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

September 9, 2009

Mr. Preston D. Swafford
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Executive Vice President
Tennessee Valley Authority
3R Lookout Place
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SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 1 - ISSUANCE OF AMENDMENT REGARDING THE COMPLETION TIME FOR CONDITION B OF TECHNICAL SPECIFICATION 3.5.1, "ACCUMULATORS" (TAC NO. ME1437)

Dear Mr. Swafford:

The Commission has issued the enclosed Amendment No. 81 to Facility Operating License No. NPF-90 for Watts Bar Nuclear Plant, Unit 1. This amendment is in response to your application dated June 5, 2009.

The proposed amendment would extend the completion time from 1 hour to 24 hours for Condition B of Technical Specification (TS) 3.5.1, "Accumulators." The change is consistent with U. S. Nuclear Regulatory Commission approved Industry/Technical Specification Task Force (TSTF) Standard Technical Specification Change Traveler, TSTF-370, "Risk Informed Evaluation of an Extension to Accumulator Completion Times for Westinghouse Plants."

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. 81 to NPF-90
2. Safety Evaluation

cc w/enclosures: Distribution via Listserv

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.1 ACCUMULATORS

LCO 3.5.1 Four ECCS accumulators shall be OPERABLE.

APPLICABILITY: MODES 1 and 2,
MODE 3 with pressurizer pressure > 1000 psig.

ACTIONS

CONDITION		REQUIRED ACTION		COMPLETION TIME
A.	One accumulator inoperable due to boron concentration not within limits.	A.1	Restore boron concentration to within limits.	72 hours
B.	One accumulator inoperable for reasons other than Condition A.	B.1	Restore accumulator to OPERABLE status.	24 hours
C.	Required Action and associated Completion Time of Condition A or B not met.	C.1 AND C.2	Be in MODE 3. Reduce pressurizer Pressure to ≤ 1000 psig.	6 hours. 12 hours
D.	Two or more accumulators inoperable.	D.1	Enter LCO 3.0.3.	Immediately

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO.81 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 June 5, 2008 (Agencywide Document and Management System Accession No. ML091610067), 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 proposed amendment would extend the completion time from 1 hour to 24 hours for Condition B of TS 3.5.1, "Accumulators." The change is consistent with U.S. Nuclear Regulatory Commission (NRC) approved Industry/Technical Specification Task Force (TSTF) Standard TS Change Traveler, TSTF-370, "Risk Informed Evaluation of an Extension to Accumulator Completion Times for Westinghouse Plants."

Notice of this amendment was published in the *Federal Register* on June 30, 2009 (74 FR 31326). The TSTF-370 notice was published in the *Federal Register* on July 15, 2002 (67 FR 46542) and March 12, 2003 (68 FR 11880).

2.0 BACKGROUND

Westinghouse Topical Report WCAP-15049, "Risk-Informed Evaluation of an Extension to Accumulator Completion Times," was submitted to the NRC on August 20, 1998, and approved in the NRC letter dated February 19, 1999. The WCAP evaluates the risk associated with extending the accumulator completion time (CT) from 1 hour to 24 hours for reasons other than boron concentration out of specification.

Wolf Creek was the lead plant for the Westinghouse Owners Group (WOG) program and received plant-specific approval for changes to the TSs on April 27, 1999 (License Amendment No. 124). In the NRC letter of February 19, 1999, the staff indicated that it will not repeat its review of the matters described in Topical Report WCAP-15049 when the report appears as a reference in license applications, except to ensure that the material presented applies to the specified plants involved.

The proposed change revises the CT from 1 hour to 24 hours for Condition B of TS 3.5.1, "Accumulators," and its associated Bases. Condition B of TS 3.5.1 currently specifies a CT of 1 hour to restore a reactor coolant system (RCS) accumulator to operable status when declared inoperable due to any reason except not being within the required boron concentration range.

3.0 EVALUATION

Deterministic Evaluation

The purpose of the emergency core cooling system (ECCS) accumulators is to supply water to the reactor vessel during the blowdown phase of a loss-of-coolant accident (LOCA). The accumulators are large volume tanks, filled with borated water and pressurized with nitrogen. The cover-pressure is less than that of the reactor coolant system so that following an accident, when the reactor coolant system pressure decreases below tank pressure, the accumulators inject the borated water into the RCS cold legs. The current deterministic safety analysis has not been changed, and thus the limiting condition of operation (LCO), that is, the lowest functional capability required for safe operation continues to be:

> "LCO 3.5.1 [Four] ECCS accumulators shall be operable.
> Applicability: Modes 1 and 2, Mode 3 with RCS pressure > [1000] psig."
> Where the bracketed information is nominal, and is subject to substitution of plant specific values.

Under Actions, TSs allow for limited deviations from the LCO. Historically, these Actions and associated CTs have been set using judgment and are not part of the deterministic safety analysis discussed above. Currently, the TS allows for one accumulator to be inoperable for 1 hour for reasons other than boron concentration not within limits during Modes 1, 2, and in Mode 3 with pressurizer pressure greater than a plant specific pressure. The WCAP, as well as this TSTF, proposes to increase this CT to 24 hours. The proposed CT of 24 hours is an extension of the current ACTION statement. CTs are by their nature determined by conditions of risk and the impact of the proposed change on risk is reviewed in the following section.

Risk Evaluation

A three-tiered approach, consistent with Regulatory Guide (RG) 1.177,[1] was used by the staff to evaluate the risk associated with the proposed accumulator CT, or allowed outage time, extension from 1 hour to 24 hours. The need for the proposed change was that the current 1-hour CT would be insufficient in most cases for licensees to take a reasonable action when an accumulator was found to be inoperable.

Tier 1: Quality of Probabilistic Risk Assessment (PRA) and Risk Impact

Westinghouse used a reasonable approach to assess the risk impact of the proposed accumulator CT extension. The approach is generally consistent with the intent of the

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[1]RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," September 1998.

applicable NRC RGs 1.174[2] and 1.177. The quantitative risk measures addressed in the topical report included the change in core damage frequency (CDF) and incremental conditional core damage probability (ICCDP[3]) for a single CT. The change in large early release frequency (LERF) and incremental conditional large early probability (ICLERP[4]) for a single CT was qualitatively addressed. Representative calculations were performed to determine the risk impact of the proposed change. Various accumulator success criteria were considered in these calculations to encompass the whole spectrum of Westinghouse plants, e.g., two-, three- and four-loop plants. A reasonable effort was also made to address the differences in other components of risk analysis such as initiating event (IE) frequency and accumulator unavailability among Westinghouse plants.

Westinghouse considered a comprehensive range of IEs in the risk analysis. LOCAs in all sizes - large, medium and small - were included, and reactor vessel failure and interfacing system LOCA were also considered. Modeling of accumulators for mitigation of events other than large, medium and small LOCAs was identified to have insignificant risk impact; therefore, the analysis was performed only on accumulator injection in response to large, medium and small LOCA events.

The success criteria considered are summarized as follows:

LOCA Category	No. of Loops	Success Criteria
Large	4	3 accumulators to 3 of 3 intact loops (3/3)
		2 accumulators to 2 of 3 intact loops (2/3)
		no accumulators required (0/3)
	3	2 accumulators to 2 of 2 intact loops (2/2)
		1 accumulator to 1 of 2 intact loops (1/2)
		no accumulators required (0/2)
Medium and Small	2	1 accumulator to 1 of 1 intact loop (1/1)
		no accumulators required (0/1)

[2]RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," July 1998.

[3]ICCDP = [(conditional CDF with the subject equipment out-of-service) - (baseline CDF with nominal expected equipment unavailabilities) x (duration of single CT under consideration)].

[4]ICLERP = [(conditional LERF with the subject equipment out-of-service) - (baseline LERF with nominal expected equipment unavailabilities) x (duration of single CT under consideration)].

LOCA Category	No. of Loops	Success Criteria
	3	2 accumulators to 2 of 2 intact loops (2/2)
	2	1 accumulator to 1 of 1 intact loop (1/1)

The success criteria considered in this analysis were comprehensive and considered conservative in many cases. For example, many plants indicated the accumulator success criteria for medium and small LOCA events resulted from their role in an alternate success path, in which high pressure injection (HPI) had already failed. Additionally, the staff's review of a number of the original individual plant examinations (IPEs) indicated that no accumulator was needed at all for many medium LOCA sequences and for most of small LOCA sequences.

The fault trees that model accumulator unavailabilities were evaluated. The assumptions made in the fault tree modeling were detailed and were found to be reasonable. For example, the model assumed that the total CT would be used for each corrective maintenance, and this was considered conservative. A comprehensive list of failure mechanisms was considered, and potential common cause failures for check valves and motor-operated valves were also included. Westinghouse used the Multiple Greek Letter technique to determine the common cause failure contributions to the accumulator injection failure.

The component failure rates were taken from the Advanced Light Water Utility Requirements Document.[5] Accumulator unavailabilities due to boron concentration out of limit and due to other reasons were calculated based on a survey of a number of Westinghouse plants. The values for component failure rates and accumulator unavailabilities were within reasonable range. The common cause factors used were also comparable to those used in other PRAs. The accumulator fault trees were quantified using the WesSAGE computer code. The code provided information on the unavailability and cutsets related to the component failures and maintenance activities modeled in the fault trees. A separate hand calculation was used to determine the unavailability due to potential common cause failures. Evaluation of some of the cutsets provided in the topical report did not reveal any unexpected results.

The staff examined the accident sequence identification for each LOCA category. The probability of the sequence leading to core damage involving accumulator failure is summarized for each LOCA category as follows:

Large LOCA	(Large LOCA IE frequency) x (accumulator unavailability)
Medium LOCA	(Medium LOCA IE frequency) x (unavailability of HPI) x (accumulator unavailability)
Small LOCA	(Small LOCA IE frequency) x (unavailability of HPI) x (accumulator unavailability)

[5]"Advanced Light Water Utility Requirements Document," Volume II, ALWR Evolutionary Plant, Chapter 1, Appendix A, PRA Key Assumptions and Ground Rules, Rev. 5, Issued December 1992.

The LOCA IE frequencies used for WCAP-15049 are summarized below. Also listed are the LOCA frequencies used in NUREG/CR-4550[6] (the NUREG-1150 study) for pressurized-water reactors and those in the original IPEs.

	WCAP-15049	NUREG-1150	IPE Average (High; Low)
Large LOCA	$3x10^{-4}$/yr	$5x10^{-4}$/yr	$3.3x10^{-4}$/yr ($5x10^{-4}$/yr; $1x10^{-5}$/yr)
Medium LOCA	$8x10^{-4}$/yr	$1x10^{-3}$/yr	$7.9x10^{-4}$/yr ($2.6x10^{-3}$/yr; $1x10^{-4}$/yr)
Small LOCA	$7x10^{-3}$/yr	$1x10^{-3}$/yr	$8.9x10^{-3}$/yr ($2.9x10^{-2}$/yr; $3.7x10^{-4}$/yr)

Westinghouse indicated that the IE frequencies for WCAP-15049 were based on the plant-specific information contained in the WOG Probabilistic Safety Analysis Comparison Database, which documented the PRA modeling methods and results of the updated PRAs for Westinghouse plants. The mean IE frequencies were used for the risk analysis. These were comparable to the values used for the NUREG-1150 study and the average values in the original IPEs. The staff also found that the IE frequency values in high range among the original IPEs were not much higher than those used for this topical report. The HPI unavailability values used were $7x10^{-3}$ and $1x10^{-3}$/yr for medium and small LOCA events, respectively. The staff's examination revealed that the HPI unavailability values were generally comparable to those used in other PRAs, and were generally conservative.

The risk measures calculated to determine the impact on plant risk were based on three different cases. The risk measures considered in each case included the impact on CDF and ICCDP for a single CT, and the impact on LERF and ICLERP for a single CT were qualitatively considered. The three cases considered were:

> Design basis case. This case required accumulator injection only for mitigation of large LOCA events (3/3 for 4-loop, 2/2 for 3-loop, and 1/1 for 2-loop).
>
> Case 1. This case credited realistic accumulator success criteria (2/3 for 4-loop, 1/2 for 3-loop, and 0/1 for 2-loop) for large LOCA events and credited the use of accumulators in responding to medium and small LOCA events (3/3, 2/2, and 1/1 for 4-loop, 3-loop, and 2-loop, respectively) following failure of HPI.
>
> Case 2. This case credited more realistic improved accumulator success criteria (no accumulator required) for large LOCA events and credited the use of accumulators in responding to medium and small LOCA events (3/3, 2/2, and 1/1 for 4-loop, 3-loop, and 2-loop, respectively) following failure of HPI.

[6]NUREG/CR-4550, "Analysis of Core Damage Frequency: Internal Events Methodology," Vol. 1, Rev. 1, January 1990.

The results were summarized as follows:

Case	LOCA CDF(/yr) (Current)	LOCA CDF(/yr) (Proposed)	ΔCDF	ICCDP
4-loop Design Basis	6.93×10^{-7}	9.24×10^{-7}	2.31×10^{-7}	8.20×10^{-7}
4-loop Case 1	6.23×10^{-8}	7.77×10^{-8}	1.54×10^{-8}	5.53×10^{-8}
4-loop Case 2	4.57×10^{-8}	6.09×10^{-8}	1.52×10^{-8}	5.41×10^{-8}
3-loop Design Basis	4.62×10^{-7}	6.18×10^{-7}	1.56×10^{-7}	8.21×10^{-7}
3-loop Case 1	4.27×10^{-8}	5.31×10^{-8}	1.04×10^{-8}	5.48×10^{-8}
3-loop Case 2	3.05×10^{-8}	4.08×10^{-8}	1.03×10^{-8}	5.42×10^{-8}
2-loop Design Basis	2.31×10^{-7}	3.09×10^{-7}	7.80×10^{-8}	8.21×10^{-7}
2-loop Case 1	1.52×10^{-8}	2.04×10^{-8}	5.20×10^{-9}	5.42×10^{-8}
2-loop Case 2	1.52×10^{-8}	2.04×10^{-8}	5.20×10^{-9}	5.42×10^{-8}

For both realistic cases, the ΔCDFs and ICCDPs were very small for 2-loop, 3-loop, and 4-loop plants, and were much below the numerical guidelines in the RGs 1.174 and 1.177. The staff also noted that the values were considered still bounding in the sense that the risk analysis used a multitude of conservative assumptions and data in the modeling. For many Westinghouse plants, the realistic impact on risk would be much smaller than the values above.

A set of sensitivity cases were also calculated using higher IE frequencies for small and medium LOCAs. The results of the sensitivity calculations did not cause the overall risk impact to increase significantly.

Westinghouse indicated that accumulator success or failure has no direct impact on the containment performance, and that the LERF would therefore increase only in direct proportion to the increased CDF due to accumulator failures. Westinghouse concluded that, since the impact on CDF was small, the impact on LERF would also be small. The staff found the Westinghouse argument to be acceptable; therefore, the impact on LERF and ICLERP for a single CT was very small.

One of the potential benefits of the proposed extended CT was the averted risk associated with avoiding a forced plant shutdown and startup. The risk associated with a forced plant shutdown and ensuing startup due to the inflexibility in current TS could be significant in comparison with the risk increase due to the proposed accumulator CT increase.

Based on the staff's Tier 1 review, the quality of risk analysis used to calculate the risk impact of the proposed accumulator CT extension was reasonable and generally conservative. It was also found that the risk impact of the proposed change was below the staff guidelines in RGs 1.174 and 1.177.

Tier 2 and 3: Configuration Risk Control

Tier 2 of RG 1.177 addresses the need to preclude potentially high risk configurations that could result if certain equipment is taken out-of-service during implementation of the proposed TS change (in this case accumulator CT). If such configurations are identified, the licensee should also identify appropriate measures to avoid them.

The accumulators are always needed to mitigate large size LOCAs. Large LOCAs require accumulators to inject as analyzed under Tier 1 in order to avoid core damage. This means that if a large LOCA occurs without the accumulator function, the core will be damaged independently of whether other systems, such as HPI, function properly or not. However, the probability that a large LOCA occurs in the 24-hour CT is extremely small (in the order of 1E-7 or less). Furthermore, no compensatory or other measures are possible. Due to the negligible risk increase associated with this scenario and the fact that there are no measures to take once a large LOCA occurs, no "high risk" configurations are associated with this scenario.

In general, medium LOCAs do not require accumulators if at least one HPI train is available. This means that if a medium LOCA occurs when minimum accumulator functionality is unavailable and at the same time HPI is unavailable, the core will be damaged. However, the probability that a medium LOCA occurs in the 24-hour CT and at the same time both trains of HPI are unavailable is extremely small (in the order of 1E-8 or less), because it is assumed that the plant is not operating at power with both HPI trains out-of-service. This assumption is based on current Standard TSs (STSs) that limit operation at power with no HPI capability. Therefore, no Tier 2 restrictions beyond those currently in the STSs are deemed necessary.

Tier 3 calls for a program to identify "risk significant" configurations beyond those identified in Tier 2 resulting from maintenance or other operational activities and take appropriate compensatory measures to avoid such configurations. Because the accumulator sequence modeling is relatively independent of that for other systems, the Tier 2 analysis by itself is sufficient.

Furthermore, Title 10, *Code of Federal Regulations* (10 CFR) Section 50.65(a)(4) (Maintenance Rule) requires that licensees assess the risk any time maintenance is being considered on safety-related equipment. This requirement serves the objectives of Tier 3.

In summary, the Tier 2 evaluation did not identify the need for any additional constraints or compensatory actions that, if implemented, would avoid or reduce the probability of a risk-significant configuration. The current TS provisions were found to be sufficient to address the Tier 2 issue. Because the accumulator sequence modeling is relatively independent of that for other systems and the implementation of the Maintenance Rule, the staff concluded that application of Tier 3 to the proposed accumulator CT was not necessary.

The NRC staff finds that the proposed changes will allow safe operation with the changes in CT from 1 hour to 24 hours for Condition B of TS LCO 3.5.1, "Accumulators," and its associated Bases. The NRC staff also finds that the proposed changes are consistent with the incremental conditional core damage probabilities calculated in WCAP-15049 for the accumulator allowed outage time increase and meet the criterion of 5E-07 in RGs 1.174 and 1.177. The analysis and acceptance provided in this safety evaluation (SE), as demonstrated by WCAP-15049, covers all Westinghouse plants regardless of plant vintage and number of loops. TVA confirmed the

applicability of the analyses and the NRC staff's model SE in its application. The NRC staff reviewed plant-specific licensing basis for WBN Unit 1 and determined that the SE above applies to WBN Unit 1. The NRC staff, therefore, concludes that the proposed plant-specific TSTF-370, Revision 0 changes to WBN Unit 1 TSs 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 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 (74 FR 31326). 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.

Principle Contributor: Matthew E. Hamm

Date: September 9, 2009

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Sincerely,
/RA/
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