December 1, 2003

Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2 - ISSUANCE OF AMENDMENT REGARDING BORON CONCENTRATION REQUIREMENTS FOR COLD LEG ACCUMULATORS AND REFUELING WATER STORAGE TANK (TAC NOS. MB8000 AND MB8001) (TS 03-01)

Dear Mr. Scalice:

The Commission has issued the enclosed Amendment No. 289 to Facility Operating License No. DPR-77 and Amendment No. 279 to Facility Operating License No. DPR-79 for the Sequoyah Nuclear Plant, Units 1 and 2, respectively. These amendments are in response to your application dated March 13, 2003, as supplemented on July 30, 2003.

This amendment revises Technical Specification 3.5.1, “Cold Leg Injection Accumulators,” and 3.5.5, “Refueling Water Storage Tank,” to insert a table that defines the minimum and maximum amount of boron that is required for accident mitigation based on the number of tritium producing rods in the core.

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

Sincerely,

/RA/

Margaret H. Chernoff, Project Manager, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-328 and 50-329

Enclosures: 1. Amendment No. 289 to License No. DPR-77
2. Amendment No. 279 to License No. DPR-79
3. Safety Evaluation

cc w/enclosures: See next page

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TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-327

SEQUOYAH NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 289
License No. DPR-77

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

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated March 13, 2003, as supplemented on July 30, 2003, 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

   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 amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-77 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 289, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance, to be implemented no later than startup from an outage in which tritium producing rods are loaded into the reactor provided no changes have occurred that materially affect the basis for approval of this amendment.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Allen G. Howe, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: December 1, 2003

ATTACHMENT TO LICENSE AMENDMENT NO. 289

FACILITY OPERATING LICENSE NO. DPR-79

DOCKET NO. 50-327

Replace the following pages of the Appendices A and B Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3/4 5-1	3/4 5-1
3/4 5-11	3/4 5-11

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-328

SEQUOYAH NUCLEAR PLANT, UNIT 2

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 279
License No. DPR-79

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

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated March 13, 2003, as supplemented on July 30, 2003, 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

   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 amended by changes to the Technical Specifications as indicated in the attachment to this license amendment and paragraph 2.C.(2) of Facility Operating License No. DPR-79 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 279, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of its date of issuance, to be implemented no later than startup from an outage in which tritium producing rods are loaded into the reactor provided no changes have occurred that materially affect the basis for approval of this amendment.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Allen G. Howe, Chief, Section 2
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical Specifications

Date of Issuance: December 1, 2003

ATTACHMENT TO LICENSE AMENDMENT NO. 279

FACILITY OPERATING LICENSE NO. DPR-77

DOCKET NO. 50-328

Replace the following pages of the Appendices A and B Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
3/4 5-1	3/4 5-1
3/4 5-11	3/4 5-11

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 289 TO FACILITY OPERATING LICENSE NO. DPR-77

AND AMENDMENT NO. 279 TO FACILITY OPERATING LICENSE NO. DPR-79

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-328 AND 50-329

1.0 INTRODUCTION

By letter dated March 13, 2003, as supplemented by letter dated July 30, 2003 (ADAMS Accession Nos. ML030790281 and ML032250093, respectively), Tennessee Valley Authority (TVA), the licensee for Sequoyah Nuclear Plant (SQN) Units 1 and 2, submitted information and requested a license amendment to revise Technical Specification (TS) Sections 3.5.1, "Cold Leg Injection Accumulators," and 3.5.5, "Refueling Water Storage Tank." The proposed TS revisions would expand the current boron concentration requirement with a table that defines the minimum and maximum boron concentrations required for accident mitigation based on the number of tritium producing burnable absorber rods (TPBARs) loaded in SQN cores. Five boron concentration ranges would be added to allow operational flexibility to adjust boron concentration based on the number of TPBARs in the core. Additionally, the licensee proposed to add a note to each of these TS sections stating that the current number of TPBARs loaded in the core for each operating cycle can be found in each unit's Core Operating Limits Report (COLR).

The supplemental letter provided clarifying information that did not expand the scope of the original amendment request and did not change the initial proposed no significant hazards consideration determination.

2.0 REGULATORY EVALUATION

The regulations in Title 10, *Code of Federal Regulations* Section 50.46 (10 CFR 50.46), "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," and 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," specify the requirements for the design and analysis of emergency core cooling systems (ECCS). These regulations are in place to ensure adequate core cooling following a loss-of-coolant accident (LOCA) such that specified acceptance criteria are satisfied. The specified acceptance criteria include peak clad temperature, total cladding oxidation, total hydrogen generation, maintaining a coolable core geometry and ensuring adequate long-term core cooling. The applicable acceptance criterion for this license amendment request is the long-term core cooling criterion. This criterion requires that the core temperature be maintained at an acceptably low value and that decay heat be removed for the extended period of time required by the long-lived radioactivity remaining in the core.

The post LOCA long-term core cooling analysis for SQN Units 1 and 2 requires that the core remain subcritical considering that all boration sources are injected and mixed in the containment sump, without taking credit for any rod cluster control assembly (RCCA) insertion. These boration sources include the cold leg accumulators (CLAs), the refueling water storage tank (RWST), and the melted ice from the ice condenser containment. The minimum boron requirement for the CLAs ensures that the reactor core will remain subcritical during the post-LOCA recirculation phase based upon the CLAs contribution to the post-LOCA sump mixture concentration. The minimum boron requirement for the RWST ensures that sufficient negative reactivity is injected into the core to counteract any positive increase in reactivity caused by reactor coolant system cooldown.

3.0 TECHNICAL EVALUATION

The NRC staff issued License Amendment Nos. 278 and 269 for SQN Units 1 and 2, respectively, on September 30, 2002. In these License Amendments, the NRC staff granted approval for each SQN Unit to load up to 2256 TPBARs in the reactor core for the purpose of producing tritium for the U.S. Department of Energy.

Loading of TPBARs at SQN introduces an additional neutron poison into the reactor core. When large amounts of excess neutron poison are added to a core, such as with TPBARS, there is competition for neutrons from all the poisons and the negative worth of each poison (including the reactor coolant system (RCS) boron) decreases. Following a LOCA, the positive reactivity insertion due to the negative moderator coefficient that occurs during the cooldown from hot full power to cold conditions must be entirely overcome by RCS boron. Because the RCS boron will be worth less with a TPBAR core, a higher boron concentration is needed to maintain subcriticality. The melted ice from the ice condenser containment (at approximately 2000 parts per million, ppm) is a dilution source which has to be overcome by the CLAs and the RWST boron concentrations in order to prevent criticality. Additionally, the licensee's supporting analyses conservatively assume failures of TPBARs and various adverse reactivity conditions. Accordingly, in License Amendments 278 and 269, the CLA boron concentration was increased to a range of 3500 to 3800 ppm, and the RWST boron concentration was increased to a range of 3600 to 3800 ppm for cores containing TPBARs. These increased boron concentration levels are calculated assuming the maximum number of 2256 TPBARs are loaded in the core.

The licensee proposes to replace the current single boron concentration requirement (based on 2256 TPBARs) with a table that defines the minimum and maximum boron concentrations required for accident mitigation based on the actual number of TPBARs loaded in SQN cores. Five boron concentration ranges will be added to allow operational flexibility to adjust boron concentration based on the number of TPBARs in the core. Additionally, the licensee proposes to add a note to each of these TS sections stating that the current number of TPBARs loaded in the core for each operating cycle can be found in each unit's COLR.

3.1 Proposed CLA and RWST Boron Concentration Changes

The boron concentration requirements based on 2256 TPBARS, which the NRC staff approved in License Amendments 278 and 269, are not being revised. Additionally, when no TPBARs are loaded in the core, the current minimum TS boron concentration requirement is retained.

Therefore, the NRC staff review focuses on the three intermediate boron concentration ranges. The proposed TS boron concentration values are as follows:

No. of TPBARs	CLA Boron minimum (ppm)	CLA Boron maximum (ppm)	RWST Boron minimum (ppm)	RWST Boron maximum (ppm)
0	2400	3800	2500	3800
1 - 250	2700	3800	2800	3800
251 - 500	2900	3800	3000	3800
501 - 1000	3200	3800	3300	3800
1001 - 2256	3500	3800	3600	3800

The licensee performed analyses using the NRC approved core simulator NEMO to verify that the proposed boron concentration ranges are adequate to maintain subcriticality following a LOCA. The methodology and analyses used to support the proposed boron concentration limits are within the same constraints as previously applied for License Amendments 278 and 269. This methodology is described in Babcock and Wilcox Topical Report BAW-10237, which was previously submitted to the NRC staff in support of the License Amendments 278 and 269.

In response to the NRC staff's request, the licensee provided detailed descriptions of the analyses performed, including quantitative results. The licensee's results demonstrate that the proposed boron concentration values are adequate to maintain a minimum post-LOCA sump boron concentration margin of 100 ppm to the post-LOCA critical boron concentration. The licensee also provided a table which quantifies the reactivity effects associated with various conservative assumptions for failed TPBARs. This table provided the post-LOCA sump boron concentration margins for a representative core with 944 TPBARs over a burnup range from 0 through 250 effective full-power days. Based on the results of the analyses, the NRC staff finds that the proposed RWST and CLA boron concentration values are adequate to ensure that the core will remain subcritical, post-LOCA, considering that all boration sources are injected and mixed in the containment sump, without taking credit for any RCCA insertion.

In support of License Amendments 278 and 269, the licensee evaluated the impacts of the maximum CLA and RWST boron concentration ranges (up to 3800 ppm) on the LOCA analyses. For both the large break (LBLOCA) and small break (SBLOCA), the licensee stated that these analyses do not explicitly model the boron concentration levels present in the CLAs or RWST. However, although not modeled in the analyses, any additional boron injected due to the increased concentration levels would increase the margin by which the core is maintained subcritical. The calculated peak clad temperature (PCT) and clad oxidation are not a function of the boron concentration. Therefore, the increased levels of CLA and RWST boron concentration will not adversely impact the PCT and clad oxidation results for the LBLOCA and SBLOCA. The NRC staff finds that the same logic applies, and the conclusion remains valid for the proposed CLA and RWST boron concentration ranges.

With respect to post-LOCA long-term core cooling requirements, to support SQN License Amendments 278 and 269, the licensee provided a summary of the hot leg switchover (HLSO)

time evaluation model it used to establish that boric acid will not precipitate in the long term following certain LOCAs. The model is consistent with the traditional 1975 model used by licensees operating Westinghouse-designed nuclear steam supply systems. Additionally, the licensee provided a discussion of conservatisms and non-conservatisms associated with the model. Predicted times available for initiation of hot leg injection included the following:

Case	Case Description	HLSO Time, hours
1	Traditional analysis with no allowance for boric acid saturation concentration uncertainty	7.25
2	Traditional analysis with allowance for boric acid saturation concentration uncertainty	5.59
3	Case 1 with Appendix K decay heat generation rate assumption	5.35
4	Case 2 with Appendix K decay heat generation rate assumption	4.15

Based on this information, the licensee stated that ". . . the SQN emergency operating procedures will be revised to require initiation of hot leg ECCS recirculation 3 hours following a large break LOCA for the tritium production core rather than 5.5 hours. The 3-hour switchover time requirement does not increase operator burden during LOCA mitigation and recovery and will provide an added measure of conservatism with respect to the tritium production core long-term cooling analysis." The NRC staff approved the 3-hour switchover time for License Amendments 278 and 269 and finds that this time remains valid for the proposed CLA and RWST boron concentration ranges because the maximum range values are not being changed and the switchover time is conservative for lower boron concentrations.

In support of License Amendments 278 and 269, the licensee also evaluated the impacts of the increased CLA and RWST boron concentrations on non-LOCA transients. The CLAs do not inject for any of the SQN non-LOCA transients and, therefore, the higher CLA boron concentration will have no impact on any of the Updated Final Safety Analysis Report (UFSAR) Chapter 15 non-LOCA transients. The following non-LOCA accidents model the RWST boron concentration: Steamline Break (SLB) at Hot Zero Power, Feedwater Line Break, Spurious Operation of the Safety Injection System at Power, SLB Mass and Energy Releases, Steam Generator Tube Rupture (SGTR) and Containment Mass and Energy Releases. The licensee concluded that the results of these accidents are not impacted by the increased boron concentrations in the RWST. The Feedwater Line Break, SGTR, and Containment Mass and Energy Release accident analyses conservatively do not credit the CLA or RWST boron concentrations and are, therefore, not impacted. For the SLB at Hot Zero Power accident, dry-out of the faulted steam generator and a subsequent reduction in RCS cooling ends the core power excursion prior to the introduction of boron into the RCS. The SLB Mass and Energy Release evaluation relies on control rods for shutdown margin. The Spurious Operation of the Safety Injection System at Power is postulated to maximize the negative reactivity insertion into the core. The SQN UFSAR analysis of record assumes an RWST boron concentration of 20,000 ppm. Because this assumed boron concentration conservatively bounds the maximum proposed RWST boron concentration of 3800 ppm, and because the TPBARs will decrease the negative worth of the RCS boron, the current analysis of record for

this event remains bounding. The NRC staff finds that these conclusions remain valid for the proposed CLA and RWST boron concentration ranges.

In support of License Amendments 278 and 269, the licensee also evaluated the issue of boron precipitation from solution at the proposed increased concentrations and concluded that this is not credible at the minimum RWST temperature of 60°F and minimum CLA temperature of 70°F. The minimum acceptable temperature associated with the previously approved maximum RWST and CLA boron concentrations is near the freezing point (32°F). Therefore, this conclusion remains valid for the proposed CLA and RWST boron concentration ranges.

3.2 Placement of Cycle Specific Number of TPBARs in COLR

The licensee proposes to add a note to TSs 3.5.1 and 3.5.5 stating that the current number of TPBARs loaded in the core for each operating cycle can be found in each unit's COLR. SQN License Amendments 278 and 269 stated that the cycle-specific parameter value would reside in the Reload Safety Evaluation Report. The number of TPBARs to be loaded in any SQN core is a cycle-specific parameter. The number is an input to the analyses used to determine the operating limits for the reactor core each cycle.

The NRC staff finds that it is acceptable to place the TPBAR number in the COLR since this document is readily available to the operators and is cycle-specific. This ensures that the operators can quickly determine the quantity of TPBARs for compliance with the proposed CLA and RWST boron concentration requirements. The licensee will retain the TPBAR limit of 2256 in TS Section 5.3.1.

4.0 SUMMARY

The NRC staff has completed its review of the proposed SQN TS changes associated with TS Sections 3.5.1, "Cold Leg Injection Accumulators," and 3.5.5, "Refueling Water Storage Tank." Based on the discussions provided above, the NRC staff finds that the proposed CLA and RWST boron concentration ranges are acceptable, and that the number of TPBARs loaded in the reactor core can be added to the COLR.

5.0 STATE CONSULTATION

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

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement 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 amendment involves 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 amendment involves no significant hazards consideration, and there has been no public comment on such finding (68 FR 18286). 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

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 amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: Mark G. Kowal

Dated: December 1, 2003

Mr. J. A. Scalice
Tennessee Valley Authority

SEQUOYAH NUCLEAR PLANT

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