupled with the capacity of the 20-ton hoist and the spent fuel rack lifting rig (special lifting device) will support the weight of the racks and the added rigging loads. In addition, the design, inspection and testing of the crane and lifting device will help to assure the licensee's safe handling of the racks with little to no risk of an accidental rack drop during rack installation.

3.2 Load Path

The new spent fuel storage racks will be installed in five sequential campaigns as follows:

	SFP 'C' (date)	SFP 'D' (date)
Campaign 1	14 (2000)	6 (2016)
Campaign 2	10 (2005)	6 (TBD)
Campaign 3	6 (2014)	

The new racks will be lifted to the FHB operating level through the equipment hatch, then moved along the safe load path that was previously identified as the path used for the spent fuel shipping cask. The racks are then moved over the fuel transfer canal from which they are moved over SFP C and D and lowered into position. The safe load path from the equipment hatch to the SFPs is clear of any safety related equipment. The licensee stated that rack installation and fuel assembly storage will begin in the south end of SFP C and proceed north to SFP D. Therefore, lifts of the racks over spent fuel will be avoided.

As stated by the licensee, the new installed fuel storage racks will not significantly change the method of handling loads during normal plant operations because the same equipment (i.e., the spent fuel handling machine and tools) and procedures as those currently used in pools A and B will be used in pools C and D.

New and spent fuel shipping casks are lifted from the carrier in the equipment hatch up to the FHB operating level by the FHB auxiliary crane or the spent fuel cask handling crane. As stated in FSAR Section 9.1.4.3.2(b), spent fuel shipping casks are handled by the 150-ton cask handling crane. Therefore, the shipping casks containing offsite spent fuel will be lifted by the cask handling crane up the equipment hatch to the operating level then moved to the cask loading pool. Permanent mechanical stops on the cask handling crane limits any travel of the crane over the SFPs. This enables the licensee to avoid traversing or dropping the cask over spent fuel in the fuel pools.

We find that the load paths for movement of the spent fuel storage racks and the pattern for storing spent fuel in the racks does not involve any movement of the racks over spent fuel. Also, cask movements do not involve travel over fuel stored in the racks or over the spent fuel pool.

3.3 Analysis of Heavy Load Drop Accidents

The licensee analyzed postulated load drops of spent fuel assemblies, spent fuel storage racks, and the gates that isolate the pool from the transfer canal. Two drops of the fuel assembly using a bounding impact weight of 2100 lbs. (includes the heaviest fuel plus the handling tool) was considered: vertical drops on top of the racks, and vertical drops to the base plate of the racks. The fuel assembly drop on top of the spent fuel racks resulted in deformation of the racks to a depth of 11 inches below the top of the rack. However, the fuel in the racks would not be damaged. The fuel assembly drop onto the base plate of the racks resulted in damage to the baseplate but no damage to the spent fuel pool liner.
SHNPP FSAR, Appendix 9.1A, "Heavy Loads Analysis," does not address the drop of a rack into the spent fuel pool. However, because a single failure proof crane is used, there is a reasonably low chance of a rack drop. Nonetheless, in the amendment, the licensee considered a vertical drop of the heaviest rack (16140lbs.) from 40 feet above the SFP floor

liner. The results indicated that some damage to the SFP liner and minor damage to the SFP concrete floor slab would occur. In a telephone conference on March 30 and April 4, 2000, we discussed with the licensee, NRC's request for additional information on the results of the rack drop analyses. By letter dated April 14, 2000, the licensee responded that a rack drop would pierce the SFP liner and result in leakage of SFP water. However, the plant's design bases leakage detection system is designed and operated to detect, limit, and contain leakage from the SFP. Valves in the leakage detection system are normally closed and are only opened to check for and measure any leakage during the operator monthly rounds. Therefore, the closed valves will enable the system to limit any SFP leakage. In addition, SFP makeup can be made available from a number of sources to supplement any leakage from the SFP. Emergency makeup can be provided from the emergency service water system. Normal SFP makeup can be provided from the demineralized water system, refueling water storage tank, the reactor coolant drain tank, and the reactor makeup water storage tank. Therefore, due to these capabilities, and because the structural integrity of the concrete slab remained unimpaired after the drop, the licensee concluded that neither catastrophic damage of the SFP structure nor rapid loss of pool water would occur.

SHNPP did not analyze the potential for a rack drop on spent fuel assemblies or on safety related equipment because (1) the racks would not be moved directly over any fuel in the pool, and (2) upending and laying down the racks is planned to occur in an area that avoids any potential impact on safety-related equipment.

The drop of the gate (4,000 lbs. each) that isolate the pool from the transfer canal was analyzed. The gates will also be lifted using the single-failure-proof auxiliary crane and dual rigging that satisfies NUREG-0612 safety margins. The gate rigging will be load-tested to lift three times the weight of the rack and the other components of the lifting device without exceeding the minimum yield strength of the material. The gate rigging also will be capable of lifting five times that weight without exceeding the ultimate strength of the rig materials. The postulated gate drops were analyzed at 15 inches above loaded fuel racks and at 40 feet above the SFP liner. A gate drop would penetrate the racks to a depth of 5 inches with no impact on the stored fuel. It also would damage the pool liner, however, the SFP concrete slab would not fail. Therefore, fuel in the racks would not be affected if a gate drop occurred. If the spent fuel pool liner is breached, the leakage detection system and makeup capability as discussed above would be effective.

NUREG-0612 recommends that licensees provide an adequate defense-in-depth approach to maintaining safety during the handling of heavy loads near spent fuel and cited four major causes of accidents: operator errors, rigging failures, lack of adequate inspection, and inadequate procedures. The licensee stated that they will implement measures using administrative controls and procedures to preclude load drop accidents in these four areas. Accordingly, the licensee plans to provide: (1) comprehensive training to the rerack installation crew in accordance with ANSI B30.2, (2) use redundantly designed and adequately tested lifting rigs in accordance with ANSI N14.6, (3) perform inspection and maintenance checks on the cranes, lifting devices, and racks themselves prior to and during the rerack operation, and (4) use specific procedures that cover the entire rerack effort, including the identification of required equipment, inspection, acceptance criteria prior to load movement, defining safe load paths, and steps and precautions for proper load handling and movement. In addition, the licensee states that its rack installation pattern will enable the racks to be lifted and inserted without travel over spent fuel in the SFP during the rack installation operation.

Since both the spent fuel cask handling crane and the configuration of the Fuel Handling Building are designed to avoid any travel of the crane hook over the spent fuel pools, the spent fuel shipping cask will not be moved over or have any opportunity to fall into the fuel pools. As a result, there is no need for a load drop analysis of the cask over the spent fuel pools.

We accept the licensee's finding that based on the load drop analyses, the integrity of the fuel and the SFP would be maintained if a fuel assembly or a spent fuel storage rack is dropped. The use of a single failure proof crane in conjunction with administrative procedures and controls that are focused on, but not limited to, the areas noted above would enable the licensee to maintain safety during the rerack operation.

4. CONCLUSION

Based on the preceding discussions, we find that the aforementioned considerations for the movement of heavy loads to support the proposed changes to TS 5.6 and the increase in the spent fuel pool storage capacity are acceptable. The licensee's use of the 10-ton single failure proof Fuel Handling Building auxiliary crane, the 20-ton hoist, the spent fuel rack lifting rig, and administrative controls and procedures that are in accordance with NUREG-0612 and ANSI N14.6, will help to maintain safety during the installation of the new racks. The reliability of the crane coupled with the design, testing and inspection of the crane, the lifting rig and other lifting devices will enable the licensee to handle safely the racks and other heavy loads during the rack installation process. The postulated accident analyses involving a dropped spent fuel storage rack and the gate indicated that the spent fuel pool liner could be breached. However, during such a breach, the licensee could maintain the pool and its contents within the acceptable consequence limits set forth in NUREG-0612. In addition, the licensees' use of administrative controls and procedures to improve the handling and control of heavy loads including the racks enhances the licensee's capability to reduce the potential for load drops.

In addition, the licensees' cask handling operations will not occur over the spent fuel pools. Therefore, movement of the cask will not impact the new racks nor the fuel configuration in the pools. Also, the licensee stated that there will be no significant changes in its method of handling new and spent fuel assemblies subsequent to the installation of the racks. Therefore, we believe that the existing fuel handling procedures as documented in the FSAR will enable the licensee to continue to maintain safety during its fuel handling operations.

Principal Contributor: Brian E. Thomas