October 3, 2003

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

SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 — ISSUANCE OF AN AMENDMENT REACTOR COOLANT SYSTEM (RCS) FLOW RATE MEASUREMENT USING ELBOW TAP METHODOLOGY (TAC NO. MB8992)

Dear Mr. Scalice:

The Commission has issued the enclosed Amendment No. 47 to Facility Operating License No. NPF-90 for Watts Bar Nuclear Plant (WBN), Unit 1. The amendment consists of changes to Technical Specifications (TS) 3.3.1, "Reactor Trip System Instrumentation," and 3.4.1, "RCS Pressure, Temperature and Flow Departure From Nucleate Boiling (DNB) Limits", and is in response to your application dated May 14, 2003, as supplemented by letter dated June 24, 2003.

The revised TS would allow an alternate method for the measurement of RCS total flow rate via measurement of the RCS elbow tap differential pressures.

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 No. 50-390

Enclosures: 1. Amendment No. 47 to NPF-90
2. Safety Evaluation

cc w/enclosures: See next page

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ADAMS Accession No. ML032820572 *No legal objections

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TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-390

WATTS BAR NUCLEAR PLANT, UNIT 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 47
License No. NPF-90

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

   A. The application for amendment by Tennessee Valley Authority (the licensee) dated May 14, 2003, as supplemented by letter dated June 24, 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. NPF-90 is hereby amended to read as follows:

   (2) <u>Technical Specifications and Environmental Protection Plan</u>

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 47, 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 within 60 days.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

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

Attachment:
Changes to the Technical
Specifications

Date of Issuance: October 3, 2003

ATTACHMENT TO AMENDMENT NO. 47

FACILITY OPERATING LICENSE NO. NPF-90

DOCKET NO. 50-390

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

Remove Pages	Insert Pages
3.3-17	3.3-17
3.4-2	3.4-2
B 3.3-4	B 3.3-4
B 3.3-5	B 3.3-5
B 3.3-24	B 3.3-24
B 3.3-25	B 3.3-25
B 3.3-63	B 3.3-63
B 3.4-2	B 3.4-2
B 3.4-5	B 3.4-5

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 47 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 May 14, 2003, as supplemented by letter dated June 24, 2003, (ADAMS Accession Nos. ML031420192 and ML032461406, respectively), the Tennessee Valley Authority (TVA or the licensee), submitted a request for changes to the Technical Specifications (TSs) for Watts Bar Nuclear Plant (WBN), Unit 1. The requested changes are needed to allow an alternate method for the measurement of Reactor Coolant System (RCS) total flow rate via measurement of the RCS elbow tap differential pressures. The changes would modify the Reactor Coolant Flow-Low reactor trip function Allowable Value in TS 3.3.1, "Reactor Trip System Instrumentation," to reflect the revised instrument uncertainty calculations arising from use of the elbow tap methodology. The changes would also modify the RCS flow measurement surveillance requirement in TS 3.4.1, "RCS Pressure, Temperature and Flow Departure From Nucleate Boiling (DNB) Limits."

Currently, the RCS total flow rate is measured by performing a precision heat balance (calorimetric flow). This method uses secondary side calorimetric measurements of feedwater flow, feedwater temperature, and steam pressure together with primary side loop temperatures as indicated by the hot and cold leg resistance temperature detectors (RTDs). WBN Unit 1 has experienced apparent decreases in flow rates determined by the calorimetric methodology. These decreases have been attributed to variations in hot leg streaming due to the implementation of low neutron leakage core loading patterns that result in changes in the core radial power distribution. Hot leg streaming is a temperature gradient within the hot leg pipe resulting from the incomplete mixing of the coolant leaving fuel assemblies at different temperatures. As a result of the increased temperature streaming, the bulk hot leg temperature as measured by the three RTDs in each hot leg is erroneous, resulting in a calculated RCS flow lower than the actual value. The use of elbow tap delta-p correlated to flow calorimetrics performed for WBN Unit 1 in baseline operating cycles improves RCS flow measurement by eliminating hot leg temperature streaming effects that occur using the flow calorimetric method.

Enclosure 2

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

2.0 REGULATORY EVALUATION

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, General Design Criterion 10, Reactor design, requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

The regulatory requirements related to the content of TS are stated in 10 CFR 50.36, “Technical specifications.” Criterion 2 of 10 CFR 50.36(c)(2)(ii) requires that limiting conditions for operation be established for a process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier. TS 3.4.1 specifies requirements for maintaining RCS pressure, temperature and flow rate within the limits assumed in the safety analyses. These limits ensure that the minimum DNB ratio will be met for each of the transients analyzed. A lower RCS flow rate would cause the core to approach DNB limits.

3.0 TECHNICAL EVALUATION

3.1 Use of Elbow Tap ΔP for RCS Flow Measurement

The principle of operation of an elbow tap flow meter is based on the centrifugal force of a fluid flowing through an elbow creating a ΔP between the outer and inner radii of the elbow. The relationship between the volumetric flow rate through an elbow, Q, and ΔP between the pressure taps at the outer and inner radii of the elbow can be expressed as $Q=C\ \Delta P^{1/2}$. The elbow meter coefficient, C, is a function of elbow bend and cross-section radii, and is affected by the location of pressure taps, upstream and downstream piping, and other factors. The cold-leg elbow tap flow element is not calibrated in advance in a laboratory, but the measurement is typically normalized against the RCS flow rate that is established from precision heat balance (calorimetric flow) measurements at the start of each fuel cycle.

The use of the cold leg elbow tap differential pressure (ΔP) measurements as an alternate method for the RCS flow surveillance after each fuel loading was developed because of the inherent limitation of the calorimetric-based method. The staff accepted the Westinghouse report (WCAP), WCAP-14750-P-A, “RCS Flow Verification Using Elbow Taps at Westinghouse 3-Loop PWRs [pressurized water reactors],” for generic application to Westinghouse 3-loop PWRs for use of elbow taps. Application to 4-loop PWRs has been approved for several 4-loop plants, including McGuire Nuclear Station, Catawba Nuclear Station, South Texas Project Electric Generating Station, Joseph M. Farley Nuclear Plant, and Seabrook Station.

WCAP 16067-P, “RCS Flow Measurement Using Elbow Tap Methodology at Watts Bar Unit 1,” Revision 0, describes the procedure for determining the RCS flow rate from elbow tap ΔP measurements. Figure 4-1 in WCAP-16067-P shows the elbow tap locations in the RCS piping. The elbow taps are installed in a plane 22.5° around the 90° crossover elbow in each of the cold legs. Each elbow has three low-pressure taps spaced 15° apart on the inside pipe radius and

one high-pressure tap on the outside pipe radius used as a common tap. The pressure taps are connected to three ΔP transmitters to obtain ΔP data. Since the elbow taps in the cold legs are fixed, the elbow meter coefficients in each elbow tap configuration should remain unchanged. An American Society of Mechanical Engineers (ASME) publication (Ref. 4) states that hydraulic tests have demonstrated that elbow tap flow measurements have a high degree of repeatability, and are not affected by changes in the elbow surface roughness.

3.1.1 Elbow Tap Flow Measurement Repeatability

To confirm elbow tap flow measurement repeatability, Section 4.1 of WCAP-16067-P, Revision 0, provides an evaluation of comparison between the RCS flow measurement data using the elbow taps and ultrasonic Leading Edge Flow Meters (LEFM) from the Hydraulic Test Program at Prairie Island Unit 2 (PI-2). The PI-2 Hydraulic Test Program was in place in 1973 and the test data covered 11 years of plant operation, during which a significant change in system hydraulics was made. The data showed that the elbow tap measurements agree within 0.3 percent of the LEFM flow measurements. Another comparison performed before and after a reactor coolant pump replacement showed that the LEFM and elbow tap measurements agreed to within an average of 0.2 percent on the ratio of flows when one and two pumps were operating.

In addition, an evaluation performed at Prairie Island Unit 2 on the possible effects of various processes or phenomena on the elbow tap flow measurements, including effects of fouling, erosion, upstream velocity distribution, and steam generator (SG) replacement concluded the following:

- The conditions for fouling processes are not present in the cold-leg elbow since there is no change in cross section to produce a velocity increase and ionization.
- Surface erosion is unlikely because of the use of stainless steel in the pipe and the flow velocities are small relative to the conditions where erosion might be expected.
- The upstream velocity distribution, including the distribution in the elbow tap flow meter, remains constant so the elbow tap flow meter ΔP versus flow relationship does not change.
- The plenum velocity head approaching the SG outlet nozzle is small compared to the piping velocity head; therefore, SG tube plugging does not affect elbow tap flow measurement repeatability.

The staff has determined that the above information is consistent with the information previously reviewed in Reference 5. The staff finds the assumptions being made by licensees to be valid. The staff also performed an independent audit as discussed in section 3.2.2 of Reference 5 of elbow tap stability and flow coefficients to reconfirm their consistency over time. Based on the above evaluation, the staff concludes that since the elbow tap flow meter coefficients remain constant, the relative changes of flow rate through the cold leg elbows can be correlated with the relative changes in the elbow tap ΔP.

3.1.2 Elbow Tap Flow Measurement Procedure

Section 4.2 of WCAP-16067-P, Revision 0 describes the procedure for determining the RCS flow from elbow tap ΔP measurements based on their repeatability. This elbow tap flow measurement procedure relies on the total baseline calorimetric flow rate, which is based on the calorimetric flow rate measurements from early fuel cycles before the deployment of the Low Leakage Loading Patterns. The procedure correlates the current cycle flow rate (CCF) with the elbow tap ΔP ratio of the current and the baseline cycles and the baseline calorimetric flow (BCF) rate. The CCF is determined by multiplying the BCF by the elbow tap flow ratio (R).

$$R=(K/B)^{1/2} \qquad (1)$$

where B is the baseline elbow tap flow coefficient defined as:

$$B= \Delta P_B \times v_B \qquad (2)$$

where: ΔP_B is baseline average elbow tap ΔP;
v_B is average cold leg specific volume; and
K is the current cycle elbow tap total flow coefficient, defined as:

$$K=\Delta P \times v \qquad (3)$$

and v is the cold leg specific volume.

Section 4.3 describes the baseline parameters for elbow tap measurements, including the BCF, and the baseline elbow tap flow coefficient, B. The procedures for defining the BCF, including the criteria for the choice of early cycle flow measurements and the determination of the BCF from the chosen cycle data, and the calculation of elbow tap flow coefficient B from the baseline cycle elbow tap ΔP measurements, are in accordance with the approved processes described in WCAP-14750-P-A, Rev. 1, and therefore, are acceptable.

3.1.3 Best Estimate Flow Confirmation

The elbow tap flow measurement procedure provides that the licensee perform a best estimate (BE) hydraulics analysis to verify the RCS flow determined from the elbow tap flow measurement. The RCS flow BE calculation is based on the flow resistance of various components in the reactor coolant loops and the reactor coolant pump performance characteristics. Therefore, changes in the RCS flow rate can be evaluated based on plant system hydraulic changes, such as plugging and sleeving of SG tubes, and fuel design changes. In the BE hydraulic analysis process, the current cycle elbow tap flow ratio R is compared to an estimated flow ratio (R'), which is defined as:

$$R'= CEF/BEF \qquad (4)$$

where R' is the ratio of the current cycle estimate RCS flow (CEF) to the baseline cycle best estimate flow (BEF) based on the flow analysis of known RCS hydraulics changes. If the measured R is greater than (1.004 x R'), R will be limited to (1.004 x R'). The multiplier 1.004 applied to R' is a measure to provide an allowance of 0.4 percent for elbow tap flow measurement repeatability.

Section 5.0 of WCAP-16067-P, Revision 0, describes a best estimate RCS flow analysis procedure developed by Westinghouse in 1974 to estimate RCS flow at all Westinghouse designed plants. The analysis uses BE values of the RCS component flow resistances and pump performance. The flow resistance of the RCS loops (i.e., the reactor vessel (RV), RCS piping, and SGs) are used in conjunction with the reactor coolant pump (RCP) head-flow performance to define individual loop and RCS total flow rates. The component hydraulic design data and hydraulic coefficients are determined from analyses of the test data. The flow resistance of the RV, consisting of the RV, RV internals and RV nozzles, is determined from the ΔP measurements of a full size fuel assembly hydraulic test and hydraulic model test data for each type of RV. The RCS piping flow resistance combines the resistances of the hot-leg, crossover-leg and cold-leg piping. The flow resistance is based on analyzing the effects of upstream and downstream components on elbow hydraulic loss coefficients, using the results of industry hydraulic tests. The SG flow resistance is defined in five parts: inlet nozzle; tube inlet; tubes; tube outlet; and outlet nozzle. Uncertainties in the BEF hydraulic analysis, based on both plant and component test data, define a flow uncertainty of 2 percent flow, indicating that actual flow is expected to be within 2 percent of the calculated BEF. The BEF based on the hydraulic analysis is only used to confirm the elbow tap flow measurement while limiting the elbow tap flow measurement to a maximum value corresponding to the best estimate flow plus an allowance for the elbow tap flow repeatability uncertainty. The BEF will not be used as a substitute for the TS Surveillance Requirement (SR) for flow measurement. The staff performed an independent audit on the effects of SG tube plugging, boric acid (fouling), and additional evaluations to confirm BE calculations and its usage are acceptable (Ref. 5).

The staff concluded that the BE hydraulic analysis was being performed in accordance with previously approved methodology. Therefore, the staff finds that the BE hydraulic flow analysis provides analytical assurance of the RCS flow determined from the elbow tap flow measurement.

3.1.4 Watts Bar RCS Flow Performance Evaluation

Section 6 of WCAP-16067-P, Revision 0, describes the evaluation of Watts Bar RCS flow performance. RCS elbow tap flow and calorimetric flow measurements were evaluated and compared with calculated BEF. The BEF analyses defined flows for the first five fuel cycles. The hydraulic changes affecting flow subsequent to cycle one were modeled to determine BEF rates of various cycles and are provided in Table 6-1. Flow decrease due to impeller smoothing was not applied since WBN RCPs had operated for a considerable time prior to plant startup and prior to the Cycle 1 baseline ΔP measurement. The licensee concluded that the flow decrease caused by impeller smoothing occurred prior to the cycle 1 measurement. SG tube plugging (negligible until cycle 5) decreased flow by 0.25 percent, and no significant fuel design changes have taken place during plant operation that would impact flow.

The cycle 1 elbow tap ΔPs defined a baseline elbow tap flow coefficient, B. Elbow tap loop and total flows are listed in Table 6-2. The RTD Bypass System was removed prior to cycle 1 and was replaced with thermowell RTDs. This modification had no effect on this analysis since it was performed prior to the cycle 1 measurement.

The calculation of the WBN baseline calorimetric flow was made in accordance with the BCF determination procedure described in Section 4.3 of WCAP-16067-P, Revision 0. Table 6-3

provides the data for calculating the baseline flow. Figure 6.1 compares total elbow tap flow to the BEF and shows it is within the repeatability allowance limit. This is consistent with the elbow tap flow measurement procedure described in Section 3.1.3 of this safety evaluation and is acceptable.

3.1.5 Flow Measurement Uncertainties

The implementation of the elbow tap ΔP method of measuring RCS flow necessitates the determination of uncertainties associated with the precision RCS flow calorimetric for the baseline cycles for WBN Unit 1. WCAP-16067-P, Revision 0, Appendix A contains the uncertainty calculation to support the elbow tap ΔP method of measuring RCS flow.

The licensee stated that the uncertainty calculation in WCAP-16067-P, Revision 0, is consistent with the methodology described in NUREG/CR-3659, "A Mathematical Model for Assessing the Uncertainties of Instrumentation Measurements for Power and Flow of PWR Reactors," except for two significant differences. The first difference in the uncertainty calculation used is the utilization of multiple precision calorimetric flow measurements. NUREG/CR-3659 limits the discussion to the performance of a single precision calorimetric measurement for RCS flow. However, the process described in WCAP-16067-P, Revision 0, extends it to encompass the additional uncertainties over several cycles. At WBN, the individual cycle uncertainties as well as the average of the uncertainties over three cycles were determined. However, for conservatism an election was made to use the Cycle 1 uncertainties instead of the average of the three cycles since the uncertainties for Cycle 1 were larger than the average of three cycles. The staff finds the licensee's approach to be conservative with respect to NUREG/CR-3659 and therefore, it is acceptable.

The second difference cited by the licensee is that NUREG/CR-3659 assumes that the elbow taps are normalized to the single cycle specific precision flow calorimetric measurement each cycle, and therefore the elbow tap uncertainties may be zeroed out. The licensee has stated that WCAP-16067-P, Revision 0, identifies a process by which the baseline measurements are utilized to establish a correlation between elbow tap differential pressure and the previously performed precision flow calorimetric measurements. This process calls for the appropriate inclusion of additional uncertainties associated with the elbow tap differential pressure measurements of each cycle. These additional uncertainties were previously zeroed out by the assumption of normalization to a calorimetric performed each cycle. Based on this, the staff considers that the licensee has properly justified the differences from the NUREG/CR-3659 and meets the intent of the methodology.

Appendix A of WCAP-16067-P, Revision 0, provides the results of the uncertainty calculation. Tables A-3, A-4, and A-5 of Appendix A to WCAP-16067-P, Revision 0, use equations to calculate uncertainties for calorimetric and elbow tap flow measurements. In response to a question raised by the staff regarding the acceptability of equations used in Appendix A to WCAP-16067-P, the licensee stated that the method used in WCAP-16067, Revision 0, is the same as used for previous WBN calculations. The basic approach was provided in WCAP-14419, Revision 0, "Westinghouse Instrument Uncertainty Methodology for Reactor Coolant System Flow Measurement," in support of initial startup of WBN and was accepted by NRC in Safety Evaluation Report (SER), Supplement No. 16, dated September 1995. This equation was presented again in WCAP-14738, Revision 0, "Westinghouse Revised Thermal Design Procedure Instrument Uncertainty Methodology for Watts Bar Nuclear Plant," in support of

cycle 2 operation and was accepted by the U.S. Nuclear Regulatory Commission (NRC) in a SER dated September 1997. The equations in WCAP-16067-P, Revision 0, are not identical to the equations in WCAP 14419 or 14738 as they represent somewhat different instruments and procedures existing for the startup of Cycle 1 but they are the same in method. Therefore, the equations of Tables A-3, A-4, and A-5 of WCAP-16067, Revision 0, do not represent a change in methodology and are consistent with previous submittals reviewed and accepted by NRC. Also, the method used at WBN Unit 1 is the same previously approved method used at other plants, such as Diablo Canyon and Seabrook. Based on the above discussion and previous reviews, the staff finds that the licensee has adequately addressed the staff's concern.

Based on the above, the staff has determined that the proposed cold-leg elbow tap ΔP measurement methodology for RCS flow rate measurements, as described in WCAP-16067, Revision 0, is an acceptable alternative to a precision heat balance measurement.

3.1.6 Reactor Coolant Flow -Low, Reactor Trip Function

TS Table 3.3.1-1, Function 10, RCS Flow-low reactor trip function ensures that protection is provided against violating the DNB limit due to low flow in one or more RCS loops while avoiding reactor trips due to normal variations in loop flow. The input to the trip is from the three elbow tap ΔP transmitters on each loop. The licensee has proposed to increase Allowable Value (AV) for the RCS Flow-low trip function 10.a and 10.b from 89.6 to 89.7 percent due to an increase in uncertainty associated with the instrument setpoint. The licensee has further stated that this uncertainty calculation is consistent with that described in WCAP-12096, Revisions 6 and 7, which were reviewed and accepted by the NRC. The NRC review and acceptance of the WCAP, Revisions 6 and 7, are documented in SER 15, dated June 1995 and by letter dated September 11, 1997, respectively. WCAP-12096, Revision 8, did not affect the RCS flow uncertainty calculation.

Table A-4 of WCAP-16067, Revision 0, shows an overall RCS flow uncertainty of 1.9 percent for the control room indicator, which bounds the process computer uncertainties in Table A-5 of WCAP-16067-P, Revision 0. This uncertainty is slightly less than the current NRC licensed value of 2.0 percent, which has been used in the NRC approved Westinghouse Revised Thermal Design Procedure (RTDP). The RTDP was used to derive the TS 2.1 reactor core safety limits and corresponding TS 3.4.1 DNB limits. Therefore, the uncertainty of 1.9 percent for use of the elbow tap flow measurement method is bounded by that assumed in the current safety analyses and no changes to the RCS flow value contained in the safety analyses are necessary. Also Table A-6 of WCAP-16067, Revision 0, shows the calculated channel statistical allowance for the reactor trip function is lower than the total allowance (2.7 percent flow span) assumed for the low flow reactor trip function. Therefore, no change is needed to the TS Table 3.3.1-1 Reactor Coolant Flow - Low nominal trip setpoint value of 90 percent flow or the current safety analyses value of 87 percent due to availability of margin in the uncertainty calculation. Since the trip setpoint did not change and remains conservative with respect to the revised AV, it will continue to bound drift and measurement test and equipment uncertainties. Also based on the availability of the margin, assurance is provided that DNB limits are not violated during RCS low flow events. Therefore, the staff finds the proposed change acceptable.

3.2 Technical Specification Changes

TVA proposes changing SR 3.4.1.4 (18 month RCS precision heat balance flow verification) and Table 3.3.1-1 (Reactor Trip System Instrumentation) to reflect the use of the elbow tap methodology as an alternate method for determining RCS flow.

The purpose of SR 3.4.1.4 is to verify that sufficient RCS flow is available to satisfy the safety analysis limits. It requires that the RCS total flow be verified to be within its limit of 380,000 gpm using a precision heat balance method every 18 months and is to be performed within 24 hours after ≥ 90 percent Rated Thermal Power. TVA proposed for the TS SR to read: "Verify by precision heat balance or elbow tap ΔP method that RCS total flow rate is ≥ 380,000 gpm." The licensee is revising the TS Bases to describe the elbow tap ΔP measurement as an alternate method of determining RCS total flow rate and to provide a reference to WCAP-16067-P, Revision 0.

The TS Table 3.3.1-1 Reactor Coolant Flow-Low reactor trip ensures that protection is provided against violating the DNB limit due to low flow in one or more RCS loops while avoiding reactor trips due to normal variations in loop flow. Revision to Table 3.3.1 (Reactor Trip System Instrumentation) allowable value from 89.6 percent to 89.7 percent is made to reflect the change in calculated uncertainties using the elbow tap methodology. The uncertainty associated with the RCS Flow-Low trip increased slightly, yet due to the availability of margin in the uncertainty calculation, no change was necessary to either the Trip Setpoint (90.0 percent flow) or the current Safety Analysis Limit (87 percent flow). The licensee is revising the TS Bases for the Reactor Coolant Flow-Low function to clarify that the trip setpoint is based on indicated flow.

The proposed SR would require that an approved method be used for the RCS flow surveillance verification, and the staff found the alternate method acceptable. The changes to the Bases are consistent with the proposed changes to the TS and the staff has no objections to the changes.

3.3 Summary

The staff reviewed the use of elbow tap flow measurement methodology for RCS flow verification described in WCAP-16067-P, Revision 0 and TVA's proposed changes to the WBN TS regarding the RCS flow surveillance and the Low-flow reactor trip function.

The RCS elbow tap flow and calorimetric flow measurement data from WBN Unit 1 have been evaluated and compared with calculated BEF to determine RCS flow performance. The procedures for the determination of baseline calorimetric flow are consistent with the approved method described in WCAP-14750-P-A, Revision 1. The evaluations determined that flow changes measured by elbow taps over several fuel cycles are consistent with and are conservative relative to predicted flow changes due to changes in RCS hydraulics. Based on its review of the technical bases regarding the elbow tap RCS flow measurement procedure and the measurement uncertainty calculation, as set forth in detail above, the staff concludes that the proposed TS changes as well as the use of the elbow tap ΔP method described in WCAP-16067-P, Revision 0 for the RCS surveillance are acceptable. The staff also finds that the proposed changes are consistent with continued compliance of the applicable regulatory requirements and with previously approved references. No change to the safety analysis is required and the margin of safety remains the same. The staff concludes that the proposed changes are acceptable.

4.0 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.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes requirements with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and changes surveillance requirements. 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 37584). 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.

6.0 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.

7.0 REFERENCES

1. Pace, P. L., Tennessee Valley Authority, letter to US Nuclear Regulatory Commission, "License Amendment Request 03-10-Reactor Coolant System (RCS) Flow Measurement Using Elbow Tap Methodology," Facility Operating License No. NPF-90, May 14, 2003.

2. WCAP-14750-P-A, Revision 1, "RCS Flow Verification Using Elbow Taps at Westinghouse 3-Loop PWRs," September 1999.

3. WCAP-16067-P, Revision 0, "RCS Flow Measurement Using Elbow Tap Methodology at Watts Bar Unit 1," April 2003.

4. "Fluid Meters, Their Theory and Application," 6th Edition, Howard S. Bean, ASME, New York, 1971.

5. Girija S. Shukla, NRC, to Gregory M. Rueger, Pacific Gas and Electric Company, "Diablo Canyon Power Plant, Unit No. 1 and Unit No. 2 - Issuance of Amendment - Revision to Technical Specification (TS) Table 3.3.1-1, Reactor Trip System Instrumentation," and revised Reactor Coolant System Flow Measurement," August 21, 2003. (ADAMS Accession No. ML032380158.)

6. NUREG/CR-3659, “A Mathematical Model for Assessing the Uncertainties of Instrumentation Measurements for Power and Flow of PWR Reactors,” February 1985.

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