



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

MAR 22 2005

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

Gentlemen:

In the Matter of ) Docket No.50-390  
Tennessee Valley Authority )

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - TRITIUM PRODUCTION  
PROGRAM - UNIT 1 CYCLE 6 OPERATING EXPERIENCE

Reference: TVA Letter to NRC dated April 27, 2004, "Watts Bar  
Nuclear Plant (WBN) Unit 1 - Tritium Production Program -  
Program Enhancements

The purpose of this letter is to provide information related to operating experience gained in the recently completed Cycle 6 of WBN operation. TVA irradiated 240 Tritium-Producing Burnable Absorber Rods (TPBARs) for the U.S. Department of Energy (DOE), as authorized by License Amendment No. 48 issued on October 8, 2003. Amendment 40 issued on September 23, 2002 authorized the irradiation of up to 2,304 TPBARs in the reactor core each cycle. This followed the irradiation of four Lead Test Assemblies (LTAs), containing a total of 32 TPBARs, in WBN Cycle 2. The approval to irradiate TPBARs was based on NRC review of material submitted by TVA and DOE.

On April 27, 2004, in the referenced letter, TVA informed NRC that certain program enhancements had been made in the form of a refinement to the analytical model used to estimate the amount of tritium that would be released from TPBARs into the Reactor Coolant System (RCS) during Cycle 7 of WBN. These

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enhancements predicted the amounts would not exceed 1000 Ci/1000 TPBARs/year (i.e., an average of 1.0 Ci/TPBAR/year), which was TVA's functional requirement for tritium release to the RCS from production TPBARs. This functional requirement was developed based on analytical models and limited prior irradiation testing. However, experience gained during Cycle 6 indicates that this functional requirement has not been met and that additional measures are needed to meet this requirement. Because the 240 TPBARs to be irradiated in Cycle 7 are of similar design to those of Cycle 6, the tritium released from the Cycle 7 TPBARs into the RCS is also predicted to exceed TVA's functional requirement. This matter is being addressed by the WBN Corrective Action Program as discussed further in this letter.

Amendment 40 to the WBN Operating License authorized TVA to place up to 2,304 TPBARs in the WBN core. The assumed tritium release from the TPBARs was 1.0 Ci/TPBAR/year, or a total of 2,304 annual curies from TPBARs. Analyses performed by TVA to support the Amendment 40 application concluded that operation of WBN with the additional 2,304 TPBAR-related curies and the resultant liquid and gaseous effluent releases would not endanger the health and safety of the public, the employees, or the environment and continued to remain well below the NRC's acceptance criteria.

On the basis of the experience gained with Cycle 6 TPBAR irradiation, TVA has revised the functional requirement related to allowable release from individual TPBARs for Cycle 7. As an interim tritium permeation functional requirement for Cycle 7, TVA will apply the Amendment 40 evaluated release of 2,304 TPBAR related tritium curies per year to the 240 TPBAR Core, that is, approximately 9.6 curies per TPBAR per year. For Cycle 7 and future cycles, TVA will limit the number of TPBARs to be irradiated in any cycle such that the total tritium releases into the RCS will remain below

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the value established with Amendment 40. For Cycle 7, TVA will again irradiate 240 TPBARs. The 240 TPBARs planned for irradiation in Cycle 7 are expected to perform in a manner similar to the 240 TPBARs irradiated in Cycle 6.

TVA has determined the Cycle 7 annual tritium permeation projections do not present any radiological concerns either to station personnel or to members of the public.

DOE has initiated actions to determine the cause of the greater than predicted tritium releases from the Cycle 6 TPBARs.

Provided in the enclosure of this letter are details related to the above noted actions. As this information is provided for NRC information only, no NRC action is being requested at this time.

There are no regulatory commitments associated with this submittal. If you have any questions, please contact me at (423) 365-1824.

Sincerely,



P. L. Pace  
Manager, Site Licensing  
and Industry Affairs

cc: see page 4

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Cc: NRC Resident Inspector  
Watts Bar Nuclear Plant  
1260 Nuclear Plant Road  
Spring City, Tennessee 37381

Mr. D. V. Pickett, Project Manager  
U.S. Nuclear Regulatory Commission  
MS O8G9  
One White Flint North  
11555 Rockville Pike  
Rockville, Maryland 20852-2738

U.S. Nuclear Regulatory Commission  
Region II  
Sam Nunn Atlanta Federal Center  
61 Forsyth St., SW, Suite 23T85  
Atlanta, Georgia 30303

ENCLOSURE  
WATTS BAR NUCLEAR PLANT  
TRITIUM PRODUCTION PROGRAM  
UNIT 1 CYCLE 6 OPERATING EXPERIENCE

Introduction

In WBN Cycle 6, TVA irradiated 240 Tritium-Producing Burnable Absorber Rods (TPBARs) for the U.S. Department of Energy (DOE), as authorized by License Amendment No. 48 issued on October 8, 2003. The irradiation of production quantities of TPBARs was authorized by the NRC with the issuance of Amendment 40 on September 23, 2003. Amendment 40 authorized the irradiation of up to 2,304 TPBARs in the reactor core each cycle. This followed the irradiation of four Lead Test Assemblies (LTAs), containing a total of 32 TPBARs in WBN Cycle 2. The approval to irradiate TPBARs was based on NRC's review of material submitted by TVA and DOE.

The TPBARs irradiated in Cycle 6 were designed to meet the TVA functional requirement on tritium release of an average of 1.0 Ci/TPBAR/year into the Reactor Coolant System (RCS) for production TPBARs. Tritium in the WBN RCS was routinely monitored by TVA and the data provided to Pacific Northwest National Laboratory (PNNL) for evaluation. In December 2004, it was determined that the tritium levels appeared to have exceeded the functional requirement. This was documented in a WBN Problem Evaluation Report (PER) and corrective actions are being taken as discussed below.

Until corrective actions are complete, TVA has informed DOE that no more than 240 TPBARs will be irradiated in any cycle.

An analytical model developed by PNNL serves as the basis for predicting tritium release from the TPBARs to the WBN RCS. Information related to this model was provided to the NRC in the TVA to NRC letter of April 27, 2004. The greater than predicted permeation from the Cycle 6 TPBARs seems to indicate an alternative mechanism for tritium release from the TPBARs, different from permeation due to the calculated tritium partial pressure inside the TPBARs during operation addressed in the model. Because there is no significant difference between the TPBARs to be irradiated in Cycle 7 and those of Cycle 6, releases of tritium into the RCS from Cycle 7 TPBARs are predicted to be similar to Cycle 6.

## Tritium Concentration in RCS

In accordance with NRC license requirements, the tritium concentration in the RCS and TPBAR performance were closely monitored by TVA and PNNL personnel. Data taken by TVA and trended by PNNL indicated late in Cycle 6 that the functional requirement (average of 1.0 Ci/TPBAR/year) had been exceeded. This was identified by TVA as a condition adverse to quality and a Problem Evaluation Report was issued and a corrective action plan prepared.

Following TVA's confirmation of the higher tritium levels, a number of actions were initiated to determine if the increase was due to greater than predicted permeation or some other factor. At the request of TVA, PNNL performed a failure modes and effects analyses (FMEA) on the TPBARs, considering plausible failure modes to examine whether the failure of any component in the TPBAR could have resulted in tritium levels similar to what was observed.

That evaluation concluded that the most probable cause for increased tritium in the RCS was a greater than predicted amount of tritium permeating through the cladding due to an alternative mechanism not considered previously.

Also evaluated, but ruled as low probability events were a fabrication-induced problem or an error in the past predictive model. Because the Cycle 7 TPBARs are essentially the same as those irradiated in Cycle 6, it is projected that the total amount of tritium released from the 240 TPBARs in Cycle 7 will reach approximately 650-750 Ci based on the planned length of Cycle 7.

A review performed by TVA's Radiological Protection staff of the projected Cycle 7 annual tritium permeation projection (650-750 Ci) confirmed that the Cycle 7 TPBARs do not present any radiological concerns either to station personnel or to members of the public. Station and public doses were assessed at a 2,304 Ci/year TPBAR tritium permeation release level. At that level the increase in the reactor coolant activity from the tritium and the consequential environmental releases were determined to have a minimal effect on the onsite and offsite doses, which remain well below the NRC's acceptance criteria.

## License Amendments 40 and 48

License amendment number 40 issued on September 23, 2002, authorized WBN to irradiate up to a maximum of 2,304 TPBARs in WBN. TVA's application for that amendment provided radiological analyses based on 2,304 Ci/year release into the RCS attributable to TPBARs, based on the TVA functional requirement for 1.0 Ci/TPBAR/year for 2,304 TPBARs. The staff's SER recognized the 2,304 Ci/year, plus non-TPBAR sources, as the limiting value.

TVA subsequently requested a reduction in the maximum number of TPBARs to 240 which was approved as amendment 48 issued on October 8, 2003 for Cycle 6. This reduction was requested to address operating RCS boron concentration analysis. This reduction did not affect the existing UFSAR bounding analysis for personnel and offsite dose exposure calculation and discharge limits that had been established for 2,304 TPBARs.

#### Application Of Cycle 6 Operating Experience

For Cycle 7, TVA has limited the number of TPBARs to be irradiated to 240 and has modified its program to sample and analyze RCS tritium on a daily basis. As a result of operating experience gained during Cycle 6, TVA now uses a revised performance metric to monitor TPBAR release to the RCS.

TVA will visually examine the Cycle 6 TPBARs to see if there are any visual indications of problems. TVA has also requested that DOE perform post-irradiation-examination (PIE) on a sample of Cycle 6 TPBARs to compare with the LTA PIE results. TVA will participate in the review of data acquired and will approve any proposed design changes.

#### Permeation Functional Requirement

As an interim tritium permeation functional requirement for Cycle 7, TVA will apply the Amendment 40 evaluated release of 2,304 TPBAR related tritium curies per year to the 240 TPBAR Core, that is, ~9.6 curies per TPBAR per year. For Cycle 7 and future cycles, TVA will limit the number of TPBARs to be irradiated in any cycle such that the total tritium releases into the RCS will remain below the value established with Amendment 40. For Cycle 7, TVA will again irradiate 240 TPBARs. The 240 TPBARs planned for irradiation in Cycle 7 are expected to perform in a manner similar to the 240 TPBARs irradiated in Cycle 6.

#### Performance Metric

The TPBAR performance metric of RCS tritium concentration ( $\mu\text{Ci/gm}$ ) included in Amendment 40 and in the staff's SER will be replaced by a metric that compensates for RCS water makeup and letdown. This revised metric successfully identified the tritium permeation to the RCS to be in excess of the Cycle 6 functional requirement.

The large relative uncertainty associated with the estimated tritium release from TPBARs in the RCS is a result of the difference between two large cumulative values: i.e., the cumulative total RCS tritium based on RCS tritium concentration and water makeup/letdown data, minus the predicted tritium from neutron/soluble boron interaction plus other non-TPBAR sources such as fuel rods, control rods, etc.

Based on the performance of the Cycle 6 TPBARs, the cumulative tritium release from TPBARs for Cycle 7 is expected to be relatively small in the first 90-120 days of the cycle, then increase slowly, with a final cumulative release value approaching 750 Ci total.

For Cycle 7, TVA will monitor RCS tritium levels to assure that the cumulative total tritium remains below limits contained in Amendment 40. This includes tritium produced from non-TPBAR sources as noted above, plus tritium released from TPBARs. In order to maintain the cumulative tritium level below applicable limits TVA will limit the number of TPBARs irradiated per cycle.

#### CONCLUSION

For Cycle 7, TVA will again irradiate 240 TPBARs. The 240 TPBARs planned for irradiation in Cycle 7 are expected to perform in a manner similar to the 240 TPBARs irradiated in Cycle 6.

TVA has determined the Cycle 7 annual tritium permeation projections do not present any radiological concerns either to station personnel or to members of the public.

As a result of operating experience gained during Cycle 6, TVA now uses a revised metric (i.e., maximum annual release) to monitor TPBAR release to the RCS. For Cycle 7, TVA will monitor tritium in the RCS on a daily basis and also limit the number of TPBARs to 240.

As an interim tritium permeation functional requirement for Cycle 7, TVA will apply the Amendment 40 evaluated release of 2,304 TPBAR related tritium curies per year into the RCS to the 240 TPBAR Core, that is approximately 9.6 curies per TPBAR per year. For Cycle 7 and future cycles, TVA will limit the number of TPBARs to be irradiated in any cycle such that the total tritium levels in the RCS will remain below the value established with Amendment 40.

TVA will participate in reviews of PIE results and will approve any proposed corrective actions.