April 27, 1999

Mr. John Paul Cowan
Vice President, Nuclear Operations
Florida Power Corporation
ATTN: Manager, Nuclear Licensing (SA2A)
Crystal River Energy Complex
15760 W. Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: CRYSTAL RIVER UNIT 3 - ISSUANCE OF AMENDMENT REGARDING METHODOLOGY CHANGE FOR BORAFLEX DEGRADATION (TAC NO. MA4148)

Dear Mr. Cowan:

The U.S. Nuclear Regulatory Commission (NRC) has issued the enclosed Amendment No. 175 to Facility Operating License No. DPR-72 for Crystal River Unit 3 (CR-3). This amendment is in response to Florida Power Corporation's (FPC's) request dated October 30, 1998, as supplemented on March 31, 1999, in which FPC proposed changes to the Updated Final Safety Analysis Report and the licensing bases, to reflect a revised methodology for the B spent fuel pool criticality analysis. The change is necessary due to Boraflex degradation in the B spent fuel pool storage racks.

A copy of the related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

Original signed by:

Leonard A. Wiens, Senior Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-302

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Enclosures: 1. Amendment No. 175 to DPR-72
2. Safety Evaluation

cc w/enclosures: See next page

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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FLORIDA POWER CORPORATION
CITY OF ALACHUA
CITY OF BUSHNELL
CITY OF GAINESVILLE
CITY OF KISSIMMEE
CITY OF LEESBURG
CITY OF NEW SMYRNA BEACH AND UTILITIES COMMISSION,
CITY OF NEW SMYRNA BEACH
CITY OF OCALA
ORLANDO UTILITIES COMMISSION AND CITY OF ORLANDO
SEMINOLE ELECTRIC COOPERATIVE, INC.
CITY OF TALLAHASSEE

DOCKET NO. 50-302

CRYSTAL RIVER UNIT 3 NUCLEAR GENERATING PLANT

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 175
License No. DPR-72

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Florida Power Corporation, et al. (the licensees), dated October 30, 1998, as supplemented March 31, 1999, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;

   C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

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E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, changes to the updated Final Safety Analysis Report (FSAR) and associated Technical Specification Bases, to reflect changes to the methodology for the B spent fuel pool criticality analysis at Crystal River Unit 3, as set forth in the application for amendment by Florida Power Corporation dated October 30, 1998, and supplemented March 31, 1998, are authorized. The licensee shall submit the revised description authorized by this amendment with the next update of the FSAR and Technical Specification Bases in accordance with 10 CFR 50.71(e).

3. This license amendment is effective as of its date of issuance and shall be implemented as specified in (2) above.

FOR THE NUCLEAR REGULATORY COMMISSION

Sheri R. Peterson, Chief, Section 2
Project Directorate II
Division of Project Licensing Management
Office of Nuclear Reactor Regulation

Date of Issuance: April 27, 1999

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO.175 TO FACILITY OPERATING LICENSE NO. DPR-72

FLORIDA POWER CORPORATION

CRYSTAL RIVER UNIT 3

DOCKET NO. 50-302

1.0 INTRODUCTION

By letter dated October 30, 1998, and supplemented by letter dated March 31, 1999, Florida Power Corporation (FPC) requested an amendment to the licensing basis for Crystal River Unit 3 (CR-3) to change the methodology for the Spent Fuel Pool B criticality analysis. The proposed change is necessary due to Boraflex degradation in the Spent Fuel Pool B storage racks. The criticality effects of the proposed change to the licensing basis as well as the proposed changes to the Final Safety Analysis Report (FSAR) and the associated Improved Technical Specification (ITS) Bases were included with the above submittal. The March 31, 1999, supplement provided clarifying information and did not affect the original no significant hazards consideration determination.

2.0 EVALUATION

CR-3 has two spent fuel pools designated as the "A" and "B" pools, which are physically joined together through a transfer canal. The A Spent Fuel Pool has high density storage rack modules which do not utilize Boraflex. The B Spent Fuel Pool has eight high density racks which are constructed with Boraflex. Fuel storage is divided into two Regions within the B pool. Region 1 was designed to accommodate new (fresh) fuel assemblies or fuel which has not experienced sufficient burnup to be stored in Region 2. Region 2 was designed to accommodate irradiated fuel, determined by burnup calculations. The Region 1 racks have a double layer of Boraflex panels within each cell with a one-inch water gap between each cell. The Region 2 racks have only a single layer of Boraflex.

Boraflex is known to degrade under the influence of gamma radiation and chemical reaction with free radicals in the pool water. Over the first few years of use, the Boraflex will shrink, typically creating gaps distributed randomly in the axial direction. As the gamma dose increases, the Boraflex panels will slowly begin to deteriorate, losing the neutron absorbing component B_4C. The proposed amendment request is intended to determine the potential effect of Boraflex degradation in Pool B on criticality safety. It is also intended to update the analyses, incorporating the more modern and improved methodologies that have become available in the last few years, and to confirm configurations for acceptable storage of fuel with enrichments up to 5.0±0.05 weight percent (w/o) U-235.

The analysis of the reactivity effects of fuel storage in the CR-3 spent fuel racks was performed primarily with the three-dimensional NITAWL-KENO5a Monte Carlo code package.

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NITAWL was used with the 238-group SCALE-4.3 cross section library and the Nordheim integral treatment for U-238 resonance shielding effects. Verification calculations were made with the MCNP4A Monte Carlo code. Since the KENO-Va code package does not have burnup capability, depletion analyses and the determination of small reactivity increments due to manufacturing tolerances were made with the two-dimensional transport theory code, CASMO4. The SCALE-4.3 system used in the reactivity analysis has been benchmarked against experimental data for fuel assemblies similar to those for which the CR-3 racks are designed and has been found to adequately reproduce the critical values. This experimental data is sufficiently diverse to establish that the method bias and uncertainty will apply to rack conditions which include close proximity storage and strong neutron absorbers. The staff concludes that the analysis methods used are acceptable and capable of predicting the reactivity of the CR-3 storage racks with a high degree of confidence.

U.S. Nuclear Regulatory Commission (NRC) General Design Criterion (GDC) 62 of Appendix A to 10 CFR 50 requires the prevention of criticality in fuel storage and handling. The NRC acceptance criterion for preventing criticality in spent fuel storage areas is that, including uncertainties, there is a 95% probability at a 95% confidence level (95/95 probability/confidence) that the effective neutron multiplication factor (k_{eff}) of the fuel assembly array will be no greater than 0.95.

For the nominal storage cell design, the racks were assumed to contain the most reactive fuel authorized to be stored without any control rods or burnable poison. These are the Babcock & Wilcox 15x15 Mark B-10F and Mark B-10 fuel. The moderator was assumed to be pure water at a temperature within the design basis range corresponding to the highest reactivity. No credit was taken for radial neutron leakage or for neutron absorption in minor structural members. Uncertainties due to tolerances in U-235 enrichment and density, boron loading, Boraflex panel width, water gap (Region 1), cell box inner diameter or lattice pitch (Region 2), and stainless steel thickness were accounted for as well as a method bias and uncertainty. These uncertainties were appropriately determined at least at the 95/95 probability/confidence level. In addition, an allowance of 5% of the reactivity decrement from beginning of life to the burnup of interest was included for uncertainty in depletion calculations for those cases where burnup credit is used. These biases and uncertainties meet the previously stated NRC requirements and are, therefore, acceptable.

In the Pool B calculations, additional assumptions are made to consider the increase in reactivity due to Boraflex gapping. Although several design enhancements and measures were integrated into the CR-3 fuel racks to minimize Boraflex gap formation, the analysis assumes the presence of a random axial distribution of 4-inch gaps in all Boraflex panels. This is an acceptable conservative assumption based on existing industry-wide test results.

The analysis also assumed a concurrent loss of up to 20% of the Boraflex (B_4C). In response to NRC Generic Letter 96-04, "Boraflex Degradation in Spent Fuel Pool Storage Racks," the licensee has stated that pool silica levels indicate some Boraflex degradation due to water ingress may be occurring. Boraflex degradation in the Pool B racks was projected using a calculated degradation rate based on the worst case weight loss of measured Boraflex samples. The current worst case calculations project that the Boraflex in the Pool B racks will have degraded to the point of 20% loss of neutron absorption in the year 2019. The estimated current (March 1999) weight loss using the same degradation rate is 5.3%. Although the

Boraflex weight loss consists of several constituents in addition to boron, the analysis conservatively assumes that the entire weight loss is attributable to boron. Therefore, the 20% loss assumed in the current analysis is acceptable.

Region 1 of Pool B is designed to accommodate a checkerboard pattern of fresh 5.0 w/o U-235 fuel intermixed with fuel of various initial enrichment vs. burnup combinations as specified in CR-3 Technical Specification (TS) Figure 3.7.15-2. Region 2 of Pool B is designed for fuel of various initial enrichment vs. burnup combinations as shown in TS Figure 3.7.15-3. The licensee's analysis using the acceptable methods discussed above has shown that the burnup/enrichment curves in the CR-3 TSs have sufficient margin to accommodate up to a 20% loss in Boraflex concurrent with a random distribution of 4-inch gaps and still maintain Pool B at less than or equal to $0.95k_{eff}$ when fully loaded and flooded with unborated water. In addition, Region 2 was evaluated with a 3-out-of-4 loading pattern. The results indicate a significantly greater reactivity margin available for this configuration to accommodate more reactive fuel (lower burnup) or greater Boraflex degradation than currently assumed.

Most abnormal storage conditions will not result in an increase in the k_{eff} of the spent fuel storage racks. However, it is possible to postulate events, such as the inadvertent misloading of an assembly in the spent fuel storage racks with a burnup and enrichment combination outside of the acceptable areas in Figures 3.7.15-2 or 3.7.15-3, which could lead to an increase in reactivity. The largest reactivity increase was caused by the inadvertent loading of a fresh Mark B-10F assembly enriched to 5.0 w/o U-235 into a fully loaded rack. For this condition, credit may be taken for the presence of 1925 ppm of soluble boron in the pool water, which is assured by TS 3.7.14, since the staff does not require the assumption of two unlikely, independent, concurrent events to ensure protection against a criticality accident (Double Contingency Principle). The reduction in k_{eff} due to only 350 ppm of boron offsets the reactivity addition caused by any credible accident.

The staff has reviewed changes to the following portions of the FSAR and the TS Bases. Based on the above evaluation, the staff finds these changes acceptable.

1) FSAR Section 9.3.2.6.1, "Spent Fuel Pools Supplemental Cooling"
2) FSAR Section 9.6.1.2.2, "Spent Fuel Storage"
3) FSAR Section 9.6.2.4, "Safety Provisions"
4) FSAR Table 9-14, "Fuel Storage Racks Subcriticality Margin-5.0% Enrichment"
5) ITS Bases B 3.7.14, "Spent Fuel Pool Boron Concentration"
6) ITS Bases B 3.7.15, "Spent Fuel Assembly Storage"

3.0 STATE CONSULTATION

Based upon a letter dated March 8, 1991, from Mary E. Clark of the State of Florida, Department of Health and Rehabilitative Services, to Deborah A. Miller, Licensing Assistant, U.S. NRC, the State of Florida does not desire notification of issuance of license amendments.

4.0 ENVIRONMENTAL CONSIDERATIONS

The amendment changes requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has

determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding (63 FR 71966). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

5.0 CONCLUSION

Based on the review described above, the staff finds the criticality aspects of the proposed license amendment for CR-3 are acceptable and meet the requirements of General Design Criterion 62 for the prevention of criticality in fuel storage and handling. The revised FSAR Sections and ITS Bases changes correctly reflect the results of the new criticality analysis and are acceptable. The staff concludes that (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: Larry Kopp

Date: April 27, 1999

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