



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS  
WASHINGTON, DC 20555 - 0001**

February 12, 2015

The Honorable Stephen G. Burns  
Chairman  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

**SUBJECT: FINAL ACRS REVIEW OF WATTS BAR NUCLEAR PLANT UNIT 2  
OPERATING LICENSE APPLICATION**

Dear Chairman Burns:

During the 621<sup>st</sup> meeting of the Advisory Committee on Reactor Safeguards, February 5-7, 2015, we met with representatives of the NRC staff and the applicant, Tennessee Valley Authority (TVA), to review the current status of the construction completion, inspection, and licensing activities related to the Watts Bar Nuclear Plant, Unit 2 (WBN 2) Operating License (OL) application.

WBN 2 is the second unit of a dual-unit plant consisting of two Westinghouse-designed four-loop pressurized water reactors within ice-condenser containments. TVA received a Construction Permit (CP) for both units in 1973 and suspended construction in 1985. Construction for WBN 1 was resumed in 1989, and WBN 1 received its full-power OL in early 1996.

Construction for WBN 2 remained suspended until 2007 when TVA informed the NRC of its plan to complete the unit under the existing CP. In Staff Requirements Memorandum SRM-SECY-07-0096, dated July 25, 2007, the Commission directed the NRC staff to employ the current licensing basis for WBN 1 for the license review of WBN 2.

Our Plant Operations and Fire Protection Subcommittee held its first meeting concerning completion of WBN 2 on March 31, 2009, and has held nine subsequent meetings. We issued an interim letter dated November 26, 2013, to reflect our review to that date. A final subcommittee meeting was held on January 13, 2015. During these meetings, we had the benefit of discussions with the NRC staff and TVA, as well as comments from several members of the public. We also had the benefit of the documents referenced.

## **CONCLUSIONS AND RECOMMENDATIONS**

1. There is reasonable assurance that WBN 2 can operate as the second unit of the dual-unit Watts Bar Nuclear Plant without undue risk to the health and safety of the public. The OL for WBN 2 should be approved following completion of remaining staff inspections and closure of remaining open items.
2. The integration of WBN 2 as the second unit in a dual-unit plant which has operated as a single unit for almost 20 years requires specific, detailed planning to ensure against creating challenges to WBN 1 operation. Our review indicates that this planning has been done and necessary preparations for WBN 2 operation have been made.
3. Adequate recirculation core cooling will be assured following a Loss of Coolant Accident, taking debris effects into account, provided high levels of containment cleanliness are maintained.
4. We strongly endorse the development of a methodology for Probabilistic Flooding Hazard Analysis. This is important for future use consistent with risk-informed, performance-based approaches to natural hazard assessment.

## **BACKGROUND**

In our interim letter dated November 26, 2013, we stated that our review to that date had not identified any issue which we did not expect to be resolved satisfactorily prior to OL issuance, and we identified eight specific items for our further review. This included seven items listed in the staff's Supplemental Safety Evaluation Report 26.

Our interim letter also noted that we had focused on the potential for the period of deferral of WBN 2 construction to affect the integration of WBN 2 operation into the dual-unit design. This included both the validation of compliance of structures, systems and components (SSCs) with the current licensing basis, which is to apply for both units, and validation that the process of startup and initial operation of WBN 2 will not adversely affect continued operation of WBN 1. We conclude that this has been satisfactorily achieved.

In SECY-14-0102 dated September 29, 2014, the staff provides a comprehensive summary of the unique construction and licensing history for WBN 2. This summary includes ongoing licensing actions applicable to the current licensing basis for WBN 1, and therefore also to WBN 2 pursuant to SRM-SECY-07-0096.

In a few instances, we have reviewed issues which are being addressed for WBN 2 in advance of their resolution as part of the WBN 1 licensing basis. This is also pursuant to SRM-SECY-07-0096. An example is TVA's response, dated May 17, 2012, to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors." Resolution prior to initial operation will avoid unnecessary radiation exposure.

## **DISCUSSION**

The results of our review of the items identified in our interim letter are summarized as follows:

### Generic Safety Issue (GSI)-191 and GL 2004-02

In a letter dated September 16, 2013, TVA affirmed that a confirmatory inspection for loose debris will be performed on WBN 2 after construction has been completed and the containment has been cleaned. In a letter to TVA dated September 18, 2014, NRC staff describes its closeout of GL 2004-02 for WBN 2 based on the “clean plant” guidelines and methodology developed by the Nuclear Energy Institute.

In support of this closeout, TVA performed a detailed evaluation for both WBN units which included conservative estimates of debris transport within the containment building, of the head loss across the sump strainer, and of vortex formation above the strainer. This evaluation was supported by appropriate testing, which was witnessed by NRC staff.

Because WBN 2 uses containment sump strainers consisting of stacked discs, we reviewed the potential for miscellaneous debris, such as tapes and labels, to block entry into the spaces between the discs and thereby to result in a loss of flow area much greater than for an equivalent mass of fibrous debris. We reviewed in detail the testing performed, the assumptions used, in-vessel debris effects, and the margin remaining in the available pump suction head. We conclude that adequate margin will remain available for recirculation flow, provided that rigorous standards of containment cleanliness, with latent debris loads of less than 100 pounds, are maintained.

### Compliance with General Design Criterion (GDC) 5

GDC 5 requires that SSCs important to safety shall not be shared, unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining unit.

TVA documented in the Updated Final Safety Analysis Report (UFSAR) a calculation which shows that the cooling water systems have the capability to bring the non-accident unit to cold shutdown within 72 hours from its entry into the hot standby mode. This assumes that the component cooling system carries all required heat loads for both the accident unit and, later in the event, the non-accident unit.

### Cyber Security Confirmatory Testing

Testing was conducted by TVA to verify that the External Communications Interface for the WBN 2 Eagle 21 Process Protection System only allows data flow in one direction (i.e., data out to the non-safety-related Plant Computer System and no data into the Eagle 21 system). We reviewed this testing and its results, and the physical design provisions which ensure it will be maintained. We conclude that these are acceptable.

### Calculation of Core Fuel Temperature

The NRC staff noted that the methodology used initially for WBN 2 to determine peak clad temperature, and other variables such as stored energy, following a Large Break Loss of Coolant Accident potentially provided non-conservative results due to lack of a thermal conductivity degradation (TCD) model. TVA performed and the staff approved further analyses which included the effects of TCD. The results have shown adequate peak clad temperature margin to the 10 CFR 50.46(b)(1) limits for the initial WBN 2 core loading. A license condition will be imposed requiring the use of methodologies which include an approved TCD model for subsequent fuel cycles. These methodologies are under staff review.

### Site Licensing Basis Hydrology

By letter dated July 19, 2012, TVA submitted a License Amendment Request (LAR) seeking approval to revise the WBN 1 UFSAR to adopt a revised hydrologic analysis for the site. This LAR was later supplemented by 10 letters submitted between March 1, 2013, and December 5, 2014. These letters provided additional information, but did not change the flood elevation or warning time. The revised hydrologic analysis for the site results in changes to the flooding protection requirements for certain WBN 1 SSCs. As the LAR revises the WBN 1 licensing basis, it is applicable to WBN 2 as well. Accordingly, we included the LAR revisions in our review. The LAR was approved and the UFSAR updated by an NRC letter dated January 28, 2015.

The site licensing basis provides for conditions in which the flood level may exceed plant grade. This is termed "Flood Mode Operation", and SSCs required to maintain plant safe shutdown under this condition are protected or designed for submergence. To prevent floods from exceeding the design basis flood level, temporary measures taken for WBN 1 will be replaced by permanent modifications prior to WBN 2 fuel loading. We have no further questions or concerns following our review.

### Fire Protection Procedures Related to Operator Manual Actions

The Watts Bar Fire Protection Program is developed for Unit 1 and Unit 2 in accordance with the requirements in 10 CFR 50, Appendix R, and the guidance in Regulatory Guide 1.189, Revision 2, "Fire Protection for Nuclear Power Plants." The Watts Bar Fire Protection Report documents the Fire Protection Plan for Unit 1 and Unit 2, the supporting fire hazards analysis, and the strategies to ensure safe shutdown. These are applicable for a fire in any plant location. The Fire Protection Plan identifies numerous operator manual actions that are needed to mitigate the consequences from fire damage and to implement the safe shutdown strategies.

We examined several challenging WBN 2 fire scenarios that require coordinated responses of several Auxiliary Unit Operators to perform local actions in Unit 1 and Unit 2. We questioned whether the feasibility and reliability of these actions were evaluated according to the methods outlined in NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire." TVA explained that the fire response procedures contain detailed guidance for every local action that is required for a fire in each plant location.

TVA also described the design of the Watts Bar fire detection systems, which provide clear indication of the fire location. They explained that a time line was developed for each fire scenario that accounts for fire detection, diagnosis of plant conditions, assembly of personnel in the Main Control Room, supervisory coordination and direction, dispatch of local operators, transit times, access requirements, action implementation times, and communication. Challenging scenarios were evaluated by walkthroughs and timing assessments. The total time required to perform the needed actions was compared with the amount of time that is available, as determined by the identified safe shutdown strategy. A 100% time margin was used to account for uncertainties in the assessments. For example, if it is necessary to complete the actions within 60 minutes, the strategy was determined to be feasible and reliable if the operators demonstrated successful completion in 30 minutes, or less. The staff audited these timing assessments and observed a sample of the walkthroughs. These activities provide reasonable assurance that the identified operator manual actions have been adequately assessed for their feasibility.

#### Operational Readiness Preparations

Both TVA and NRC staff are following detailed plans for closeout of remaining inspections and open items prior to each stage of operational readiness, with active management oversight of these activities. The required resources appear to be available and capable of meeting currently scheduled milestones, and emergent inspection findings are being addressed appropriately.

#### Development of Probabilistic Flood Hazard Assessment Capability

During our review, we noted that the Probable Maximum Flood is a deterministically established value for each plant site. This is increasingly inconsistent with the agency use of risk-informed, performance-based approaches to natural hazard assessment. In response to our questions in this regard, the staff informed us of their consideration of a multi-year Probabilistic Flooding Hazard Analysis (PFHA) Research Plan. We strongly endorse development of a PFHA methodology and would welcome further discussion with the staff.

## SUMMARY

There is reasonable assurance that WBN 2 can operate as the second unit of the dual-unit Watts Bar Nuclear Plant without undue risk to the health and safety of the public. The OL for WBN 2 should be approved following completion of remaining staff inspections and closure of remaining open items.

Sincerely,

*/RA/*

John W. Stetkar  
Chairman

## REFERENCES

1. Tennessee Valley Authority, Watts Bar Nuclear Plant Unit 2 Final Safety Analysis Report (FSAR), Amendments No. 92 through 112.

Below is the list of FSAR Amendments that was submitted as part of the Unit 2 review.

Amendment 92, dated December 18, 2008 (ML090980525)  
Amendment 93, dated April 30, 2009 (ML091400068)  
Amendment 94, dated August 27, 2009 (ML092460758)  
Amendment 95, dated November 24, 2009 (ML093370274)  
Amendment 96, dated December 14, 2009 (ML093570464)  
Amendment 97, dated January 11, 2010 (ML100191426)  
Amendment 98, dated May 7, 2010 (ML101340795)  
Amendment 99, dated May 27, 2010 (ML101610291)  
Amendment 100, dated September 1, 2010 (ML102530216)  
Amendment 101, dated October 29, 2010 (ML103160411)  
Amendment 102, dated December 17, 2010 (ML112210425)  
Amendment 103, dated March 15, 2011 (ML110840665)  
Amendment 104, dated June 3, 2011 (ML111780527)  
Amendment 105, dated August 12, 2011 (ML121700642)  
Amendment 106, dated September 15, 2011 (ML121700412)  
Amendment 107, dated November 17, 2011 (ML121780190)  
Amendment 108, dated March 5, 2012 (ML120830237)  
Amendment 109, dated August 23, 2012 (ML122440027)  
Amendment 110, dated August 14, 2013 (ML13255A164)  
Amendment 111, dated February 13, 2014 (ML14051A680)  
Amendment 112, dated May 30, 2014 (ML14160A901)

2. U.S. Nuclear Regulatory Commission, NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplements (SSER) 21 - 27.

Below is the list of SSERs issued as part of the Unit 2 review.

SSER 21, dated February 28, 2009 (ML090570741)  
SSER 22, dated January 31, 2011 (ML110390197)  
SSER 23, dated June 30, 2011 (ML11206A499)  
SSER 24, dated September 30, 2011 (ML11277A148)  
SSER 25, dated November 30, 2011 (ML12011A024)  
SSER 26, dated June 30, 2013 (ML13205A136)  
SSER 27, dated January, 31, 2015 (ML15033A041)

3. Staff Requirements Memorandum, SECY-07-0096, "Possible Reactivation of Construction and Licensing Activities for the Watts Bar Nuclear Plant Unit 2," dated July 25, 2007 (ML072060688)
4. Tennessee Valley Authority, "Watts Bar Nuclear Plant (WBN) Unit 2 – Transmittal of Revised Unit 1/Unit 2 As-Designed Fire Protection Report," dated March 13, 2013 (ML13081A002, ML13081A003, ML13081A004)
5. Regulatory Guide 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," dated October, 2009 (ML092580550)
6. NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire," dated October, 2007 (ML073020676)
7. NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors", dated September 13, 2004 (ML042360586)
8. Information Notice 2011-21, "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting from Nuclear Fuel Thermal Conductivity Degradation," dated December 13, 2011 (ML113430785)
9. Staff Requirements Memorandum, SECY-14-0102, "Construction and Licensing for Watts Bar Nuclear Plant, Unit 2, dated September 29, 2014 (ML14238A672)

2. U.S. Nuclear Regulatory Commission, NUREG-0847, "Safety Evaluation Report Related to the Operation of Watts Bar Nuclear Plant, Unit 2," Supplements (SSER) 21 - 27.

Below is the list of SSERs issued as part of the Unit 2 review.

SSER 21, dated February 28, 2009 (ML090570741)  
SSER 22, dated January 31, 2011 (ML110390197)  
SSER 23, dated June 30, 2011 (ML11206A499)  
SSER 24, dated September 30, 2011 (ML11277A148)  
SSER 25, dated November 30, 2011 (ML12011A024)  
SSER 26, dated June 30, 2013 (ML13205A136)  
SSER 27, dated January, 31, 2015 (ML15033A041)

3. Staff Requirements Memorandum, SECY-07-0096, "Possible Reactivation of Construction and Licensing Activities for the Watts Bar Nuclear Plant Unit 2," dated July 25, 2007 (ML072060688)
4. Tennessee Valley Authority, "Watts Bar Nuclear Plant (WBN) Unit 2 – Transmittal of Revised Unit 1/Unit 2 As-Designed Fire Protection Report," dated March 13, 2013 (ML13081A002, ML13081A003, ML13081A004)
5. Regulatory Guide 1.189, Revision 2, "Fire Protection for Nuclear Power Plants," dated October, 2009 (ML092580550)
6. NUREG-1852, "Demonstrating the Feasibility and Reliability of Operator Manual Actions in Response to Fire," dated October, 2007 (ML073020676)
7. NRC Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors", dated September 13, 2004 (ML042360586)
8. Information Notice 2011-21, "Realistic Emergency Core Cooling System Evaluation Model Effects Resulting from Nuclear Fuel Thermal Conductivity Degradation," dated December 13, 2011 (ML113430785)
9. Staff Requirements Memorandum, SECY-14-0102, "Construction and Licensing for Watts Bar Nuclear Plant, Unit 2, dated September 29, 2014 (ML14238A672)

Accession No: **ML15039A005**

Publicly Available **Y**

Sensitive **N**

Viewing Rights:  NRC Users or  ACRS Only or  See Restricted distribution

OFFICE	ACRS	SUNSI Review	ACRS	ACRS	ACRS
NAME	GShukla	GShukla	MSnodderly for MLB	EMHackett	EMH for JWS
DATE	02/12/15	02/12/15	02/12/15	02/12/15	02/12/15

OFFICIAL RECORD COPY