September 27, 2006

Mr. Dhiaa Jamil
Vice President
Catawba Nuclear Station
Duke Power Company LLC
4800 Concord Road
York, SC 29745

SUBJECT: CATAWBA NUCLEAR STATION, UNITS 1 AND 2, ISSUANCE OF AMENDMENTS REGARDING REVISED STORAGE CRITERIA FOR LOW-ENRICHED URANIUM FUEL (TAC NOS. MC8439 and MC8440)

Dear Mr. Jamil:

The Nuclear Regulatory Commission has issued the enclosed Amendment No. 233 to Renewed Facility Operating License NPF-35 and Amendment No. 229 to Renewed Facility Operating License NPF-52 for the Catawba Nuclear Station, Units 1 and 2, respectively. The amendments consist of changes to the Technical Specifications (TSs) in response to your application dated September 13, 2005, as supplemented March 20, 2006.

The amendments revise a nonconservative TS associated with spent fuel storage in the spent fuel pool. The licensee identified the nonconservative TS while comparing results from spent fuel pool criticality codes.

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

Sincerely,

/RA/

John Stang, Senior Project Manager
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-413 and 50-414

Enclosures:
1. Amendment No. 233 to NPF-35
2. Amendment No. 229 to NPF-52
3. Safety Evaluation

cc w/encls: See next page

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Package No. ML062710490
Amendment No. ML062540237
Tech Spec No. ML062710596

*SE input date NRR-058

OFFICE	NRR/LPL2-1/PM	NRR/LPL2-1/LA	NRR/SBPB/ABC	OGC	NRR/LPL2-1/BC
NAME	JStang :klr	MO'Brien	CLi*	JMartin (nlo w/comments)	EMarinos
DATE	09/12/06	09/12/06	06/21/06	09/26/06	09/27/06

OFFICIAL RECORD COPY

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DUKE POWER COMPANY LLC

NORTH CAROLINA ELECTRIC MEMBERSHIP CORPORATION

SALUDA RIVER ELECTRIC COOPERATIVE, INC.

DOCKET NO. 50-413

CATAWBA NUCLEAR STATION, UNIT 1

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 233
Renewed License No. NPF-35

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

   A. The application for amendment to the Catawba Nuclear Station, Unit 1 (the facility) Renewed Facility Operating License No. NPF-35 filed by the Duke Power Company LLC, acting for itself, North Carolina Electric Membership Corporation and Saluda River Electric Cooperative, Inc. (licensees), dated September 13, 2005, as supplemented March 20, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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

   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, the license is hereby amended by page changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-35 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 233, which are attached hereto, are hereby incorporated into this license. Duke Power Company LLC shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Evangelos C. Marinos, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to License No. NPF-35
and the Technical Specifications

Date of Issuance: September 27, 2006

DUKE POWER COMPANY LLC

NORTH CAROLINA MUNICIPAL POWER AGENCY NO. 1

PIEDMONT MUNICIPAL POWER AGENCY

DOCKET NO. 50-414

CATAWBA NUCLEAR STATION, UNIT 2

AMENDMENT TO RENEWED FACILITY OPERATING LICENSE

Amendment No. 229
Renewed License No. NPF-52

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

   A. The application for amendment to the Catawba Nuclear Station, Unit 2 (the facility) Renewed Facility Operating License No. NPF-52 filed by the Duke Power Company LLC, acting for itself, North Carolina Municipal Power Agency No. 1 and Piedmont Municipal Power Agency (licensees), dated September 13, 2005, as supplemented March 20, 2006, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations as 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 set forth in 10 CFR Chapter I;

   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

   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, the license is hereby amended by page changes to the Technical Specifications as indicated in the attachment to this license amendment, and Paragraph 2.C.(2) of Renewed Facility Operating License No. NPF-52 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendix A, as revised through Amendment No. 229 , which are attached hereto, are hereby incorporated into this license. Duke Power Company LLC shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance and shall be implemented within 60 days of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Evangelos C. Marinos, Chief
Plant Licensing Branch II-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment:
Changes to License No. NPF-52
and the Technical Specifications

Date of Issuance: September 27, 2006

ATTACHMENT TO LICENSE AMENDMENT NO. 233

RENEWED FACILITY OPERATING LICENSE NO. NPF-35

DOCKET NO. 50-413

AND LICENSE AMENDMENT NO. 229

RENEWED FACILITY OPERATING LICENSE NO. NPF-52

DOCKET NO. 50-414

Replace the following pages of the Renewed Facility Operating Licenses and Appendix A Technical Specifications (TSs) with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

Remove	Insert
Licenses	Licenses
License No. NPF-35, page 4	License No. NPF-35, page 4
License No. NPF-52, page 4	License No. NPF-52, page 4
TSs	TSs
3.7.16-1	3.7.16-1
3.7.16-2	3.7.16-2
3.7.16-3	3.7.16-3
4.0-2	4.0-2
B 3.7.15-1	B 3.7.15-1
B 3.7.15-2	B 3.7.15-2
B 3.7.15-3	B 3.7.15-3
	B 3.7.15-4
B 3.7.16-1	B 3.7.16-1
B 3.7.16-2	B 3.7.16-2
B 3.7.16-3	B 3.7.16-3
	B 3.7.16-4

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO

AMENDMENT NO. 233 TO RENEWED FACILITY OPERATING LICENSE NPF-35

AND

AMENDMENT NO. 229 TO RENEWED FACILITY OPERATING LICENSE NPF-52

DUKE POWER COMPANY LLC

CATAWBA NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-413 AND 50-414

1.0 INTRODUCTION

By application dated September 13, 2005 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML052590247), as supplemented by letter dated March 20, 2006 (ADAMS Accession No. ML060880447), Duke Power Company LLC (Duke, the licensee), requested changes to the Technical Specifications (TSs) for the Catawba Nuclear Station, Units 1 and 2 (Catawba 1 and 2). The supplement dated March 20, 2006, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the Nuclear Regulatory Commission (NRC) staff's original proposed no significant hazards consideration determination as published the *Federal Register* on November 21, 2005 (70 FR 70104).

The proposed changes would revise TSs Section 3.7.16, "Spent Fuel Assembly Storage," and Section 4.3, "Fuel Storage." The amendment revises the storage criteria for low-enriched uranium fuel stored at Catawba 1 and 2 to correct the nonconservative TSs. This is accomplished by taking partial credit for soluble boron in the Catawba 1 and 2 spent fuel pool, in accordance with the regulatory requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.68(b).

2.0 REGULATORY EVALUATION

Appendix A of, 10 CFR Part 50, General Design Criterion (GDC) 62, "Prevention of criticality in fuel storage and handling," states, "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by use of geometrically safe configurations." In NUREG-0800 "Standard Review Plan," Section 9.1.2, the NRC has established a five-percent subcriticality margin (K-effective 0.95) for nuclear power plant operators to comply with GDC 62.

Section 50.68, “Criticality accident requirements,” states in subpart 50.68(b)(4), “If credit is taken for soluble boron, the k-effective of the spent fuel storage racks loaded with fuel of the maximum fuel assembly reactivity must not exceed 0.95, at a 95 percent probability, 95 percent confidence level, if flooded with borated water, and the k-effective must remain below 1.0 (subcritical), at a 95 percent confidence level, if flooded with unborated water.”

The NRC staff, has accepted Westinghouse Owners Group Topical Report WCAP-14416-P in licensing applications to credit soluble boron in spent fuel pool criticality. The review and acceptance of WCAP-14416-P focused on the methodology whereby credit could be taken for soluble boron in the spent fuel pool (SFP) to meet the NRC-recommended criteria stated previously. All licensee’s proposing to use this method for soluble boron credit are required to identify potential events which could dilute the SFP soluble boron to the concentration required to maintain the 0.95 k-effective limit in accordance with 10 CFR 50.68. They were also advised to quantify the time span of these dilution events to show that sufficient time is available to enable detection and mitigation of any dilution event.

The SFPs storage and SFPs cooling systems are described in Chapter 9 of the Catawba1 and 2 Updated Final Safety Analysis Report (UFSAR). The information provided by the licensee in its license amendment request dated September 13, 2005, and its response to the NRC staff’s request for additional information, dated March 20, 2006, along with the applicable design-basis information in the Catawba 1 and 2 UFSAR, provide criteria needed to evaluate the ability of equipment to comply with the appropriate requirements of 10 CFR 50.68 and NRC-approved WCAP recommendations, as relates to proposed license amendment request changes.

Several provisions of the NRC regulations and the licensees' plant operating licenses TSs pertain to spent fuel pool criticality. The NRC regulations for preventing spent fuel pool criticality include the general design criteria for nuclear power plants (10 CFR Part 50, Appendix A) and 10 CFR 50.68, while 10 CFR 70.24, “Criticality accident requirements,” contains requirements for detection of an SFP criticality event.

Appendix A to 10 CFR Part 50 and the plant safety analyses require or commit licensees to design and test safety-related structures, systems, and components (SSCs) to provide adequate assurance that they can perform their safety functions. The NRC staff applies these criteria to plants with construction permits issued on or after May 21, 1971, and to plants whose licensees have committed to them. With respect to spent fuel pool criticality, the applicable General Design Criterion (GDC) is GDC 62, "Prevention of criticality in fuel storage and handling." GDC 62 states "Criticality in the fuel storage and handling system shall be prevented by physical systems or processes, preferably by the use of geometrically safe configurations." As written, GDC 62 emphasizes the prevention of an inadvertent criticality in the spent fuel pool as opposed to detection and mitigation. The preferred method of prevention is the use of geometrically safe configurations.

Section 70.24(a) of 10 CFR 70.24 states that each licensee authorized to possess special nuclear material in excess of certain defined quantities must maintain in each area in which such licensed special nuclear material is handled, used, or stored, a monitoring system capable of detecting a criticality that produces either (1) a defined absorbed dose or (2) a specific radiation level. The date of the facility’s licensing determines whether the dose or radiation level requirements apply. In the mid-1990s the nuclear industry and NRC staff determined that a number of facilities had not maintained a criticality-monitoring system in accordance with the

requirements of 10 CFR 70.24. Recognizing that numerous licensees were out of compliance with 10 CFR 70.24 due to a regulatory oversight in the issuance of their operating licenses and realizing that the system required by 10 CFR 70.24 emphasized detection of a criticality event rather than prevention, the staff issued Information Notice (IN) 97-77, "Exemption from the Requirements of Section 70.24 of Title 10 of the Code of Federal Regulations." IN 97-77 provided the staff's criteria for evaluating exemptions from 10 CFR 70.24. The staff's seven criteria, if satisfied, ensured that a licensee complied with GDC 62. The criteria emphasized prevention of spent fuel pool criticality rather than detection. Most licensees followed this approach and the staff issued a number of exemptions to 10 CFR 70.24 based on the criteria in IN 97-77.

In 1998, the staff published 10 CFR 50.68 to formally issue the staff's criteria from IN 97-77 with minor but notable changes, as regulatory requirements for ensuring subcriticality in spent fuel pools. Part 50 licensees may choose to comply with 10 CFR 50.68 in lieu of installing and maintaining a criticality-monitoring system as required by 10 CFR 70.24 or seeking an exemption from 10 CFR 70.24. A licensee's compliance with 10 CFR 50.68 ensures that an inadvertent criticality in the spent fuel pool is extremely unlikely. Section 50.68 requires that licensees demonstrate that subcritical conditions ($K_{eff} < 1.0$) can be maintained in the spent fuel pool under normal conditions without a soluble boron credit. However, under 10 CFR 50.68, licensees may credit soluble boron both during normal conditions to maintain a 5-percent subcriticality margin (K_{eff} 0.95) and during accident conditions to maintain the spent fuel pool subcritical ($K_{eff} < 1.0$). Specifically, 10 CFR 50.68(b)(1) states "Plant procedures shall prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible by unborated water." This requirement assures public health and safety during all fuel handling and storage operations, including cask loading, unloading, and handling, because subcritical conditions are maintained by geometrically safe configurations, in accordance with GDC 62. Therefore, the soluble boron in the spent fuel pool is available to ensure defense-in-depth requirements are satisfied under accident conditions.

Since the issuance of 10 CFR 50.68 in 1998, numerous facilities have requested license amendment changes to take advantage of this new regulation. Many licensees have submitted license amendment requests (LARs) to rerack the spent fuel pool in accordance with the subcriticality requirements in 10 CFR 50.68.

Under 10 CFR 50.68, licensees may credit soluble boron to demonstrate that the spent fuel pool storage racks can maintain a 5-percent subcriticality margin. By permitting a soluble boron credit for normal storage conditions, 10 CFR 50.68 gives licensees more flexibility than was available under 10 CFR 70.24 and 10 CFR 70.24 exemptions, where licensees were required to maintain the 5-percent subcriticality margin without a soluble boron credit. However, a licensee who takes advantage of the greater flexibility of 10 CFR 50.68 must also show that the spent fuel pool will remain subcritical if flooded with unborated water. This second requirement ensures that the full soluble boron concentration is available to prevent credible accidents from resulting in an inadvertent criticality.

The NRC defines acceptable methodologies for performing criticality analyses in the following documents:

1. NUREG-0800, Standard Review Plan, Section 9.1.2, Draft Revision 4, "Spent Fuel Storage".

2. NRC Memorandum from L. Kopp to T. Collins, "Guidance on the Regulatory Requirements for Criticality Analysis of Fuel Storage at Light-Water Reactor Power Plants," August 19, 1998. The NRC staff used these documents to assist in its review of the licensee's LAR to ensure compliance with GDC 62 and 10 CFR 50.68.

3.0 TECHNICAL EVALUATION

Catawba 1 and 2 currently complies with a design basis that requires preventing criticality in a spent fuel pool based on the K_{eff} of the SFP storage racks loaded with fuel of the maximum fuel assembly reactivity not exceeding 0.95, at 95-percent probability, 95-percent confidence level, if fully flooded with unborated water. The proposed TS change will revise TS Sections 3.7.16 and 4.3 by eliminating restrictions on placement of low enriched uranium fuel assemblies in either the Unit 1 or Unit 2 SFP based on the use of partial soluble boron credit for soluble boron in the SFPs. This is accomplished by taking credit for soluble boron in accordance with 10 CFR 50.68. The current TSs are nonconservative with respect to spent fuel storage criteria. The licensee has implemented compensatory measures and the proposed amendments correct the nonconservative TSs.

The licensee has determined that for normal conditions both of the boron-credited subcriticality analysis criteria in 10 CFR 50.68(b)(4) can be achieved if credit is taken for 200 ppm soluble boron in the SFPs. The current minimum boron concentration for the Catawba 1 and 2 SFPs as controlled through the Core Operating Limit Report (COLR) per TS 3.7.15 is 2700 ppm. Since the amendment request by the licensee now credits soluble boron, the licensee has completed a boron dilution analysis to demonstrate that potential boron dilution events will not result in an SFP boron concentration below the acceptable minimum boron concentration of 200 ppm credited in the criticality analyses performed for the SFPs. The NRC staff's review of the licensee's boron dilution analysis is provided below.

3.1 Boron Dilution Analysis

The licensee performed a detailed boron dilution analysis in which the various boron dilution scenarios for the Catawba 1 and 2 spent fuel pool were examined to ensure that sufficient time is available to detect and mitigate the dilution prior to the boron concentration falling below the minimum concentration required to maintain K_{eff} below 0.95. The dilution events considered included pipe breaks, misalignment of systems interfacing with spent fuel pool cooling, and safe shutdown facility (SSF) events in which the SFP is used as a source of cooling water and unborated make-up water is used to refill the pool. The potential dilution sources considered included pipe breaks and system misalignments involving the following tanks and systems:

Fire Protection
Recycle Hold-up Tanks (RHTs)
Recycle MonitorTanks

Reactor Make-up Water Storage Tanks (RMWSTs)
Low-Pressure Service Water
Nuclear Service Water
Standby Shutdown Facility Standby Make-up Pump
Equipment Decontamination
Drinking Water
Make-up Demineralized Water
Heated Water
Reactor Building Ventilation Cooling Water

Based on its review of the various potential dilution events, the licensee concluded that the worst-case dilution scenario is one initiated by a "continuous flow" event involving the break of a 4-inch pipe in the non-seismic fire protection system. The postulated break may be one due to seismic or tornado activity, and is based on a break size of approximately 1.5 in^2, which results in a maximum flow rate of 701 gpm of unborated water to the SFP.

TS LCO (limiting condition for operation) 3.7.15 states "The spent fuel pool boron concentration shall be within the limit specified in the COLR." In its boron dilution analysis the licensee assumed an initial SFP boron concentration of 2700 parts per million (ppm), which is the minimum boron concentration specified in the COLR. Based on the 2700 ppm initial pool boron concentration, a minimum starting pool volume of 374,403, gallons and an inflow of 701 gpm from the break of the fire protection line, the time required to dilute the pool to a boron concentration of 200 ppm, which corresponds to the K_{eff} 0.95 safety limit was calculated to be 32.36 hours, and the total volume of water required for the dilution was over 1.3 million gallons.

Since for the worst case dilution event it would take over 32 hours to dilute a SFP to the concentration required to maintain K_{eff} below 0.95 (200 ppm), and would involve substantial overflow of a SFP, the licensee will have ample time to detect, identify, and mitigate the dilution event. Operators will receive numerous indicators to alert them long before 32 hours have elapsed. Among the indicators would be SFP level Hi/Lo alarms, flooding in the auxiliary building, and observations via shift rounds. The alarm response procedures direct operations to restore the SFP level to normal, and contain guidance for make-up to the SFP, and instructions for barriers to preclude adding sufficient unborated water to dilute boron concentration below the COLR minimum allowed concentration, and guidance on system alignment for adding boric acid to the SFP, should it be needed.

Low-flow, long-term dilution events in which the rate of inleakage of unborated water approximately matches normal water loss can also result in dilution of the SFP boron concentration. However, because of the large quantity of water required to dilute the SFP boron concentration to the 200 ppm minimum, the leak would have to go undetected for several weeks. The plant TS, SR 3.7.15.1, requires that every 7 days the spent fuel pool boron concentration be verified to be within the limits specified in the COLR. Therefore, low-flow long-term dilution events will be detected as a result of the plants' normal surveillance, as required by the plants' TSs.

The licensee analyzed the boron dilution event involving system misalignment and determined the worst-case dilution from a finite-source system misalignment involved aligning the SFP cooling to take suction on the RMWST, and allowing the RHTs to piggyback on the RMWST. The result of this misalignment event would be an introduction of just over 226,000 gallons of

unborated water to a SFP, which is not a sufficient amount to dilute the pool boron concentration below the 200 ppm safety limit. The licensee also determined that the worst-case dilution from an infinite-source misalignment results from aligning SFP cooling to take suction from nuclear service water. At a nominal rate of 140 gpm, the 200 ppm boron safety limit would be reached in just under 83 hours. Therefore this dilution case is bounded by the fire protection pipe break.

The only credible scenario during a standby shutdown facility (SSF) event is for the SSF standby make-up pump to take suction on a SFP for up to 72 hours for reactor coolant pump seal injection. After 72 hours the pump is secured, and the SFP make-up could occur using unborated water. The licensee determined that in the worst-case scenario the final concentration of the SFP water will be 1324 ppm boron which is well above the safety limit of 200 ppm boron concentration. The licensee also indicated that since the SFP cooling system operates at a higher pressure than the component cooling system, any dilution via SFP cooling heat exchanger leakage is not expected.

The licensee has analyzed various potential dilution events and has concluded that unplanned and inadvertent events would not result in the dilution of a SFP to boron concentration less than that required to maintain K_{eff} below 0.95. The NRC staff has reviewed the results of the licensees boron dilution evaluations. The minimum concentration of boron required for the K_{eff} in a SFP remains below 0.95 and is assured based on the following

- The flow rates associated with the dilution events
- The large volume of water required for dilution
- The long dilution times associated with the events
- The SFP level detection alarms coupled with operator surveillance
- Plant procedures to control SFP water level

3.2 Criticality Analysis

3.2.1 Criticality Analysis Codes

The code employed in the licensee's SFP criticality analysis is SCALE 4.4/KENO V.a. KENO V.a is a 3-D Monte Carlo criticality module in the SCALE 4.4 package. The licensee has performed a SCALE 4.4/KENO V.a benchmark analysis to determine calculational biases and uncertainties.

The criticality analysis for the Catawba 1 and 2 new fuel storage vaults (NFVs) and SFPs has been performed in accordance with the requirements of 10 CFR 50.68(b). This evaluation takes partial credit for soluble boron in the SFPs. The analysis determined that the Catawba 1 and 2 NFVs and SFPs can store unirradiated fuel up to 5 wt % U-235, with no location restrictions.

The maximum 95/95 K_{eff} for the NFV analysis was calculated to be 0.9324, meeting the requirements of 10 CFR 50.68(b)(2) and (3).

For the Catawba 1 and 2 SFP criticality analyses, the maximum 95/95 K_{eff} with no boron in the SFP was calculated to be 0.9680. This meets the no-boron 95/95 K_{eff} **<** 1.0 criterion in 10 CFR 50.68(b)(4). The SFP evaluation also confirmed that with 200 ppm of partial soluble boron credit, the maximum 95/95 K_{eff} of 0.9294 remains well below the regulatory requirement that the maximum 95/95 K_{eff} be less than 0.95 for all normal conditions.

The current minimum boron concentration required in the Catawba 1 and 2 SFPs (2700 ppm) is adequate to maintain the maximum 95/95 K_{eff} below 0.95 for all credible accident scenarios in the Catawba 1 and 2 SFPs.

3.2.2 Bias and Uncertainty

The NRC SFP criticality analysis guidance specifies that the maximum K_{eff} value for the criticality analysis should be the summation of the calculated nominal K_{eff}, the bias in criticality analysis methods, manufacturing and calculational uncertainties, and the correction for the effect of the axial distribution in burnup when credit for burnup is taken. Uncertainties should be determined for the proposed storage facilities and fuel assemblies to account for tolerances in the mechanical and material specifications. An acceptable method for determining the maximum reactivity may be either (1) a worst-case combination with mechanical and material conditions set to maximize K_{eff}, or (2) a sensitivity study of the reactivity effects of tolerance variations. If used, a sensitivity study should indicate all possible significant variations (tolerances) in the material and mechanical specifications of the racks; the results may be statistically combined provided they are independent variations. Combinations of the two methods may also be used.

The licensee has performed a SCALE 4.4/KENO V.a benchmark analysis of critical experiments to determine calculational biases and uncertainties for both the 44-group and 238-group cross-section libraries included with the SCALE 4.4 package.

For Catawba 1 and 2 criticality applications, the SCALE 4.4/KENO V.a method biases and uncertainties are based on analysis of 41 LEU critical experiments performed by Pacific Northwest Laboratories. These critical experiments model various square-pitch arrangements of fuel rods, and include both over- and under-moderated lattices.

Because the NFV and SFP analyses model fresh fuel at only the highest permissible enrichment (5.00 ± 0.05 wt % U-235), each of the 41 critical experiments selected was at the highest enrichment available (4.31 wt % U-235).

The results from the benchmark analyses indicated that the 238-group cross-section library yields the more consistent results (i.e., smaller variations in reactivity bias) across the range of moderation in the selected critical experiments. Therefore, the 238-group cross-section library is used for all the SCALE 4.4/KENO V.a computations performed in the Catawba 1 and 2 NFV and SFPs criticality analyses.

SCALE 4.4/KENO V.a modeling of these 41 critical experiments with the 238-group library yielded a benchmark calculational bias of +0.0061 k (average under-prediction of K_{eff}) and an uncertainty of ±0.0071 k. This bias and uncertainty are used in determining the total bounding 95/95 system K_{effs} for each NFV or SFPs storage configuration. They were analyzed with

SCALE 4.4/KENO V.a. and provide the results of the Catawba 1 and 2 NFV and SFPs criticality evaluations, respectively.

3.2.3 Computation of the Maximum 95/95 K_{eff}

For every fuel assembly design that is considered in the scope of the Catawba 1 and 2 SFPs and NFV criticality analyses, a nominal K_{eff} is calculated. This K_{eff} is only the base value, however. A total K_{eff} is determined by adding several pertinent reactivity biases and uncertainties, to provide an overall 95-percent probability, at a 95-percent confidence level (95/95), that the true system K_{eff} does not exceed the 95/95 K_{eff} for that particular storage condition.

Table 4 in the licensee's September 13, 2005, application lists the various biases and uncertainties that are considered in the Catawba 1 and 2 NFV and SFPs criticality analyses. Each of these biases and uncertainties is discussed in more detail below:

- Benchmark Method Bias

  This bias is determined from the benchmarking of the code system used (SCALE 4.4/KENO V.a), and represents how much the code system is expected to over predict (negative bias) or under predict (positive bias) the "true K_{eff}" of the physical system being modeled. The bias for SCALE 4.4/KENO V.a with its 238- group cross-section library is +0.0061 k.

- Benchmark Method Uncertainty

  This uncertainty is determined from the benchmarking of the code system used, and is a measure of the expected variance (95/95 one-sided uncertainty) of predicted reactivity from the "true K_{eff}" of the physical system being modeled. The method uncertainty for SCALE 4.4/KENO V.a, with its 238-group cross-section library, is ±0.0071 k.

- Monte Carlo Computational Uncertainty

  For all the nominal SCALE 4.4/KENO V.a computations performed in this analysis to determine 95/95 K_{effs}, the Monte Carlo computational uncertainty is equal to 1.727*ξ nominal. The ξ nominal factor is the calculated standard deviation of k nominal (the nominal K_{eff} for that particular case). The 1.727 multiplier is the one-sided 95/95 tolerance factor for 1000 neutron generations. Each of the SCALE 4.4/KENO V.a cases in the SFP and NFV calculations counted 1000 neutron generations.

- Mechanical Uncertainties

  The "mechanical uncertainty" represents the total reactivity uncertainty contributions of various independent storage rack-related and fuel manufacturing-related mechanical uncertainty factors. These factors include reactivity effects for possible variations in fuel enrichment, fuel pellet diameter, fuel density, cladding dimensions, storage rack dimensions and material thickness tolerances, fuel assembly positioning within the storage cell, etc. The worst-case reactivity conditions are used for the nominal models in

the Catawba 1 and 2 NFV evaluation; therefore, mechanical uncertainty factor needs to be applied in the 95/95 K_{eff} calculations for the NFV cases.

The NRC staff has performed an independent evaluation of the licensee's analysis and reviewed the uncertainties. Based on the review the NRC staff found the licensee's analysis acceptable.

3.3 Compliance with 10 CFR 50.68(b) for the SFPs

Licensees electing to comply with 10 CFR 50.68(b) must satisfy eight requirements. The licensee provided justification showing compliance with each of these requirements.

Section 50.68(b)(1) requires that plant procedures prohibit the handling and storage at any one time of more fuel assemblies than have been determined to be safely subcritical under the most adverse moderation conditions feasible with unborated water. The licensee provided information in the application that current plant provisions meet the requirements of 50.68(b)(1) for other operations involving movement and storage of spent and new fuel at the Catawba 1 and 2 sites.

Section 50.68(b)(2) requires that the estimated ratio of neutron production to neutron absorption and leakage (K_{eff}) for the fresh fuel in the fresh fuel storage racks be calculated assuming the racks are loaded with fuel of the maximum fuel assembly reactivity and flooded with unborated water. The K_{eff} must not exceed 0.95, 95/95 probability/confidence. Analyses by the licensee for the Catawba 1 and 2 SFPs have determined that, for new fuel stored in a SFP, the K_{eff} will be less than 0.95, 95/95 probability/confidence.

Section 50.68(b)(3) requires that the K_{eff} not exceed 0.98, 95/95 probability/confidence, when the fuel storage racks are loaded with fresh fuel and filled with a low-density hydrogenous material other than water. Analyses by the licensee for the Catawba 1 and 2 SFPs have determined that, for new fuel stored in the SFPs, the K_{eff} will be less than 0.95, 95/95 probability/confidence levels.

Section 50.68(b)(4) requires that if no credit is taken for soluble boron, the K_{eff} of the spent fuel storage racks not exceed 0.95, 95/95 probability/confidence, or if credit is taken for soluble boron that the K_{eff} of the spent fuel storage racks not exceed 0.95, 95/95 probability/confidence, when flooded with borated water and the K_{eff} remain below 1.0 (subcritical) if flooded with unborated water. Analyses by the licensee have shown that, for new fuel stored in the SFPs, the K_{eff} will be less than 0.95, 95/95 probability/confidence levels.

Section 50.68(b)(5) requires that the quantity of special nuclear material (SNM) stored on site, other than nuclear fuel, be less than the quantity necessary for a critical mass. The licensee preforms a periodic inventory of SNM and will determine that the amount of non-fuel SNM stored at the Catawba 1 and 2 is very small and in a form which precludes criticality.

Section 50.68(b)(6) requires the presence of radiation monitors at fuel storage and associated handling areas to detect excessive radiation levels and to initiate appropriate safety actions. Area radiation monitors are permanently installed in selected areas throughout Catawba 1 and 2 including the new fuel storage area and on the SFP bridge crane. In locations that do not have permanently installed area radiation monitors, the licensee will utilize temporary gamma sensitive monitors which will be required by procedure whenever fuel is being stored or handled.

Section 50.68(b)(7) limits the maximum nominal U235 enrichment of fresh fuel to 5.0 percent by weight. TS section 4.3.1.2 restricts U235 enrichment of fresh fuel to less than 5.0 percent by weight.

Section 50.68(b)(8) requires that the UFSAR be amended no later than the next update required by 50.71(e) to indicate that the licensee has chosen to comply with 50.68(b). The licensee has committed to make this change in the UFSAR update for Catawba 1 and 2.

The NRC staff has reviewed the licensee's compliance with 10 CFR 50.68. With the implementation of this amendment and the updating of the UFSAR the NRC staff finds that Catawba 1 and 2 are in compliance with 10 CFR 50.68.

4.0 SUMMARY

The NRC staff has reviewed the licensee's proposed amendment and finds that adequate time is available for detection and mitigation of events capable of diluting the SFP from the SFP minimum soluble boron concentration of 2700 ppm per COLR per TS 3.7.15, to the minimum concentration of 200 ppm required to maintain k_{eff} below 0.95. The methodology used was found to be consistent with the NRC staff-approved Westinghouse Owners Group generic methodology for crediting soluble boron given in Topical Report WCAP-14416-P. The NRC staff finds that the dilution requirements within 10 CFR 50.68, "Criticality accident requirements," and GDC 62, "Prevention of criticality in fuel storage and handling," are met.

The NRC staff also finds that the proposed changes for the SFPs meet appropriate subcriticality requirements of 10 CFR 50.68 and GDC 62. In addition, the NRC staff finds that the licensee's amendment request provides reasonable assurance that under both normal and accident/upset conditions, that the licensee would be able to safely operate the plant and comply with the NRC regulations.

The NRC staff has reviewed the changes to the TS Bases and finds they are consistent with the changes to the TSs.

The NRC staff finds the proposed changes to the TSs acceptable.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the South Carolina State official was notified of the proposed issuance of the amendments. The State official had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to the installation or use of facility components 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 the amendments involve no significant hazards consideration, and there has been no public comment on such finding (70 FR 70104). Accordingly, the amendments meet 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 amendments.

7.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, 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 amendments will not be inimical to the common defense and security or to the health and safety of the public.

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Date: September 27, 2006