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

May 4, 2009

Mr. Preston D. Swafford
Chief Nuclear Officer and
Executive Vice President
Tennessee Valley Authority
3R Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 - ISSUANCE OF AMENDMENT REGARDING THE MAXIMUM NUMBER OF TRITIUM PRODUCING BURNABLE ASSEMBLY RODS IN THE REACTOR CORE (TAC NO. MD9396)

Dear Mr. Swafford:

The Commission has issued the enclosed Amendment No. 77 to Facility Operating License No. NPF-90 for Watts Bar Nuclear Plant, Unit 1. This amendment is in response to your revised application dated December 31, 2008. The revised application dated December 31, 2008, superseded the application dated August 1, 2008, as supplemented by letters dated November 25 and December 31, 2008.

The proposed amendment revises Technical Specification (TS) 4.2.1, "Fuel Assemblies," and TS surveillance requirements 3.5.1.4, "Accumulators," and 3.5.4.3, "RWST [Refueling Water Storage Tank]," to increase the maximum number of tritium producing burnable absorber rods from 400 to 704.

A copy of the safety evaluation is also enclosed. Notice of issuance will be included in the Commission's biweekly *Federal Register* notice.

Sincerely,

John G. Lamb, Senior Project Manager
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosures: 1. Amendment No. 77 to NPF-90
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-390

WATTS BAR NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 77
License No. NPF-90

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

   A. The application for amendment by the Tennessee Valley Authority (the licensee) dated December 31, 2008, which superseded the application dated August 1, 2008, as supplemented by letters dated November 25 and December 31, 2008, complies with the standards and requirements of the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 Title 10 *Code of Federal Regulations* (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. NPF-90 is hereby amended to read as follows:

   (2) Technical Specifications and Environmental Protection Plan

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 77 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

3. This license amendment is effective as of the date of its issuance, and shall be implemented no later than 180 days from the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

L. Raghavan, Branch Chief
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Attachment: Changes to License No. NPF-90 and the Technical Specifications

Date of Issuance: May 4, 2009

ATTACHMENT TO LICENSE AMENDMENT NO. 77

FACILITY OPERATING LICENSE NO. NPF-90

DOCKET NO. 50-390

Replace page 3 of Operating License No. NPF-90 with the attached page 3.

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

REMOVE	INSERT
3.5-2	3.5-2
3.5-10	3.5-10
4.0-1	4.0-1

(4) TVA, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to receive, possess, and use in amounts as required, any byproduct, source or special nuclear material without restriction to chemical or physical form, for sample analysis, instrument calibration, or other activity associated with radioactive apparatus or components; and

(5) TVA, pursuant to the Act and 10 CFR Parts 30, 40 and 70, to possess, but not separate, such byproduct and special nuclear materials as may be produced by the operation of the facility.

C. This license shall be deemed to contain and is subject to the conditions specified in the Commission's regulations set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act and to the rules, regulations, and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified or incorporated below.

(1) Maximum Power Level

TVA is authorized to operate the facility at reactor core power levels not in excess of 3459 megawatts thermal.

(2) Technical Specifications and Environmental Protection Plan

The Technical Specifications contained in Appendix A, as revised through Amendment No. 77 , and the Environmental Protection Plan contained in Appendix B, both of which are attached hereto, are hereby incorporated into this license. TVA shall operate the facility in accordance with the Technical Specifications and the Environmental Protection Plan.

(3) Safety Parameter Display System (SPDS) (Section 18.2 of SER Supplements 5 and 15)

Prior to startup following the first refueling outage, TVA shall accomplish the necessary activities, provide acceptable responses, and implement all proposed corrective actions related to having the Watts Bar Unit 1 SPDS operational.

(4) Vehicle Bomb Control Program (Section 13.6.9 of SSER 20)

During the period of the exemption granted in paragraph 2.D.(3) of this license, in implementing the power ascension phase of the approved initial test program, TVA shall not exceed 50% power until the requirements of 10 CFR 73.55(c)(7) and (8) are fully implemented. TVA shall submit a letter under oath or affirmation when the requirements of 73.55(c)(7) and (8) have been fully implemented.

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.5.1.1	Verify each accumulator isolation valve is fully open.	12 hours
SR 3.5.1.2	Verify borated water volume in each accumulator is ≥ 7630 gallons and ≤ 8000 gallons.	12 hours
SR 3.5.1.3	Verify nitrogen cover pressure in each accumulator is ≥ 610 psig and ≤ 660 psig	12 hours
SR 3.5.1.4	-----------------------------NOTE----------------------------- The number of TPBARs in the reactor core is contained in the Core Operating Limits Report (COLR) for each operating cycle. -- Verify boron concentration in each accumulator is as provided below depending on the number of tritium producing burnable absorber rods (TPBARs) installed in the reactor core for this operating cycle: (see table below)	31 days AND -------NOTE ----------- Only required to be performed for affected accumulators. --------------------------- Once within 6 hours after each solution volume increase of ≥ 75 gallons, that is not the result of addition from the refueling water storage tank.

Number of TPBARs	Boron Concentration Ranges
0-704	≥ 3000 ppm and ≤ 3300 ppm

(continued)

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.4.1	-----------------------------NOTE----------------------------- Only required to be performed when ambient air temperature is < 60°F or > 105°F. -- Verify RWST borated water temperature is ≥ 60°F and ≤ 105°F.	24 hours
SR 3.5.4.2	Verify RWST borated water volume is ≥ 370,000 gallons.	7 days
SR 3.5.4.3	-----------------------------NOTE----------------------------- The number of TPBARs in the reactor core is contained in the Core Operating Limits Report (COLR) for each operating cycle. -- Verify boron concentration in the RWST is as provided below depending on the number of tritium producing burnable absorber rods (TPBARs) installed in the reactor core for this operating cycle:	7 days

Number of TPBARS	Boron Concentration Ranges
0-704	≥ 3100 ppm and ≤ 3300 ppm

4.0 DESIGN FEATURES

4.1 Site

4.1.1 Site and Exclusion Area Boundaries

The site and exclusion area boundaries shall be as shown in Figure 4.1-1.

4.1.2 Low Population Zone (LPZ)

The LPZ shall be as shown in Figure 4.1-2 (within the 3-mile circle).

4.2 Reactor Core

4.2.1 Fuel Assemblies

The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of Zircalloy or Zirlo fuel rods with an initial composition of natural or slightly enriched uranium dioxide (UO_2) as fuel material. Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff approved codes and methods and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. For Unit 1, Watts Bar is authorized to place a maximum of 704 Tritium Producing Burnable Absorber Rods into the reactor in an operating cycle.

4.2.2 Control Rod Assemblies

The reactor core shall contain 57 control rod assemblies. The control material shall be boron carbide with silver indium cadmium tips as approved by the NRC.

(continued)

UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 77 TO FACILITY OPERATING LICENSE NO. NPF-90

TENNESSEE VALLEY AUTHORITY

WATTS BAR NUCLEAR PLANT, UNIT 1

DOCKET NO. 50-390

1.0 INTRODUCTION

By letter dated December 31, 2008 (Agencywide Document and Management System Accession No. ML090090044), the Tennessee Valley Authority (TVA, licensee) submitted a request for changes to the Technical Specifications (TSs) for Watts Bar Nuclear Plant (WBN), Unit 1.

The amendment request dated December 31, 2008 (ML090090044), superseded the application dated August 1, 2008 (ML082180091), as supplemented by letters dated November 25 (ML083360191) and December 31, 2008 (ML0900220258).

The proposed amendment revises TS 4.2.1, "Fuel Assemblies," and TS surveillance requirements (SRs) 3.5.1.4, "Accumulators," and 3.5.4.3, "RWST [Refueling Water Storage Tank]," to increase the maximum number of tritium producing burnable absorber rods (TPBARs) from 400 to 704.

Although TVA is planning to irradiate only approximately 576 TPBARs in the WBN Unit 1 reactor core during Cycle 10, the proposed change increases the limit on TPBARs that can be irradiated to 704, and the licensee has provided an analysis to support the irradiation of up to 704 TPBARs.

Notice of this amendment was originally given in the *Federal Register* on November 12, 2008 (73 FR 66946). This original *Federal Register* notice was superseded by a notice in the *Federal Register* on January 27, 2009 (74 FR 4776).

2.0 BACKGROUND

The U.S. Department of Energy (DOE) has chosen TVA's WBN Unit 1 to produce tritium for the replenishment of the National Security Stockpile by irradiating TPBARs installed in the core. The number of TPBARs required to be irradiated is to be identified by DOE. Based on these numbers, TVA, along with its fuel vendors, will determine the number of TPBARs to be installed and irradiated.

TPBARs are similar to standard burnable poison rod assemblies (BPRAs) inserted into fuel assemblies. The BPRAs absorb excess neutrons, and help control the power in the reactor to ensure an even power distribution and extend the time between refueling outages. TPBARs functions in a matter similar to a BPRA, but TPBARs absorb neutrons using lithium aluminate instead of boron. Tritium is produced when the neutrons strike the lithium material. A solid zirconium material in the TPBAR, called a getter, captures the tritium as it is produced. Most of the tritium is trapped in the getter material. However, a small fraction of the tritium will permeate through the TPBAR cladding into the reactor coolant system (RCS). After the TPBARs are removed from the core, and shipped to a DOE extraction facility, the TPBARs are heated in a vacuum at high temperature to extract the tritium.

On September 15, 1997, the U. S. Nuclear Regulatory Commission (NRC) issued Amendment No. 8 (ML020780128) to the WBN Unit 1 Operating License, which authorized the irradiation of 32 Lead Test Assembly TPBARs in the WBN Unit 1 core during operating Cycle 2.

Amendment No. 40 (ML022540925) to the WBN Unit 1 Operating License was issued September 23, 2002, and authorized the insertion of up to 2304 TPBARs in the WBN Unit 1 core. Amendment No. 40 addressed the changes needed for the production of tritium and included boron changes for the cold leg accumulators (CLAs) and RWST. The amendment stated that the number of TPBARs to be inserted in the WBN Unit 1 core would be determined for each cycle, but would be less than or equal to 2304.

Amendment No. 48 (ML032880062) was issued on October 8, 2003, and authorized the irradiation of 240 TPBARs in the WBN Unit 1 core during operating Cycle 6. Based on issues related to credit for control rod insertion during a cold leg loss-of-coolant-accident (LOCA) and containment sump boron concentration, TVA noted that the number of TPBARs to be irradiated would be limited to 240 instead of the previously approved limit of 2304.

Because the tritium permeation from TPBARs was found to be greater than expected in Cycle 6, TVA stated in a March 22, 2005, letter to NRC that the number of TPBARs irradiated in WBN Unit 1 would remain at 240 until the permeation issue was understood and resolved, thus only 240 TPBARs were irradiated in operating Cycles 6, 7, and 8. Design changes were made to the TPBARs for Cycle 9 resulted in a TVA request to increase the number of TPBARs to be irradiated to 400. Amendment No. 67 (ML073520546) was issued on January 18, 2008, and authorized the irradiation of 400 TPBARs in the WBN Unit 1 core.

The soluble boron in the CLAs and RWST provides negative reactivity to maintain subcriticality following a LOCA. For a given core design, the boron concentration required to achieve subcriticality is a function of several variables, including global core reactivity and boron worth. The global core reactivity is determined by the cycle energy and the detailed core design. The boron worth is dependent upon the total neutron absorption in the core, which is also determined by the detailed core design. When large amounts of neutron absorbers are used in the core design, as in the case with large numbers of TPBARs, there is competition for thermal neutrons among all the absorbers which result in hardening of the thermal neutron spectrum, a shift towards higher neutron energy. As a consequence, the negative worth of each absorber, including RCS boron worth, decreases. The positive reactivity insertion due to the cooldown from hot full power to cold conditions following a LOCA must be overcome by RCS boron and burnable absorbers to maintain subcriticality.

The minimum boron requirement for the CLA ensures that the reactor core will remain subcritical during the post-LOCA recirculation phase based upon the CLA's 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.

TVA uses Westinghouse to perform reload safety evaluations for each reload core design to ensure that safety limits will continue to be met. The analyses performed include post-LOCA subcriticality analyses to demonstrate that subcriticality is maintained in the event of a LOCA. Post-LOCA subcriticality margin is a function of overall core design, not simply the number of TPBARs. TVA requested that the limit on the number of TPBARs be increased from 400 to 704, with the understanding that WBN Unit 1 Cycle 10 will be analyzed using the same post-LOCA subcriticality methodology and assumptions used in Cycles 6 through 9. The core will be designed to ensure that subcriticality is maintained when the current methodology is employed.

3.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.46, "Acceptance criteria for emergency core cooling systems for light-water nuclear power reactors," specifies the requirements for the design of emergency core cooling systems (ECCSs). These regulations require adequate core cooling following a 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 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 radioactive nuclides remaining in the core.

The post-LOCA long-term core cooling analysis for WBN Unit 1 requires that the core remain subcritical considering that all boration sources are injected and mixed in the containment sump. These boration sources include the CLAs, the 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 by ensuring there is sufficient boron concentration in the containment sump following a LOCA. 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 (RCS) cooldown.

The provisions of 10 CFR 50.36, "Technical Specifications," include requirements for the contents of TSs. These shall include SRs relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation (LCO) will be met.

TECHNICAL EVALUATION

4.1 ECCS Boron Requirements - Introduction

The licensee proposes to revise SR 3.5.1.4 for the Accumulators by revising the number of TPBARs in the table from "0-400" to "0-704." The same changes are proposed for SR 3.5.4.3 for the RWST.

For a maximum number of 704 TPBARs, the purpose of the SRs is to assure that the LCOs for operability of the RWST and accumulators will be maintained by periodically verifying that their boron concentrations are within the designated ranges required by the analyses supporting the number of TPBARs in the core. The boron concentration ranges specified in the TS remain the same; the table in the LCO has been revised to reflect the new TPBAR limit.

Because the intended purpose of the SRs is to assure that the necessary quality of systems is maintained, the NRC staff reviewed the information provided by the licensee to determine whether the specified boron concentration, 3000 to 3300 parts per million (ppm) in the cold leg accumulators, and 3100 to 3300 ppm in the RWST, was appropriate in light of the requested increase in TPBAR inventory to a maximum of 704.

The ECCS boron concentration is constrained by, among others, two noteworthy factors. First, the injected boron must be of sufficient concentration to hold the core in a subcritical concentration following the postulated LOCA. Post-LOCA subcriticality requirements constitute the lower bound on the required ECCS component boron concentrations. Second, the injected boron must not be of such high concentration that appropriate operator actions to flush boric acid, which accumulates in the core, would be unsuccessful at preventing the buildup and precipitation of boric acid deposits, which could ultimately inhibit the long-term coolability of the core. Boron precipitation requirements constitute the upper bound on the required ECCS component boron concentrations.

4.1.1 Post-LOCA Subcriticality Margin

Post-LOCA subcriticality analysis is a function of the detailed core design and key assumptions like the RWST and CLA boron concentrations. Post-LOCA subcriticality margin, which is evaluated each cycle as part of the reload safety evaluation process, is determined by (1) the core excess reactivity at cold conditions and (2) by the sump boron concentration.

The NRC staff's review focused on the calculation of core excess reactivity at cold conditions. The purpose of the NRC staff's review was to establish that the current ECCS boron concentrations could provide the required post-LOCA subcriticality margin. The NRC staff performed its review by evaluating experimental and numerical validation data supporting the predictive capability of the licensee's lattice physics and core simulator codes to confirm their capability to predict sub-criticality margin for core designs similar to the tritium production core for a maximum of 704 TPBARs.

As part of the review in support of the license amendment request, the NRC staff requested additional information regarding Westinghouse's methodology for calculating critical boron concentration for a maximum of 704 TPBARs. Specifically, additional information was needed regarding the validation basis of the critical boron calculational methodology in situations of high (greater than 2000 ppm) RCS boron concentrations or high spectral indices resulting from heavy burnable absorber loadings.

The critical boron concentration is determined via an iterative process in the Westinghouse core design methodology. The nodal fast and thermal macroscopic cross sections are determined using the lattice physics code PHOENIX-L. These cross sections are adjusted by iterating on the boron number density (and thus boron concentration) in the three-dimensional nodal core simulator code ANC until the critical eigenvalue (Keff = 1) is achieved. The boron concentration resulting in the critical eigenvalue is called the critical boron concentration. The same iterative scheme for calculating critical boron concentration is used to determine the LOCA precondition critical boron concentration and the post-LOCA cold critical boron concentration.

Comparisons with plant data were presented to validate the PHOENIX/ANC code suite's ability to predict critical boron concentration adequately under high boron concentration conditions. A series of comparisons were presented in Westinghouse Commercial Atomic Power (WCAP) report, WCAP-11596-P-A, "Qualification of the PHOENIX-P/ANC Nuclear Design System for Pressurized Water Reactor Cores" (ML080630391), which demonstrated PHOENIX/ANC's predictive ability under both hot full power and hot zero power conditions. Additionally, in WCAP-16045-NP-A, "Qualification of the Two-Dimensional Transport Code PARAGON" (ML030760103), the measured critical boron concentrations from a total of 22 cycles covering 11 plants were compared with the PHOENIX/ANC predicted values for boron concentrations ranging in the critical boron concentration expected at WBN Unit 1. The mean difference between measured and predicted was small, as was the standard deviation. Westinghouse has also stated that current designs for WBN Unit 1 cores must have a critical hot full power boron concentration of less than 1250 ppm, a value representative of current Westinghouse core designs. This value of hot full power critical boron will be maintained for future WBN Unit 1 cores, regardless of the number of TPBARs installed. Based on this information, the NRC staff concludes that PHOENIX/ANC is qualified for critical boron predictions under hot conditions.

The NRC staff recognizes that the licensee's validation data set considers critical boron concentration at hot full-power and hot zero-power conditions; however, additional operational and analytic conservatisms in the physics calculations justify the extension of applicability of the hot condition validation discussed above to the post-LOCA core at cold conditions. For instance, assumptions regarding the xenon conditions in the core analytically introduce more positive reactivity than would be expected at the plant under LOCA conditions.

The predictive ability of PHOENIX/ANC under high spectral index conditions was also evaluated. The spectral index of the flux within a region is defined as the ratio of the fast flux to the thermal flux. In media with a high concentration of burnable absorbers, the flux spectrum tends to harden (the average particle energy increases), which increases the spectral index. Several of the cores presented in the comparison discussed in the preceding paragraph had spectral indices that bound the predicted spectral indices in cores loaded with significant numbers of TPBARs in post-LOCA conditions. Additionally, several of the cores described in the previous comparison had a heavy burnable absorber loading but maintained a comparable degree of accuracy in critical boron prediction with the other cores presented. These comparisons indicate that the ability of PHEONIX/ANC to predict critical boron concentration at hot conditions has little if any sensitivity to the spectral index of the core it is attempting to model within the range of spectral indices typical of pressurized water reactor core designs.

To verify that the core remains subcritical during the long-term core cooling phase of a LOCA, PHEONIX/ANC is used to calculate the critical boron concentration at three times after the break: (1) at the initiation of cold leg recirculation, (2) at hot leg switchover, and (3) at 16 hours after the break. The critical boron concentration at these times is compared with the predicted boron concentration in the sump corresponding with those times; the sump boron concentration must be greater than the critical boron concentration to ensure subcriticality. A number of conservative assumptions are incorporated into the analysis to ensure that core subcriticality can be demonstrated throughout the long-term core cooling phase.

Based on its review of the validation data set provided by the licensee, and on consideration of the additional conservative assumptions used to predict critical boron concentrations at cold, post-LOCA conditions, the NRC staff finds the approach described by the licensee for demonstrating long-term post-LOCA subcriticality to be acceptable for a maximum number of 704 TPBARs.

4.1.2 Post-LOCA Long Term Core Cooling

The allowable ECCS boron concentration is constrained on the upper end by the possibility of boron concentrating in the core following a LOCA to the extent that it could precipitate in the core structures, thus inhibiting long-term core cooling. TVA is not proposing to change the upper end of the TS-required ECCS boron concentration, such that existing calculations should demonstrate that the upper limit of boron concentration in the ECCS components would not be susceptible to post-LOCA precipitation.

The existing calculations are described by the NRC staff in a safety evaluation for a license amendment dated September 23, 2002 (ML022540925). These calculations showed that 3 hours would be available, following a limiting LOCA, for operators to take action to re-align safety injection flow to flush boric acid from the core, an action known as hot leg swap over (HLSO).

Since the time these calculations were performed, however, the NRC and the Pressurized-Water Reactor Owners Group (PWROG) have communicated about the consistency of boric acid precipitation calculation and potential non-conservative assumptions used in many of these calculations. Therefore, the licensee surveyed the communications between the NRC staff and the PWROG, and performed new boric acid precipitation calculations to address the potential nonconservatisms identified by the NRC staff and re-confirm the HLSO time of 3 hours.
The NRC staff enumerated its technical concerns with boric acid precipitation calculation methods in a letter, dated November 23, 2005 (ML053220569), to the PWROG These concerns, in summary, are as follows:

1. The assumed mixing volume for the calculation needs to be justified.

2. The precipitation calculation needs to take into account time-dependent variations in the available mixing volume, and the effect that coolant loop pressure losses can have on the liquid level in the reactor vessel.
3. The boric acid solubility limit assumed in the analysis must be justified.
4. The assumed decay heat, if based on a 10 CFR Part 50 Appendix K model, must be multiplied by 1.2.

The licensee's calculation is described in a letter dated December 31, 2008 (ML090220255). The calculation employs sufficient conservative assumptions to indicate that the licensee has addressed the NRC staff's concerns identified above. Namely, the boric acid precipitation calculation was performed as follows:

- The boric acid concentration is calculated as a function of time, modeling core voiding and accounting for the effect of pressure losses in the reactor coolant loop.
- The modeled solubility limit is based on experimentally determined limits modeled at atmospheric pressure, which is acceptable because, at higher pressures, the solubility limit would increase and more boric acid could be contained in solution without precipitating.
- The calculation credits the availability of 50-percent of the lower plenum for mixing, which is an assumption that the NRC staff currently accepts in boric acid precipitation calculations.
- The decay heat is based on an Appendix K model with a 1.2 multiplier to account for decay heat model uncertainties.

The licensee's calculations reaffirm the acceptability of the 3-hour HLSO time by demonstrating that the boric acid concentration in the core (the assumed mixing volume) does not reach the boric acid solubility limit by the 3-hour HLSO time, for several different postulated LOCA scenarios.

4.1.3 ECCS Boron Concentration - Conclusion

The NRC staff reviewed the predictive capability of the licensee's computer codes used to predict the required minimum ECCS boron concentrations for a maximum number of 704 TPBARs. The NRC staff also reviewed the acceptability of the allowable maximum ECCS boron concentration with regard to the potential for post-LOCA boric acid core precipitation for a maximum number of 704 TPBARs. Based on the considerations discussed in the preceding sections, the NRC staff concludes that the licensee's required ECCS boron concentrations are acceptable, because they will provide sufficient negative reactivity to hold the core subcritical, and because the boron concentration is not so high as to inhibit core cooling by concentrating in the core and precipitating on the core structures. The NRC staff finds the licensee's requested increase in the number of TPBARs from 400 to 704 in TS SR 3.5.1.4 and 3.5.4.3 to be acceptable, and the corresponding ECCS boron concentrations need not change to preserve the necessary quality of the subsystems.

4.2 Design Features

In the Design Features section of the TSs, TS 4.2.1, "Fuel Assemblies," is revised to state that WBN Unit 1 is authorized to place a maximum of 704 TPBARs into the reactor.

The NRC staff finds the change to TS 4.2.1 acceptable to update the fuel assembly design information to reflect a maximum of 704 TPBARs into the reactor for the following reasons:

(1) The NRC staff reviewed the information for Cycles 6, 7, and 8 that has shown the primary constraint on the number of TPBARs in the core is the TPBAR tritium release per year of 2304 curies per year. The NRC staff finds that the maximum number of 704 TPBARs is bounded by the mechanical design limitations on the TPBARs as reviewed in Amendment 67.

(2) The other limitations to the maximum number of 704 TPBARs relate to the excess reactivity contributions of the TPBARs in post-LOCA scenarios, which the NRC staff finds acceptable as evaluated in the preceding sections.

4.3 Technical Conclusion

Based on the above discussion, the NRC staff finds that the proposed revisions to TS 4.2.1, "Fuel Assemblies," and TS SRs 3.5.1.4, "Accumulators," and 3.5.4.3, "RWST," are acceptable to increase the maximum number of TPBARs from 400 to 704.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, an official of the Tennessee Bureau of Radiological Health 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, and changes SRs. 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 (74 FR 4776). 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 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 these amendments will not be inimical to the common defense and security or to the health and safety of the public.

Principle Contributors: Benjamin Parks
Andrew Bielen

Date: May 4, 2009

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SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 - ISSUANCE OF AMENDMENT REGARDING THE MAXIMUM NUMBER OF TRITIUM PRODUCING BURNABLE ABOSRBER RODS IN THE REACTOR CORE (TAC NO. MD9396)

Dear Mr. Campbell:

The Commission has issued the enclosed Amendment No. 77 to Facility Operating License No. NPF-90 for Watts Bar Nuclear Plant, Unit 1. This amendment is in response to your revised application dated December 31, 2008. The revised application dated December 31, 2008, superseded the application dated August 1, 2008, as supplemented by letters dated November 25 and December 31, 2008.

The proposed amendment revises Technical Specification (TS) 4.2.1, "Fuel Assemblies," and TS surveillance requirements 3.5.1.4, "Accumulators," and 3.5.4.3, "RWST [Refueling Water Storage Tank]," to increase the maximum number of tritium producing burnable absorber rods from 400 to 704.

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/
John G. Lamb, Senior Project Manager
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-390

Enclosures: 1. Amendment No. 77 to NPF-90
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

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OFFICE	WBSP/PM	WBSP/LA	SRXB/BC	OGC – "NLO"	WBSP/BC
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DATE	04 / 30 /09	04 / 30 /09	03/ 30 /09	04 / 28 /09	05 / 04 /09

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