Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant (WBN) Unit 2 – Long-Term Stability Analysis Methodology**

Reference: 1. TVA Letter to NRC dated April 20, 2011, "Response to Request for Additional Information Regarding Final Safety Analysis Report Section 2.4 (TAC NO. ME3945)"

The purpose of this submittal is to provide information to satisfy the following commitment previously made in Reference 1. The previous commitment verbiage is as follows:

> "TVA will provide an update of the WBN Unit 2 FSAR to describe the long-term stability analysis methodology following the completion of the finite element analyses . . ."

Enclosure 1 provides a summary of the long-term stability analysis methodology. Enclosure 2 provides the list of regulatory commitments contained within this letter.

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HRR

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 6th day of September, 2012.

Respectfully,

R. A. Hruby, Jr.

Raymond A. Hruby, Jr.
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Watts Bar Unit 2

Enclosure:

1. Summary of the Long-Term Stability Analysis Methodology

2. New Regulatory Commitment

cc (Enclosures):

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Enclosure 1
Summary of the Long-Term Stability Analysis Methodology

Summary

In 2009, the Probable Maximum Flood (PMF) analysis for the Watts Bar Nuclear Plant (WBN) site was revised to address a number of issues, including non-conservative assumptions. The revised PMF analysis resulted in a higher PMF level for the WBN site. This prompted a re-evaluation of stability for dams upstream of WBN.

Both Cherokee and Douglas Dams were re-evaluated with higher PMF levels using the current nuclear design and licensing basis criteria and satisfactorily meet those criteria. However, a simplified, conservative re-evaluation to present day industry standard criteria resulted in a lower than allowable factor of safety for sliding and overturning for the concrete portions of Cherokee Dam which prompted a more refined finite element analysis. Present day industry standard criteria specify a cracked base analysis methodology that was not used in nuclear design and licensing basis calculation nor had not been used historically in the evaluations of TVA dams. The cracked base analysis is implemented if tension exists in the base of the dam. Then cracking in the foundation is assumed resulting in increased uplift pressure in the cracks forming at the base of the dam. Douglas Dam is included in the extent of condition because it is of similar design to Cherokee Dam.

Recently completed finite element analyses for both Cherokee and Douglas Dams utilizing current industry standards (Ref. 1) indicate the potential for failure of portions of the dams in extreme flood events. As a result, Cherokee and Douglas Dams will require modifications to ensure that the dams meet the current industry stability criteria. While the finite element analyses are informative, and TVA will be prudently taking action to upgrade the dam, these analyses do not invalidate the nuclear design basis analysis of record.

The analyses which determine the design basis flood or PMF elevations for WBN credit the stability of Cherokee and Douglas Dams for PMF headwater and tailwater loading conditions.

Section 2.4.3.4 of the Watts Bar Nuclear Plant UFSAR states:

> "For concrete dam sections, comparisons were made between the original design headwater and tailwater levels and those that would prevail in the PMF. If the overturning moments and horizontal forces were not increased by more than about 20%, the structures were considered safe against failure. All upstream dams passed this test except Douglas, Fort Loudoun, and Watts Bar. Original designs showed the spillway sections of these dams to be most vulnerable. These spillway sections were examined in further detail and judged to be stable."

The critical headwater elevation for Cherokee Dam and Douglas Dam at which the factor of safety for some blocks is not satisfactory is 1,085 ft and 1,015 ft. respectively. The probabilities of reaching these critical headwater elevations are small. During studies completed in 2004, a total of 140 hypothetical design storms were analyzed at Cherokee and Douglas Dams. None of these design storms, including some with estimated

recurrence intervals in excess of 10,000 years, produced headwater elevations greater than 1,075 ft. and 1,002.3 ft. respectively, well below the critical headwater elevations. Therefore, it can be judged that the probabilities of exceeding the critical headwater elevations are significantly smaller than $1x10^{-4}$.

TVA is committed to prudently pursuing a dam safety improvement project as described below. The modifications for Cherokee and Douglas Dams will be designed and implemented prior to WBN Unit 2 startup.

Extent of Condition Review

In 2010, TVA developed the Dam Safety Governance organization in an effort not related to the Cherokee/Douglas issue or the PMF analysis update. Through efforts of this organization, TVA has recently adopted the Federal Energy Regulatory Commission (FERC) and other State and Federal dam safety provisions as the basis for the design and evaluation of TVA dams as specified in TVA-SPP-27.1. TVA's River Operations' Non Power Assets program has initiated a multi-year dam safety improvement program which will systematically evaluate all the dams using criteria which incorporates current industry standards/practices. As these dams are found to require modifications, the findings will be prioritized and remediated as appropriate.

Conclusion

Cherokee and Douglas Dams have been evaluated to the licensing and design basis for updated PMF elevations which found the dams to be stable. In addition, the Cherokee and Douglas Dams were also evaluated using the analysis of record with more limiting assumptions of no cohesion, uplift pressure without drain efficiency, and tailwater reduction for the spillway sections; and the dams were found stable. However, an analysis, using current industry criteria, indicates stability concerns with Cherokee and Douglas Dams. Cherokee Dam and Douglas Dam finite element analyses have been completed (References 2 and 3) which refine the area of the dam which is susceptible to potential instability during PMF loading. These references are available for NRC review. TVA is committed to prudently pursuing a dam safety improvement project. The modifications for Cherokee and Douglas Dams will be designed and implemented prior to WBN Unit 2 startup.

References

1. "Stability Analysis of Concrete Structures," EM 1110-2-2100, U.S. Army Corps of Engineers, December 2005.

2. "Cherokee Dam - Stress and Stability Analysis of the Concrete Sections Using 3D Finite Element Analysis - 100% Submittal," Calculation RSOCRHROGCDX00032620110001 Revision 1, dated May 9, 2012.

3. "Douglas Dam - Stress and Stability Analysis of the Concrete Sections Using 3D Finite Element Analysis - 100% Submittal," Calculation RSODGHROGCDX00032620110001 Revision 1, dated August 30, 2012.

ENCLOSURE 2
New Regulatory Commitment

TVA is committed to prudently pursuing a dam safety improvement project. The modifications for Cherokee and Douglas Dams will be designed and implemented prior to WBN Unit 2 startup.