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

JUL 25 2001

10 CFR 50.4

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - RESPONSES TO REQUEST FOR ADDITIONAL INFORMATION (RAI) REGARDING TRITIUM PRODUCTION - INTERFACE ITEM NUMBER 4 - REACTOR VESSEL INTEGRITY ANALYSIS - TAC NO. MB1884

The purpose of this letter to provide TVA's response to NRC's request for additional information regarding the Tritium Production Program Interface Item Number 4, "Reactor Vessel Integrity Analysis." This request was made via email from NRC Project Manager for WBN on July 3, 2001. Initial information related to this interface issue was supplied by TVA on May 1, 2001. The enclosure provides both the questions asked and the responses to those questions.

There are no regulatory commitments made by this letter. If you have any questions about this letter, please contact me at (423) 365-1824.

Sincerely,

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

Enclosures
cc: See page 2

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cc (Enclosure):

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

Mr. L. Mark Padovan, Senior Project Manager
U.S. Nuclear Regulatory Commission
MS 08G9
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852-2739

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

ENCLOSURE
TENNESSEE VALLEY AUTHORITY
WATTS NUCLEAR PLANT (WBN)
UNIT 1
DOCKET NO. 390
RESPONSES TO NRC REQUEST FOR ADDITIONAL INFORMATION

Question No. 1

"We assume that the RT_{PTS} shown in NUREG-1672 is actually the value of RT_{PTS} as defined by 10 CFR 50.61. Is this correct?"

TVA Response No. 1

Yes, RT_{PTS} is that defined by 10CFR50.61. The 126/127 values of RT_{PTS} from NUREG-1672 were calculated for a reference plant, while the 253 value of EOL RT_{NDT} (which is the same as RT_{PTS}) is for Watts Bar.

Question No. 2

"On page 1-23 of your submittal you state that: "...the burned assemblies placed on the periphery are only once-burned and therefore, more reactive." Your submittal did not identify the methodology, its qualification, the input parameters, the approximations, etc. used to calculate the fluence value which supports the following statement:

"...the cycle specific core designs will employ the approach of maintaining the power in critical peripheral assemblies such that the existing design-basis RPV exposure projections remain bounding."

Please provide the methodology, its qualification, and the plant specific data which support the above statement."

TVA Response No. 2

Prior to introducing the 1.4% mini-uprate conditions and Tritium Production Core (TPC) design at the Watts Bar plant, fast ($E > 1.0$ MeV) neutron fluence projections for the reactor pressure vessel were based on the original licensed reactor power of 3411 MWt and were performed in conjunction with the Surveillance Capsule U dosimetry evaluation that was analyzed at the End of Cycle 1 (EOC 1) and documented in WCAP-15046 ("Analysis of Capsule U from the Tennessee Valley Authority Watts Bar Unit 1

Reactor Vessel Radiation Surveillance Program"). At the time these baseline vessel fluence projections were made, a checkerboard loading pattern had been utilized during Cycle 1 operation, where fresh fuel was placed at every core location, and it was anticipated that the plant would be transitioning to a low-leakage loading pattern that places burnt fuel along the core periphery for enhanced neutron economy and a concomitant reduction in the vessel fluence. As a result of uncertainties in the degree to which low-leakage loading pattern might be applied in future Watts Bar core designs, and for added conservatism, the baseline vessel fluence projections utilized design basis exposure rates that were assumed to remain applicable throughout plant life. The conservative design basis data for Westinghouse 4-loop plants is described below.

The design basis statistical analysis of limiting core radial power distributions for Westinghouse plants included calculated data from twenty-three independent fuel cycles in ten 4-loop reactors. These long-term power distributions represent an upper tolerance limit on the average of Beginning of Cycle (BOC) and End of Cycle (EOC) power in peripheral assemblies based on a 95% probability with 95% confidence. These distributions were also biased to account for observed differences between calculated versus measured power in the peripheral fuel assemblies. A quarter-core picture of the design basis radial power distribution generated for Westinghouse 4-loop plants is given in Figure 1. This figure demonstrates that the relative power is skewed toward the peripheral fuel assemblies, which subsequently results in conservative fluence projections for the reactor pressure vessel.

When the pressure vessel fluences were reexamined to support the TPC Program, the assessment was based on actual Watts Bar plant operating conditions that occurred during the first three cycles of operation (i.e., where the loading patterns transitioned from checkerboard to low-leakage loading pattern designs and operated for 3.96 EFPY at 3411 MWt) and the equilibrium cycle TPC design which was assumed to operate with the reactor power at 3459 MWt for all subsequent fuel cycles. The radial power distribution of the TPC design is illustrated in Figure 2. The methodology that was followed in the vessel fluence calculations for the TPC program is a 2-D/1-D synthesis approach. This is the same methodology as that described in WCAP-15353 ("Palisades Reactor Pressure Vessel Neutron Fluence Evaluation") which was submitted to the USNRC by Consumers Energy Company for the Palisades Plant. In an SER dated November 14, 2000, the USNRC stated that the methodology was acceptable for predicting reactor vessel fluence. The methodology adheres to the requirements set forth in Regulatory Guide 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence," dated March 2001.

Selected maximum exposure rates along the Watts Bar pressure vessel inner radius (PVIR) that were determined from the 2-D/1-D synthesis methodology are provided in Table 1. For comparison purposes, the corresponding Watts Bar baseline exposure rates are also presented. An examination of this data shows that the original baseline exposure rates (and corresponding fluences) clearly bound the 2-D/1-D synthesized results that includes the impact of the 1.4% power uprate and the TPC. Hence, the baseline calculations that were performed for Watts Bar continue to remain limiting.

Question No. 3

"Is there a significant spectral effect on the leakage source neutrons due to the presence of 6Li and 1H3 (toward the end of the cycle) in the peripheral assemblies?"

TVA Response No. 3

Because Li-6 is a good thermal neutron absorber, the presence of TPBARs in any core location, including the periphery, has the effect of reducing the thermal flux in that location. This makes the local fast-to-thermal flux ratio larger, not because the fast flux is larger, but because the thermal flux is smaller. To this extent, the neutron spectrum is altered due to the TPBARs. This spectrum effect occurs throughout cycle life since the Li-6 in TPBARs depletes slowly (especially true for TPBARs on the core periphery). The flux of interest for vessel fluence, however, is the > 1 MeV neutron flux. This flux is primarily a function of the local power density and the fission spectrum. Like any burnable absorber, TPBARs have the effect of reducing the local power density, i.e., suppressing the local fission rate, and therefore, reducing the > 1 MeV flux. The fission spectrum is not affected by TPBARs. Tritium, because it has essentially no neutron absorption cross section, has a negligible effect on the neutron spectrum.

Question No. 4

"The conclusion (page 1-24) that: "The fluence projections for the tritium production core are bounded by the existing fluence projections for Watts Bar" should be restated to the effect that it is bounded by the 10 CFR 50.61 values."

Response No. 4

That conclusion can be restated as follows: "The fluence projections for the tritium production core are bounded by the fluence projections used in the existing Watts Bar 10 CFR 50.61 analyses."

Figure 1
Design Basis Radial Power Distribution for Westinghouse 4-loop Plants

	1	2	3	4	5	6	7	8
1	0.860	1.070	0.870	0.900	1.090	1.050	1.020	1.060
2	1.070	1.060	0.940	1.040	1.060	0.870	1.100	1.090
3	0.870	0.940	1.090	1.120	0.880	0.870	1.000	1.010
4	0.900	1.040	1.120	0.920	1.100	1.070	1.050	0.810
5	1.090	1.060	0.880	1.100	1.040	1.000	1.150	
6	1.050	0.870	0.870	1.070	1.000	1.050	0.750	
7	1.020	1.100	1.000	1.050	1.150	0.750		
8	1.060	1.090	1.010	0.810				

45 Deg

0 Deg

Figure 2
Equilibrium Cycle Tritium Production Core Radial Power Distribution for Watts Bar

	1	2	3	4	5	6	7	8
1	1.124	1.213	1.237	1.274	1.238	1.185	1.236	0.636
2	1.213	1.123	1.265	1.240	1.241	1.162	1.058	0.621
3	1.237	1.265	1.251	1.226	1.184	1.162	0.990	0.549
4	1.274	1.241	1.227	1.229	1.163	1.136	0.889	0.356
5	1.238	1.242	1.185	1.163	1.139	1.002	0.629	
6	1.185	1.160	1.159	1.134	1.001	0.783	0.340	
7	1.236	1.055	0.987	0.890	0.629	0.340		
8	0.636	0.621	0.551	0.357				45 Deg

0 Deg

Table 1
Westinghouse Design Basis 4-Loop Plant versus Watts Bar Equilibrium Cycle TPC Design Neutron Fluxes at Selected Pressure Vessel Inner Radius Azimuth Locations

Neutron Flux (neutrons/cm^2-s)

PVIR Location	**4-Loop Plant Design-Basis Values From R,È Models (at 3411 MWt)**	**Watts Bar TPC Equilibrium Cycle Values From 2-D/1-D Synthesis (at 3459 MWt)**
0°	1.761E+10	1.074E+10
15°	2.718E+10	1.479E+10
30°#	2.589E+10	9.465E+09
45°	3.120E+10	1.577E+10

The maximum neutron flux reported for this location coincides with the octant containing the 15° neutron pad.