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April 20, 2011

10 CFR 50.4

U.S. Nuclear Regulatory Commission  
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Watts Bar Nuclear Plant, Unit 2  
Docket No. 50-391

**Subject: Response to Request for Additional Information Regarding Final Safety Analysis Report Section 2.4 (TAC NO. ME3945)**

Reference: Letter from NRC to TVA, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Final Safety Analysis Report Section 2.4 (TAC NO. ME3945)," dated March 30, 2011

The purpose of this letter is to provide the Tennessee Valley Authority's (TVA's) response to the Request for Additional Information (RAI) submitted in the referenced letter. Enclosure 1 to this letter provides TVA's responses to the NRC's questions.

Enclosure 2 provides the commitments as described in this submittal. If you have any questions, please contact Bill Crouch at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 20th day of April, 2011.

Respectfully,

A handwritten signature in black ink, appearing to read "Dave Stinson".

Dave Stinson  
Watts Bar Unit 2 Vice President

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Enclosures:

1. Response to Request for Additional Information Regarding Final Safety Analysis Report Section 2.4
2. List of Commitments

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U.S. Nuclear Regulatory Commission  
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## ENCLOSURE 1

### RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FINAL SAFETY ANALYSIS REPORT SECTION 2.4

#### TENNESSEE VALLEY AUTHORITY DOCKET NO. 50-391

*“By letter dated May 7, 2010, Tennessee Valley Authority (TVA) provided Amendment 98 to the Watts Bar Nuclear Plant (WBN), Unit 2, Final Safety Analysis Report (FSAR). In Amendment 98, TVA included information in Section 2.4, “Hydrologic Engineering.” In a letter dated January 24, 2011, TVA also provided anticipated changes to FSAR Section 2.4 in advance of FSAR Amendment 103, to facilitate the continuing review by the Nuclear Regulatory Commission (NRC) staff. In the discussion in FSAR Subsection 2.4.3 regarding probable maximum flood (PMF) on streams and rivers, the staff finds that TVA make no mention that the predicted PMF level is dependent on temporary modifications currently in place where sand baskets about 4 feet in height are deployed in the vicinity of four dams (Fort Loudoun, Tellico, Cherokee, and Watts Bar). Thus, the NRC staff requests the following additional information in order to continue its review:”*

1. **NRC Request:**

*“How does WBN Unit 2 licensing bases credit the use of the sand baskets with regards to protecting Unit 2?”*

**TVA Response:**

The WBN Unit 2 probable maximum flood (PMF) analysis and the seismic dam failure analysis credit an increased height of embankment at four dams (Fort Loudoun, Tellico, Cherokee and Watts Bar). The increased height prevents overtopping and failure of these embankments in a PMF. The increased height of the embankments used in the analysis at each of these structures is currently being fulfilled through the use of sand baskets.

In the seismic dam failure flood analysis, the sand baskets at one location are credited to remain stable following the seismic event for one combination seismic dam failure and flood. In that combination, failure of Norris, Tellico, Cherokee and Douglas dams under a safe shutdown earthquake combined with a 25-year flood load case, the Fort Loudoun Dam sand baskets are assumed to remain stable until overtopping of the sand baskets occurs. At the time of the seismic event, the reservoir headwaters have not reached the bottom elevation of the sand baskets; therefore, a hydrodynamic loading condition does not apply. The sand basket elevation is reached later at the Fort Loudoun Dam after the failure of the upstream dams (i.e., Norris, Tellico, Cherokee and Douglas) in the safe shutdown earthquake.

Stability analysis of the Fort Loudoun embankment sand baskets for the seismic load case, which is based on the simultaneous application of seismic base accelerations at the top of the embankment as shown in WBN Unit 2 FSAR Figure 2.4-72, showed that the sand baskets are stable and meet or exceed the acceptable stability factors of safety. To confirm this stability determination, TVA will perform either a hydrology analysis without crediting the use of the sand baskets at Fort Loudoun dam for the seismic dam failure and flood combination described above or TVA will perform a seismic test of the sand baskets. TVA will report the results of this analysis or test to the NRC by October 31, 2011.

## ENCLOSURE 1

### RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FINAL SAFETY ANALYSIS REPORT SECTION 2.4

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#### 2. NRC Request:

*“During the meeting between TVA and the NRC on July 2, 2010, to discuss hydrology concerns expressed by the staff related to the operating TVA units, TVA indicated that the Cherokee and Douglas dams require rigorous evaluation in the form of finite element analysis to confirm their structural adequacy and functionality for long term operation. The NRC staff agreed with TVA’s action as a confirmation of its earlier operability determination for PMF related to the operating units. TVA indicated that the estimated completion of such analysis will likely extend beyond the project start of operation of WBN Unit 2. Discuss how the short-term operability and the long-term functionality of these dams are reflected in the licensing basis for WBN Unit 2.”*

#### TVA Response:

The WBN Unit 2 licensing basis PMF hydrologic analysis, as described in Section 2.4 of the WBN Unit 2 FSAR, considers Cherokee and Douglas dams fully stable for the PMF loading conditions. To address short-term functionality of Cherokee and Douglas dams for new PMF loads, stability evaluations of both dams were performed by ARCADIS. Based on these evaluations, ARCADIS recommended continued operation of Cherokee and Douglas dams until a more rigorous finite element analysis (FEA) is performed. TVA subsequently provided the ARCADIS evaluation of Cherokee Dam to the TVA Hydro Board of Consultants (HBOC) for review. In December 2009, the HBOC concluded that “The sliding factors of safety and resistance against overturning are considered adequate for the continued operation of the dam under the normal pool and new PMF loading conditions while the finite element analysis is being planned and carried out.” Since the Douglas Dam is similar to Cherokee Dam, TVA concluded that the HBOC assessment of Cherokee Dam was applicable to Douglas Dam. The FEA, which is addressed in the TVA corrective action program, will be completed before the projected start of operation of WBN Unit 2. TVA will provide an update of the WBN Unit 2 FSAR to describe the long-term stability analysis methodology following the completion of the FEA by August 31, 2012.

#### 3. NRC Request:

*“Discuss the basis for concluding the structural adequacy of the sand baskets under either scenarios of temporary or long-term deployment. Specifically, address the ability of the sand baskets to withstand debris, erosion and impact loading caused by tornado, hurricane, or large moving objects such as trucks.”*

## ENCLOSURE 1

### RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FINAL SAFETY ANALYSIS REPORT SECTION 2.4

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#### TVA Response:

Stability calculations were performed by TVA for the sand baskets under PMF conditions using vendor test data for sliding resistance. The PMF stability analysis demonstrated an acceptable factor of safety in sliding for each installation. Based on sand basket vendor estimation of a design life of between 5 and 7 years, the sand baskets can perform their intended function until decisions are made relative to the long-term solution for preventing embankment overflow.

Vendor (HESCO Concertainers) information regarding the ability of the sand baskets to withstand debris and impact loading was provided in TVA's letter to the NRC dated January 14, 2011, "Response to Hydrology Action Items."

Since water does not overtop the sand baskets under PMF conditions, a large sand basket base erosion mechanism does not exist. Testing performed by the sand basket vendor and reviews of the performance of similar sand baskets in the 2009 Fargo, North Dakota, flood did not identify sliding or stability concerns resulting from seepage through the baskets. As described in the response to Question 1, the sand baskets are considered to fail when overtopped during the Norris, Cherokee, Douglas and Tellico seismic-flood failure combination.

Impact loading caused by tornado, hurricane or large moving objects, such as trucks, is not evaluated in the sand basket structural adequacy calculations. However, should tornado, hurricane or large moving object (such as a land-based truck) impact cause damage to sand baskets, inspections by TVA personnel within 24 hours after these events would detect the damage, and the appropriate repairs would be implemented. Sand basket impact from larger moving objects (such as trucks) in flood conditions is not considered since the driving water flow through the reservoirs would carry such objects to the discharge points of the reservoirs.

Any general degradation of the sand baskets would be detected during the routine periodic inspection by the TVA personnel and would be repaired to vendor specifications.

#### 4. NRC Request

*"Clarify whether the sand baskets will be replaced or modified as permanent structures as some point in the future after WBN Unit 2 receives its operating license. When does TVA expect to perform such replacement or modification? If the sand baskets will be made permanent, provide documentation of long-term usage either from the manufacturer, equivalent projects, or other appropriate supporting documentation. The documentation should include references to maintenance and operation plans of the systems, or replacement plans to achieve a long term solution."*



## ENCLOSURE 1

### RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING FINAL SAFETY ANALYSIS REPORT SECTION 2.4

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##### TVA Response:

As stated in TVA's letter to the NRC dated January 14, 2011, "Response to Hydrology Action Items," permanent modifications are in the conceptual design phase; therefore, the transition from temporary modifications to permanent modification has not yet been formally planned. Permanent modification options to address each of the sand basket installations are currently underway as part of the TVA NEPA review process. TVA expects a formal decision on the preferred alternative by September 2012. Implementation of the preferred alternative is expected to be completed by October 2015 before the end of the vendor projected 5-7 years sand basket design life. Transition plans will be written and the impacts to the operating plants' design bases will be considered to ensure the design bases are maintained as part of the modification process.

TVA has performed a stability calculation for the sand basket installations to support their short-term usage. The calculation, including vendor data, is available for review at the TVA offices. Documentation of the long-term modifications to raise the height of the embankments will be available following the implementation of the preferred alternative.

TVA will continue to inspect and maintain the baskets as required until the implementation of the permanent solution at all four dams.

##### 5. NRC Request

*"Identify all incidents of current operability determinations TVA made related to WBN Unit 1, that are relevant to Unit 2, where the licensing bases for Unit 1 regarding hydrology and probable maximum flood level were not fully met. Discuss how TVA intends to address in the licensing basis for Unit 2, each incident where TVA relied on an operability determination for continued operation at Unit 1 until full compliance with the licensing basis is reached."*

##### TVA Response:

During the re-verification of the design basis flood levels for WBN Unit 2, inconsistencies and erroneous input assumptions were identified in the existing design basis hydrologic analysis for WBN Unit 1. As these issues were identified, corrective action documents were written and evaluations performed to assess the estimated impact of the issues on the WBN Unit 1 design bases. After each issue or group of issues had been reviewed for impact to WBN Unit 1 operability and design bases, the corrective action documents were closed to a single corrective action document, WBN Problem Evaluation Report (PER) 154477, tracking resolution of the final design basis flood hydrologic analyses and update of the WBN Unit 1 FSAR licensing basis.

## ENCLOSURE 1

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The re-verification of design basis flood levels for WBN Units 1 and 2 is complete. As a result of the issues associated with the WBN Unit 1 design basis flood hydrologic analysis, the maximum PMF elevation at the WBN site increased from elevation 734.9 ft to 738.8 ft. Evaluations performed for the impact of the revised PMF elevation of 738.8 ft identified no operability concerns for Unit 1. However, an update of the WBN Unit 1 FSAR for the revised hydrologic analysis and the increased design basis flood elevation is required and is scheduled as described in TVA's Corrective Action Program.

In previously submitted FSAR Sections 2.4.3 and 2.4.4, TVA provided the WBN Unit 2 design basis flood licensing bases. The hydrological analysis performed in support of the WBN Unit 2 design basis flood evaluation has resolved the deficiencies identified in the re-verification process. In Amendment 104 of the WBN Unit 2 FSAR, TVA will provide an update describing the increased height credited at Fort Loudoun, Cherokee, WBN and Tellico dams as the current licensing basis for WBN Unit 2.

## **ENCLOSURE 2**

### **LIST OF COMMITMENTS**

1. TVA will report the results of the hydrology analysis without use of sand baskets or the seismic test of the sand baskets to the NRC by October 31, 2011.
2. 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 by August 31, 2012.
3. TVA will continue to inspect and maintain the baskets as required until the implementation of the permanent solution at all four dams.
4. In Amendment 104 of the WBN Unit 2 FSAR, TVA will provide an update describing the increased height at Fort Loudoun, Cherokee, WBN and Tellico dams as the current licensing basis for WBN Unit 2.