OCT 28 1985

Docket No.: 70-2997

Applicants: Carolina Power & Light Company
North Carolina Eastern Municipal Power Agency

Facility: Shearon Harris Nuclear Power Plant, Unit 1

Subject: SAFETY EVALUATION REPORT - REVIEW OF LICENSE APPLICATION DATED APRIL 12, 1984, ITS REVISION DATED SEPTEMBER 17, 1984, AND SUPPLEMENT DATED OCTOBER 10, 1985, FOR A MATERIALS LICENSE

I. Introduction

A. General

By application dated April 12, 1984, its revision dated September 17, 1984, and supplement dated October 10, 1985, Carolina Power & Light Company (CPL) on behalf of itself and the North Carolina Eastern Municipal Power Agency (NCEMPA) requested an NRC materials license for the receipt, possession, inspection, and storage of special nuclear material in the form of unirradiated nuclear fuel assemblies, the packaging of such fuel assemblies for delivery to a carrier, and the receipt, possession, inspection, and use of incore fission chambers and sealed sources for irradiation surveillance capsules as follows:

Byproduct, source and special nuclear material	Chemical and physical form	Maximum amount to be possessed
A. Uranium enriched in the U-235 isotope	In unirradiated reactor fuel assemblies	4,157 pounds of U-235 in uranium enriched to no more than 3.1% in U-235
B. Uranium enriched in the U-235 isotope	Contained in sealed sources	2.06 grams of uranium at any enrichment
C. Uranium-neptunium	Contained in sealed sources	120 mgm Np 237 and 72 mgm U-238
D. Californium-252	Primary startup sources	300 millicuries

CPL requested authorization for the above by January 1, 1985.

B. Fuel Assembly Design

The finished fuel assemblies will be supplied by Westinghouse Electric Corporation. Each fuel assembly contains 264 fuel rods, 24 control rod guide tubes,

and 1 instrument tube. The rods are spaced in a 17 x 17 array pattern, are supported laterally by 8 inconel spacer grids, and are supported on top and bottom by stainless steel end fittings. Table 1 gives general fuel rod parameters that describe the fuel which will eventually be used in the Shearon Harris Nuclear Power Plant, Unit 1. Unit 1 is a pressurized water reactor (PWR). The materials license is being requested to allow early receipt of the fuel for the purpose of inspection and preparation of the fuel for reactor loading. The license will automatically terminate upon issuance of the Part 50 operating license.

Table 1

Shearon Harris Station, Unit 1
General Fuel Data

Fuel Assembly Data	Inches
Overall Length	159.8
Nominal Active Fuel Length	144
Fuel Rod Pitch	0.496
Rod Array	17 x 17
Rods Per Assembly	264
Fuel Rod Data	
Outside Diameter	0.374
Cladding Inside Diameter	0.329
Cladding Thickness	0.0225
Fuel Rod Data	**Inches**
Fuel Pellet Immersion Density (% theoretical)	95.0
Fuel Pellet Diameter	0.3225

C. Location Description

The Shearon Harris Station is located in the southwest corner of Wake County and the southeast corner of Chatham County, North Carolina. The site is approximately 16 miles southwest of Raleigh and 15 miles northeast of Sanford, North Carolina. The Construction Permit, CPPR-158 was issued on January 27, 1978, (Docket No. STN 50-400).

II. Authorized Activities

The license will authorize the receipt, possession, and storage of 157 finished fuel assemblies (no spares) required for the first core. The maximum pin enrichment will be 3.15 w/o. The applicant also requests authorization to repackage any assembly, if necessary, for delivery to a carrier. It should be noted the license will not authorize insertion of a fuel assembly into the reactor vessel. Authorization is also requested for the receipt, possession, inspection, and use of incore fission chambers and sealed sources for irradiation surveillance capsules.

III. Scope of Review

The current safety review of the CPL request for a materials license included an evaluation of the Shearon Harris Nuclear Power Plant organization, administration, nuclear criticality safety, radiation protection, and fire protection programs. During the course of the review, discussions were held with the NRR Project Manager, the Resident Inspector, and the applicant's staff members.

The evaluation of the Fuel Storage Physical Security Plan was made by the SG Material Licensing and International Activities Branch, Division of Safeguards, Office of Nuclear Material Safety and Safeguards.

IV. Possession Limits

Although the applicant requested authorization for a maximum of 4,157 pounds (1890 kilograms) contained U-235 in uranium enriched to no more than 3.1 w/o, we propose to license a maximum of 1,900 kilograms U-235 in uranium enriched to no more than 3.15 w/o because of measurement and enrichment variations usually encountered.

The applicant also requested the possession of incore and excore fission chambers sealed sources for irradiation surveillance capsules, and californium-252 primary startup sources.

It is recommended Conditions 6, 7, and 8 of the license specify the type, form, and quantity of material the licensee may possess at any one time under this license and will read as follows:

6. Material	7. Form	8. Quantity
A. Uranium enriched in the U-235 isotope	A. In unirradiated reactor fuel assemblies	A. 1,900 kilograms of U-235 in uranium enriched to no more than 3.15% in U-235
B. Uranium enriched in the U-235 isotope	B. Contained in sealed sources	B. 2.5 grams of uranium at any enrichment
C. Uranium-neptunium	C. Contained in sealed sources	C. 130 milligrams Np-237 and 80 milligrams U-238
D. Californium-252	D. Primary startup sources	D. 300 millicuries

V. Organization

The facility organization chart was included as part of the Part 50 "storage only" license application. The Manager, Plant Operations, has overall responsibility for the facility-and safety-related functions. Reporting to him and

having safety-related responsibilities are the Manager, Operations, and the Manager, Environmental and Radiation Control.

A. Nuclear Criticality Safety and Radiation Protection Responsibilities

The Manager, Operations, is responsible for approval of fuel handling procedures and a certified Reactor Operator is in overall charge of criticality safety for movement of fuel assemblies outside their shipping containers. The applicant also states the movement and inspection of new fuel assemblies are a "team effort" whose leader is responsible for criticality safety and direction of new fuel handling. The leader has either held a reactor operator's license at another facility and had direct fuel handling experience or has been in a responsible position in charge of new fuel receipt and handling at another facility. The team also includes a radiation control technician directly responsible for radiation safety during shipping container and fuel handling operations.

The Manager, Technical Support, is responsible for fuel inspections, accountability, and storage procedures as well as for overall coordination of the receipt and storage of new fuel.

The Manager, Environmental and Radiation Control, is responsible for the review and approval of Radiation Control Procedures for the receipt and survey of new fuel. He is also responsible for periodic surveys for radiation and contamination of special nuclear material handling and storage areas. He is responsible for the overall activities of the Radiation Control Subunit including developing and approving Radiation Control Procedures and instructions to ensure ALARA philosophies have been incorporated.

The Radiation Control Supervisor reporting to the Manager, Environmental and Radiation Control, is responsible for ensuring that the Radiation Control Programs and related procedures meet the facility needs and regulatory requirements.

The applicant did not specify the technical position responsible for approval of the nuclear criticality safety aspects of the procedures. It is recommended this responsibility be included in Condition 11.

Condition 11. Procedures, and changes thereto, for the control and handling of nuclear fuel shall include the review and approval of the Reactor Operator and the Manager, Technical Support.

B. Minimum Qualifications

The applicant has identified the responsibilities for the safety-related personnel, submitted resumes of present holders of the positions, and specified minimum qualifications for the positions. However, the minimum qualifications are identified with a September 1979 draft of ANSI/ANS-3.1, "Selection, Qualification and Training of Personnel for Nuclear Power Plants," as modified by CP&L's position on Regulatory Guide 1.8 as discussed in FSAR Section 1.8. The minimum technical qualifications for the Reactor Operator responsible for the criticality safety for fuel assembly handling were specified by the applicant in terms of previous fuel receipt and handling experience. Conditions 12-15

are recommended to more clearly identify the minimum qualifications of the safety-related personnel and shall read as follows:

Condition 12. The minimum technical qualifications of the Manager, Operations, shall be in accordance with Section 4.2.2, "Operations Manager," of ANSI/ANS-3.1-1978.

Condition 13. The minimum technical qualifications of the Manager, Technical Support, shall be in accordance with Section 4.2.4, "Technical Manager," of ANSI/ANS-3.1-1978.

Condition 14. The minimum qualifications for the Reactor Operator responsible for criticality safety for fuel assembly handling shall be in accordance with the following:

a. The Reactor Operator shall have held a Commission Reactor Operator's license at another facility and have had direct fuel handling experience, or

b. The Reactor Operator shall have held a responsible position in charge of new fuel receipt and handling at another facility.

Condition 15. The minimum qualifications of the Manager, Environmental and Radiation Control, and the Supervisor, Radiation Control, shall be in accordance with that of the Radiation Protection Manager specified in Regulatory Guide 1.8, "Personnel Selection and Training."

C. Training

The applicant has committed to the training of personnel who will handle fuel assemblies. The training includes classroom instruction and actual manipulation of fuel handling equipment. The Harris Training Unit is responsible for the training.

The training for Radiation Control personnel is the responsibility of the Radiation Control Supervisor. This includes radiological control functions during fuel receipt, procedural instruction, and "walk-through exercises."

The staff has concluded that the applicant's fuel handling and radiation safety training programs are adequate to allow them to responsibly carryout the activities for which the license is requested.

VI. Nuclear Criticality Safety

The applicant requests authorization to store fuel assemblies in their shipping containers in the unloading bay and the staging area or in the storage racks in the New Fuel Pool. The storage racks in the pool have a capacity (for new and spent PWR fuel) for 480 PWR fuel assemblies, a capacity of more than 3 cores.

The applicant has committed to the completion of "major construction and testing of the necessary portions of the FHB (Fuel Handling Building) prior to

the receipt and storage of new fuel." CPL considers the FHB complete for receipt of the first core when the new fuel system (New Fuel Handling Tool, Rod Cluster Control Assembly Handling Tool, and Unit 1 New Fuel Elevator), the FHB Auxiliary Crane, and the Spent Fuel Pool Bridge Crane are tested in addition to the installation of all new fuel storage racks in the storage locations.

A. New Fuel Storage Pool

The fuel assemblies (enriched to the 3.15 w/o maximum U-235 enrichment) in the racks in the New Fuel Storage Pool are spaced on 10.5-inch centers. The racks consist of square stainless steel tubes having a thickness of 0.075 inches. The tubes are fastened together through top and bottom supporting grid structures to form integral modules. Boraflex sheets are encapsulated into the stainless steel walls of each tube with stainless steel welded to the outside of the tubes. The staff calculated the k_∞ for an infinite array of assemblies in racks of the above design and found it to be 0.92 at optimum water density (full density water). Even if the center-to-center spacing between all assemblies was reduced to 10.05 inches (based on the most conservative considerations of the mechanical tolerances of each rack design specification), the staff calculated the k_∞ to be 0.96. The latter assumptions are overly conservative since reduction in the space between adjacent tubes on one side (<10.5 inches center-to-center) would increase the corresponding center-to-center distance between adjacent tubes on the opposite side. Therefore, the assembly storage racks, filled with fuel assemblies, are safe independent of the degree of water flooding.

CPL has committed to a quality assurance program to assure the presence of Boraflex in the storage racks as designed. This includes inspection and verification of insertion of the correct sheet of Boraflex on all four sides of each storage tube per design and the necessary related welding operations.

B. Shipping Container Storage

The fuel assemblies may also be stored in the shipping containers (Certificate of Compliance No. 5450). Although the applicant concluded that the shipping containers may be stored in any array, no basis was given for the safety of the array. Certificate of Compliance No. 5450 authorizes the shipment of the assemblies as a Class II Shipment (Transport Index of 1.2/shipping container) or as a Class III (exclusive use of vehicle) shipment with a maximum of 60 containers per shipment, independent of container stacking. Therefore, the staff recommends Condition 16 be added limiting the number of shipping containers in a single array to 60.

Condition 16. No more than 60 shipping containers, containing fuel, shall be stored in a single array.

Should there become a need for the storage for more than 60 loaded shipping containers, additional containers may be stored in an array at least 20 feet (edge-to-edge) from the first array. It is recommended Condition 17 be added to permit the additional storage.

Condition 17. There shall be an edge-to-edge separation of at least 20 feet between groupings of 60 fuel assembly-bearing shipping containers.

Calculations have indicated that two assemblies could be made critical at optimum conditions of water moderation and reflection; however, one assembly, separated from another assembly by 12 inches edge-to-edge, cannot be made critical under any conditions. Because of this, the applicant has committed to have only one fuel assembly at a time handled or inspected "in any single pool, canal, or inspection (staging) area." However, the applicant did not specify the minimum separation between this assembly and others. Therefore, the staff recommends the following license conditions limiting the number of fuel assemblies out of storage in the staging area or New Fuel Pool and the minimum distance from all other fuel:

Condition 18. No more than one fuel assembly shall be out of its shipping container or storage location in the staging area or New Fuel Pool at any given time.

Condition 19. The minimum edge-to-edge distance between a fuel assembly outside its shipping container or storage rack and all other fuel assemblies shall be 12 inches.

In response to an NRC request to describe the type of covers to be used to protect the fuel assemblies from dust while in storage, the applicant responded that the top of the assemblies will be covered by a fire resistant plastic sheet while stored in the New Fuel Pool and the plastic shipping sleeves in which the assemblies arrive will not be re-used. This does not indicate whether the sleeves will be used in assembly storage if they are not removed. If the covers are used in assembly storage and are sealed at their bottoms, the assemblies could become internally moderated with water while the spaces between assemblies will be occupied only with air. This could occur if the bottoms were closed, the storage area flooded and drained, and water retained inside the covers. Large arrays, under these conditions, may become critical. Therefore, it is recommended Condition 20 be added to preclude the above from happening in the event plastic covers are used.

Condition 20. Fuel assemblies shall be stored in such a manner that water would drain freely from the assemblies in the event of flooding and subsequent draining of the fuel storage area.

It is the staff's opinion that, with this condition, the licensee has established responsible and satisfactory precautions to avoid accidental criticality.

The licensee has requested, pursuant to 10 CFR 70.24(d), an exemption from the provisions of 10 CFR 70.24. Because of the inherent features associated with the storage and inspection of unirradiated fuel containing uranium enriched to less than 5 percent in the U-235 isotope when no fuel processing activities are to be performed and the inherent safety features in handling limited quantities of incore fission chambers and sealed sources for irradiation surveillance, the staff hereby determines that granting such an exemption will not endanger life or property, or the common defense and security, and is otherwise in the public interest. This exemption is authorized pursuant to 10 CFR 70.14. It is recommended that the exemption be identified as Condition 21.

Condition 21. The licensee is hereby exempted from the provisions of 10 CFR 70.24 insofar as this section applies to material held under this license.

VII. Radiation Safety

Since the radioactive material (fresh fuel assemblies) are sealed sources, the principal pathway to an individual is via external radiation from the fuel assemblies. For a low enriched uranium fuel bundle ($\leq$ 4 percent U-235 enrichment), the exposure rate at 1 foot from the surface is normally less than 1 mr/hr, therefore, it is estimated that the exposure level to workers from these sources would be less than 25 percent of the maximum permissible exposure specified in 10 CFR 20. At the Shearon Harris Nuclear Power Plant, Unit 1, personnel external exposures are continuously monitored using devices such as thermal luminescent dosimeters (TLDs) and self-reading pocket dosimeters (SRPDs). Since the applicant did not specify the minimum frequency for reading the personnel monitoring devices, it is recommended they be read daily (Condition 22).

Condition 22. The personnel exposure monitoring devices shall be read daily and an individual's dose shall be estimated at least every two weeks and recorded.

Each fuel assembly shipping container is gamma surveyed and tested for smearable beta-gamma contamination. If smearable contamination in excess of 1000 dpm/100 cm^2 is found, the container is isolated, an investigation initiated, and corrective action is taken.

Each fuel assembly is smeared and checked for alpha contamination. If a smearable alpha greater than 20 dpm/100 cm^2 is found, the assembly is isolated and an inspection is conducted to determine the cause of contamination.

Each instrument will be calibrated on a 6-month basis. The sources used for calibration will be traceable to the National Bureau of Standards or other standards laboratory.

The incore fission chambers are sealed sources. The sealed sources containing Np-237 and U-238 are enclosed in a stainless steel capsule, sealed in a steel block, and enclosed in a second stainless steel capsule. Prior to installation, the fission chambers and sealed sources will be stored in their shipping containers in an area for which access controls are established by Radiation Controls. The controls for the handling and storage of fuel assemblies, incore fission chambers, and sealed sources are adequate for the protection of personnel, property, and the environment.

Since the licensee did not specify the leak tests made periodically to determine the integrity of the sealed sources, it is recommended Condition 23 be added.

Condition 23. The licensee shall comply with the provisions of Annex A,"License Conditions for Leak Testing Sealed Sources Which Contain Alpha and/or Beta-Gamma Emitters."

VIII. Environmental Protection

The Final Environmental Statement related to the operation of Shearon Harris Nuclear Power Plant, Units 1 and 2, dated October 1983 has been prepared and

issued by the NRC as NUREG-0972. An Environmental Assessment has also been prepared for the 10 CFR Part 70 fuel storage license in accordance with 10 CFR 51.21. This Assessment supports a Finding of No Significant Impact which was published in the Federal Register on January 7, 1985.

IX. Fire Safety

The FHB is separated from other structures by 3-hour fire barriers. Combustible loading is minimal. Hand portable extinguishers and standpipe hose stations are installed throughout the building. Manual fire alarm stations are located throughout the FHB near hose stations with local alarm and annunciation in the control room.

X. Physical Protection

The Division of Safeguards, NMSS, has reviewed CP&L's Physical Security Plan and has determined that it meets the requirements of 10 CFR 73.67. To insure that the security plan shall be fully implemented and remain in effect whenever fresh fuel is onsite, the staff recommends Condition 24.

Condition 24. The licensee shall maintain and fully implement all provisions of the Commission approved Physical Security Plan, including changes made pursuant to the authority of 10 CFR 70.32(e). The approved Physical Security Plan consists of Revision 1 to the Plan for Receipt, Possession, Storage, and Preparation for Transport of Special Nuclear Material of Low Strategic Significance for Shearon Harris Nuclear Power Plant, Unit No. 1, dated April 12, 1984, and as revised July 8, 1985. The Physical Security Plan shall be withheld from public disclosure pursuant to 10 CFR 2.790(d).

XI. Conclusions

1. After reviewing the application and its revision, the staff finds that:

   a. The application meets the requirements of the Atomic Energy Act, as amended, and of the regulations of the Commission,

   b. Issuance of the license would not be inimical to the common defense and security, and

   c. Issuance of the license would not constitute an unreasonable risk to the health and safety of the public.

2. With the recommended license conditions, the NRC staff finds that:

   a. The applicant is qualified by reason of training and experience to use the material for the purpose requested in accordance with the regulations in 10 CFR 70.23.

   b. The applicant's proposed equipment and facilities are adequate to protect health and minimize danger to life or property.

c. The applicant's proposed procedures to protect health and to minimize danger to life or property are adequate.

XII. Recommendations

The staff recommends approval of the application and its revision subject to the following conditions which the staff finds are appropriate to protect health or to minimize danger to life or property:

Condition 11. Procedures, and changes thereto, for the control and handling of nuclear fuel shall include the review and approval of the Reactor Operator and the Manager, Technical Support.

Condition 12. The minimum technical qualifications of the Manager, Operations, shall be in accordance with Section 4.2.2, "Operations Manager," of ANSI/ANS-3.1-1978.

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Condition 15. The minimum qualifications of the Manager, Environmental and Radiation Control, and the Supervisor, Radiation Control, shall be in accordance with that of the Radiation Protection Manager specified in Regulatory Guide 1.8, "Personnel Selection and Training."

Condition 16. No more than 60 shipping containers, containing fuel, shall be stored in a single array.

Condition 17. There shall be an edge-to-edge separation of at least 20 feet between groupings of 60 fuel assembly-bearing shipping containers.

Condition 18. No more than one fuel assembly shall be out of its shipping container or storage location in the staging area or New Fuel Pool at any given time.

Condition 19. The minimum edge-to-edge distance between a fuel assembly outside its shipping container or storage rack and all other fuel assemblies shall be 12 inches.

Condition 20. Fuel assemblies shall be stored in such a manner that water would drain freely from the assemblies in the event of flooding and subsequent draining of the fuel storage area.

Condition 21. The licensee is hereby exempted from the provisions of 10 CFR 70.24 insofar as this section applies to material held under this license.

Condition 22. The personnel exposure monitoring devices shall be read daily and an individual's dose shall be estimated at least every two weeks and recorded.

Condition 23. The licensee shall comply with the provisions of Annex A, "License Conditions for Leak Testing Sealed Sources Which Contain Alpha and/or Beta Gamma Emitters."

Condition 24. The licensee shall maintain and fully implement all provisions of the Commission approved Physical Security Plan, including changes made pursuant to the authority of 10 CFR 70.32(e). The approved Physical Security Plan consists of Revision 1 to the Plan for Receipt, Possession, Storage, and Preparation for Transport of Special Nuclear Material of Low Strategic Significance for Shearon Harris Nuclear Power Plant, Unit No. 1, dated April 12, 1984, and as revised July 8, 1985. The Physical Security Plan shall be withheld from public disclosure pursuant to 10 CFR 2.790(d).

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