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AUG 0 7 1997

U.S. Nuclear Regulatory Commission
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Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - TRITIUM PRODUCING BURNABLE ABSORBER ROD (TPBAR) LEAD TEST ASSEMBLIES (LTAs) - TECHNICAL SPECIFICATIONS CHANGE 97-001 - SUPPLEMENTAL INFORMATION

The purpose of this letter is to provide information supplementing previously docketed document PNNL-11419, Revision 1. The enclosure provides this supplemental information and reflects the results of completed design analyses. Most of the revised values reported in the attached document result from the disposition of previously unverified assumptions. In addition, the Department of Energy (DOE) is providing the classified version of this information by separate correspondence. None of these revisions change the overall conclusions of the TVA subject amendment dated April 30, 1997.

If you should have any questions, please contact P. L. Pace at (423) 365-1824.

Sincerely,

R. Purcell for
J. A. Scalice

Enclosure
cc: See page 2

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ENCLOSURE
SUPPLEMENT TO PNNL-11419, REVISION 1

INFORMATION SUPPLEMENTING PNNL-11419, Rev. 1

The following information supplements PNNL-11419, "Report on the Evaluation of the Tritium Producing Burnable Absorber Rod Lead Test Assembly" Revision 1 dated March 1997. This supplemental information reflects the results of completed design and design analyses. Most of the revised values reported in this document result from incorporation of changes in previously unverified assumptions which have been verified by TVA and/or Westinghouse. None of these revisions change the overall conclusions of the TVA amendment request or the original report regarding the safety of TPBAR irradiation during the Watts Bar Unit 1 Cycle 2.

CHAPTER 2

TPBAR Thermal Flux and Fluence

Section 2.1 and Table 2-5 of PNNL-11419, Revision 1, indicate that the thermal flux and fluence for the TPBARs are bounded by the previous ATR tests. Further review of the ATR data indicate that the thermal flux and fluence may not be bounded by the ATR tests since thermal cutoff energies were not specified in the ATR test reports. Nevertheless, the previous test data together with substantial TPBAR design improvements, large design margins, and conservative analysis provide a high degree of confidence in the performance of the LTAs.

Table 2-5, pages 2.24 and 2.25, of PNNL-11419, Revision 1 provides values of fast neutron flux, fast neutron fluence, axial peak n-a power, axially averaged n-a power, axial peak gas volume ratio (GVR), and ^{6}Li burnup for the TPBAR which reflect early scoping calculations. The final calculations for the TPBAR in Watts Bar Cycle 2 resulted in changes to these values.

A revised Table 2-5 is attached to reflect this information.

TPBAR Design Conditions

Section 2.2, page 2.4, and Section 2.2.5.2, page 2.13 of PNNL-11419, Revision 1, indicate that the TPBAR maximum internal design pressure is 3000 psia at an average gas temperature of 675°F. The limiting design criterion for internal gas pressure is 3000 psia at an average gas

temperature of 682°F. This represents a slight change in the design internal gas temperature which is accommodated by the design of the TPBAR.

TPBAR Cladding Factors of Safety

Section 2.2.1.1, page 2.6, of PNNL-11419, Revision 1 indicates that, except for the LBLOCA where the TPBARs are assumed to fail, the lowest factor of safety to yield for an in-reactor condition is 1.70, which corresponds to the reactor coolant system (RCS) pressure during the hydrostatic test at 1.25 times the reactor design pressure. The final design analyses indicate the lowest factor of safety to yield for an in-reactor condition to be 1.66 which corresponds to loss of load without reactor trip (Condition II) and to reactor coolant pump locked rotor event (Condition III). This change in limiting events resulted from incorporation of plant specific information from Watts Bar and does not represent a significant reduction in minimum factor of safety.

Design Cycles for Steady State Transient Conditions

Table 2-4, page 2.23, of PNNL-11419, Revision 1, lists the design cycles for steady state fluctuations as 13,200. This value should have been 132,000. This corrects a typographical error in the original technical report.

TPBAR Component Operating Temperatures

Section 2.2.5.1, page 2.13 of PNNL-11419, Revision 1 reports that the coolant temperature rises from 559°F at the bottom of the TPBAR to 620°F at the top of the TPBAR. The final design analysis predicts that the coolant temperature rises from 558°F at the bottom of the TPBAR to 624°F at the top of the TPBAR. These changes reflect incorporation of the analyzed conditions within the core for Watts Bar Cycle 2 and do not alter the conclusions regarding the acceptability of the TPBAR design.

CHAPTER 3

Computer Code Used for Scoping Neutronics Calculations

Chapter 3 of PNNL-11419, Revision 1 identifies WIMS-E (Reference 3-1, Askew, J. R., and M. J. Roth, WIMS-E A Scheme For Neutronics Calculations, Winfrith, June 1982) as the computer code used for scoping neutronics calculations. The final scoping calculations used WIMS6 (AEA Technology, *WIMS6 - WIMSE User Guide*, AEEW-R 2442, Winfrith, England, April 1995). WIMS6 is a new version of WIMS-E, however the basic code methodologies have not changed.

CHAPTER 4

TPBAR Thermal and Hydraulic Design

Section 4.1.2, page 4.3, and Sections 4.1.3 and 4.2, page 4.4, of PNNL-11419, Revision 1 indicate that the total assembly power peaking used in the analysis was 1.42. For Watts Bar, the total assembly power peaking limit is 1.40, with a hot channel rise factor consistent with Watts Bar operating limits. In addition, the analysis described in Chapter 4 of PNNL-11419, Revision 1, has been finalized in an auditable file and reviewed by Westinghouse.

Table 4-1, page 4.6, of PNNL-11419, Revision 1 provides a comparison of TPBAR parameters to burnable poison rod assembly (BPRA) and Westinghouse Annular Burnable Absorber (WABA) parameters. Based on corrected information from Westinghouse, values of nominal TPBAR absorber power should be 0.560, and peak TPBAR absorber power should be 0.974. The thermal hydraulic analysis supports values as high as 1.66 Kw/ft. A revised Table 4-1 is attached to reflect these revised values.

Table 4-2, page 4.7, of PNNL-11419, Revision 1 provides Host Plant off-normal thermal hydraulic parameters. Values of most parameters have been corrected based upon information from TVA and Westinghouse. A revised Table 4-2 is attached, providing correct values.

Table 4-4, pages 4.8 and 4.9, of PNNL-11419, Revision 1 provides thermal and hydraulic design parameters. Values of many parameters have been updated based upon information from TVA and Westinghouse to reflect changes in Watts Bar Thermal hydraulic analyses unrelated to the TPBAR LTAs. None of these changes invalidate the LTA analysis, and the original conclusion of Table 4-4, that LTAs do not cause any changes in reactor thermal hydraulic parameters, remains unchanged. A revised Table 4-4 is attached, reflecting the updated values.

CHAPTER 5

Standard for Testing of Weld Quality

Section 5.3.1.5, page 5.6, of PNNL-11419, Revision 1, identifies ASTM E2 as the standard to be used for metallographic examination during qualification of the weld process. As identified in the response to NRC Question 12, the proper citation is ASTM E3 for specimen preparation and ASTM E883 for metallographic examination process parameters.

CHAPTER 6

Potential Offsite Doses during Normal Operation

Section 6.1, pages 6.1 through 6.3, of PNNL-11419, Revision 1, discusses only exposures due to water releases from the plant. Some tritium will be released to the air during normal operation via leakage of RCS water. The offsite dose from an annual airborne release of 214 Ci was calculated using the methodology outlined in the ODCM. The maximum dose is 1×10^{-4} mrem which is less than the waterborne release dose. Thus, it is conservative to assume that all of the tritium released from the TPBARs during normal operation is discharged via water.

Refueling Occupational Exposures

Section 6.2.3, pages 6.5 and 6.6, of PNNL-11419, Revision 1 discusses the environmental conditions and resulting pool evaporation rates used in the calculation of occupational exposures during refueling. Based upon input from TVA, the worst case conditions were changed from 160°F (water), 100°F (air) and 100% humidity to 159.2°F (water), 104°F (air), and

80% humidity. The worst case evaporation rate, using pool dimensions provided by TVA, was revised from 407.3 kg/hr to 596 kg/hr ±25% (745 kg/hr used). The expected conditions were changed from 90°F (water), 70°F (air) and 75% humidity to 124.7°F (water), 80°F (air), and 55% humidity. The resulting expected evaporation rate was revised from 34.8 kg/hr to 227 kg/hr ±25% (284 kg/hr used).

Tables 6-2 and 6-3, page 6.17, of PNNL-11419, Revision 1 provide refueling occupational doses based upon the conditions stated in Section 6.2.3. Revised Tables 6-2 and 6-3 are attached to provide revised exposure values. While these values represent increases over those previously provided in PNNL-11419, Revision 1 and those provided with the TVA license amendment request, they are still well below DAC and do not alter the conclusions of the report, or of the license amendment request.

Radiological Consequences of LBLOCA with TPBAR Rupture

Table 6-1, page 6.16, of PNNL-11419, Revision 1 reflects no change in LOCA offsite doses with LTAs installed. Final calculations using site parameters and TPBAR design parameters predict an increase of 0.07 rem total body dose at the low population zone (LPZ) boundary. A revised Table 6-1 reflecting this change is attached.

Section 6.4.3.4, page 6.13, of PNNL-11419, Revision 1 states that the dose to a control room worker due to TPBAR tritium at the end of 30 days, using occupational factors given in host plant FSARs is 0.03 rem. Using Watts Bar occupational factors, this value is 0.05 rem. This change is a minor increase over the values in PNNL-11419, Revision 1 and does not alter the conclusions of the report.

REVISED TABLES

TABLE 2-5
Comparison of Irradiation Conditions for the Tritium Test Rods and the TPBAR

Parameter	WC-1 Test	S-1 Test	B-1 Test	Loop-1 Test	TPBAR
Total Exposure, EFPD	281	143	143	217	450 to 500 550 Max
Axial Peak-to-Average Thermal Neutron Flux Ratio	1.3	1.3	1.3	1.46	1.2
Cladding Fast Neutron Flux, 10^{13} n/cm^2/s (E>1 MeV)	0.7	0.7	0.7	14	9.8
Fast Neutron Fluence, 10^{21} n/cm^2 (E>1 MeV)	0.17	0.09	0.09	2.60	4.6
Axial Peak *n-a* Power Level, kW/ft (kW/m)	0.60 (2.0)	0.60 (2.0)	0.9 (3.0)	0.45 (1.5)	BOL 0.68 (2.3) EOL 0.37 (1.2)
Axially Averaged *n-a* Power Level, kW/ft (kW/m)	0.43 (1.4)	0.43 (1.4)	0.63 (2.1)	0.32 (1.05)	BOL 0.57 (1.9) EOL 0.31 (1.0)
Rod Average GVR	116	53	80	68	174
Axial Peak GVR[1]	159	73	110	99	208
Rod Average ^{6}Li Burnup, atom %	15.7	7.2	10.8	8.4	64
^{6}Li Enrichment, at.%	57	57	57	59.2	~22[2]
Tritium Produced per 4 ft (1.22 m) Rod, Ci (g)	2700 (0.28)	1240 (0.13)	1860 (0.19)	1559 (0.16)	3900 (0.40)
pH of Water	5.5 to 9.4	5.5 to 10	5.5 to 10	6.65 ±0.2	6.5 to 7.0

[1]See Table 2-6 for bounding GVR data.

[2]The nominal ^{6}Li loading is 0.0247 g/in.

TABLE 4-1. TPBAR Comparison to BPRA and WABA Rods			
Parameter	**TPBAR**	**BPRA**	**WABA**
Guide Thimble ID	0.442 in	0.442 in	0.442 in
Rod OD	0.381 in	0.381 in	0.381 in
Rod ID	NA	NA	[ ][a]
Nominal Guide Thimble Flow 17x17	[ ][a]	[ ][a]	[ ][a]
Nominal Absorber Power kW/ft avg.	0.560 BOL	[ ][a]	[ ][a]
Peak Linear Absorber Power kW/ft[3]	0.974	[ ][a]	[ ][a]
Rod Length	152.35 in	152.59 in	149.83 in
Poison Length	142.0 in	142.0 in	134.0 in[4]

[ ][a] Denotes Westinghouse proprietary data.

[3]Generic values based on 28.8 W/cm^3 in absorber and 14.1 W/cm^3 in steel.

[4]Length may vary to accommodate a specific plant specification.

TABLE 4-2 Host Plant Bounding Off-Normal T-H Parameters		
Parameter	**Condition I Event Analysis Value**	**Condition II Event Analysis Value**
Power	102 %	121%
Pressure	2200 psi	2250 psia
Inlet Temperature	563.7 °F	557.7 °F
Assembly Coolant Flow	[ ][(a)6]	[ ][(a)]
Guide Thimble Flow	[ ][(a)]	[ ][(a)]

[ ][(a)] Denotes Westinghouse proprietary data.

TABLE 4-4 Thermal and Hydraulic Comparison Table		
Design Parameters	**Host Plant w/o LTA**	**With LTAs**
Reactor core heat output, MW_t	3,411	No change
Reactor core heat output, 10^6 Btu/hr	11,641.7	No change
Heat generated in Fuel, %	97.4	No change
System Pressure, nominal, psia	2,250	No change
System pressure, minimum steady state, psia	2,200	No change
Coolant Flow		
Total thermal flow rate, 10^6 lb_m/hr	138.5	No change
Effective flow rate for heat transfer, 10^6 lb_m/hr	126.0	No change
Effective core flow, gpm	372,400	No change

[6]Host plant cycle 2 flow at 557.7°F inlet temperature is [ ][(a)] nominal, [ ][(a)] guaranteed minimum.

TABLE 4-4
Thermal and Hydraulic Comparison Table

Design Parameters	Host Plant w/o LTA	With LTAs
Average flow per assembly, gpm	[ ][a]	No change
Effective flow area for heat transfer, ft^2	51.3	No change
Average velocity along fuel rods, ft/sec	14.7	No change
Average mass velocity, 10^6 $lb_m/hr\text{-}ft^2$	2.46	No change
Coolant Temperature		
Nominal inlet,°F	557.7	No change
Average rise in vessel,°F	61.0	No change
Average rise in core,°F	66.2	No change
Average in core,°F	592.8	No change
Average temperature in vessel,°F	588.2	No change
Heat Transfer		
Active heat transfer surface area, ft^2	59,700	No change
Average heat flux, $Btu/hr\text{-}ft^2$	189,800	No change
Maximum heat flux for normal operation, $Btu/hr\text{-}ft^2$	474,500	No change
Average linear power, kW/ft	5.45	No change
Peak linear power for normal operation, kW/ft	13.6	No change
Peak linear power resulting from overpower transients/operator errors, assuming a maximum overpower of 121%, kW/ft	22.4	No change
Peak linear power for prevention of fuel centerline melt, kW/ft	>22.4	No change
Power density, kW per liter of core	104.5	No change
Specific power, kW per kg uranium	38.4	No change
Fuel Central Temperature		
Peak at peak linear power for prevention of fuel centerline melt,°F	4,700	No change
TPBAR Parameters		
TPBAR total power, kW	N/A	6.9

TABLE 4-4 Thermal and Hydraulic Comparison Table		
Design Parameters	**Host Plant w/o LTA**	**With LTAs**
Pressure Drop		
Across core, psi	23.6 ±2.4	No change
Across vessel, including nozzle, psi	44.5 ±6.7	No change

TABLE 6-1
Summary of Off-Site Radiological Consequences for the TPBARs in the host plant

Condition	Receptor	Current Total Body Dose[(A)] (rem)	Total Body Dose with LTA (rem)	Reference Value / Source
Normal Operation	MEI[(B)]	0.000700	0.000700	0.003 rem / 10CFR50, App. I
Cladding Breach	MEI	0.000700	0.000713	0.003 rem / 10CFR50, App.I
SGTR	EAB[(C)]	0.863	0.863	2.5 rem / SRP 15.6.3
	LPZ[(D)] (8 h)	0.200	0.200	
Fuel Handling Accident (Containment)	EAB	2.01	2.01	
	LPZ (2 h)	0.466	0.466	
Fuel Handling Accident (Auxiliary Bldg)	EAB	0.782	0.782	
	LPZ (2 h)	0.182	0.182	
LOCA	EAB	3.29	3.29	25 rem / 10CFR100
	LPZ (30 d)	2.00	2.07	

NOTES:

[(A)] The total body doses for accident cases were calculated using the following equation:

Total Body Dose = g whole body dose + w_T*Thyroid dose + w_b*b dose

where:

w_T = Thyroid weighting factor from 10CFR20.1003 (= 0.03)

w_b = Beta skin dose weighting factor (= 0.01) from ICRP Publication 60 [Ref. 6-7]

[(B)] Maximum Exposed Individual.

[(C)] Exclusion Area Boundary for 2 h = Fenceline Receptor

[(D)] Low Population Zone = MEI Receptor

TABLE 6-2 Refueling Occupational Exposures for a Constant Design Goal Tritium Release from Intact TPBARs			
Containment		**Fuel Handling Area**	
Expected Conditions (% of DAC)	Worst-Case Conditions (% of DAC)	Expected Conditions (% of DAC)	Worst-Case Conditions (% of DAC)
0.41 %	1.08 %	0.09 %	0.24 %

TABLE 6-3 Refueling Occupational Exposures Assuming a Release of the Inventory of 1 TPBAR During the Cycle at a Constant Rate			
Containment		**Fuel Handling Area**	
Expected Conditions (% of DAC)	Worst-Case Conditions (% of DAC)	Expected Conditions (% of DAC)	Worst-Case Conditions (% of DAC)
16.3 %	42.8 %	3.69 %	9.67 %