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

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

Subject: Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Request for Additional Information (RAI) Regarding Accident Dose Analysis Basis

References:

1. NRC letter to TVA dated June 11, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Request for Additional Information Regarding Licensee's Final Safety Analysis Report Amendment Related to Accident Dose (TAC NO. ME3091)"
2. TVA letter to NRC dated August 30, 2010, ""Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information"
3. E-mail from Justin C. Poole, U.S. Nuclear Regulatory Commission to William D. Crouch, TVA, dated March 4, 2011

This letter provides a response to a request to provide additional information comparing the Unit 2 accident dose analysis presented in FSAR Chapter 15.5 with the Unit 1 analysis.

Enclosure 1 provides the requested information. Unit 1 values will be the same as the Unit 2 values except as described in Enclosure 1. There are no new commitments made in this submittal.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 6th day of June, 2011.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

Enclosure:

1. Response to RAI Concerning WBN Unit 2 Accident Dose Analysis

cc (Enclosure):

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Enclosure 1
Watts Bar Nuclear Plant
Response to Request for Additional Information (RAI)
Regarding Accident Dose Analysis Basis

NRC Question from Reference 1

15.5-1. To ensure a complete and accurate safety assessment of the proposed changes to the Watts Bar FSAR, the NRC staff needs to assess the safety significant of all of the changes to the current licensing basis (CLB) parameter used in the dose consequences described in Chapter 15.5.

Please provide additional information describing, for each design basis accident described in FSAR Section 15.5 all the basic parameters used in the dose consequence analyses. For each parameter, please list the WBN Unit 1 CLB value, the revised value where applicable as will be applied to Unit 1 and 2, and the basis for any changes mode to the WBN Unit 1 CLB values. The NRC staff requests that this information be presented in separate tables for each accident evaluated.

TVA Response:

The WBN Unit 1 UFSAR addresses the dose consequences of seven postulated design basis accidents in Section 15.5. The accidents addressed are:

1. Loss of AC Power to the Plant Auxiliaries
2. Waste Gas Decay Tank Rupture
3. Loss of Coolant Accident (LOCA)
4. Steam Line Break
5. Steam Generator Tube Rupture
6. Fuel Handling Accident
7. Rod Ejection Accident

The Rod Ejection Accident is bounded by the LOCA, and is not addressed in detail.

The following table provides the Unit 1 current licensing basis (column 1), the revised value where applicable as will be applied to Unit 2 (column 2), and the basis for any changes made to the Unit 1 values (column 3). Only those values that have been revised are presented with their basis in columns 2 and 3, respectively. The table numbers specified in the comparison table below are from the UFSAR for Unit 1 and from Amendment 103 of the Unit 2 FSAR. The analyses for steam line break, steam generator tube rupture, and loss of AC power for the plant were updated recently. The reactor coolant system dose equivalent iodine for the steam line break and steam generator tube rupture was set at the Technical Specification (TS) value. The value for secondary side dose equivalent iodine for the loss of AC Power was also set at the TS limit. Unit 2 Table 15.5-16 on page E1-14 was updated due to these revisions. The changes to the Unit 2 Accident Analyses were submitted in Amendment 104. A revised Unit 1 Table 15.1-4 is provided on page E1-13. The new values are reflected in the comparison table.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.1 Loss of AC Power		
1. A conservative analysis of the potential offsite doses resulting from this accident is presented with steam generator leakage as a parameter. This analysis incorporates assumptions of one percent defective fuel and a realistic source term. Parameters used in both the realistic and conservative analyses are listed in Table 15.5-1.	1. Unit 2 replaced 1% failed fuel source term with the TS Allowable source term. Also, Unit 1 used I-131 dose equivalent factors from ICRP-2, where Unit 2 used Dose Factors from Regulatory Guide (RG) 1.109, Appendix E.	1. To provide a conservative bounding dose, Unit 2 uses the TS Allowable source term of 0.1 μCi/g I-131 dose equivalent for the secondary coolant in conjunction with the Dose Factors from RG 1.109, Appendix E.
2. The steam release from four steam generators is 455,718 lbs (0-2 hr) and 962,213 lbs (2-8 hr).	2. The Unit 2 steam release from four steam generators is 444,875 lbs (0-2 hr) and 903,530 lbs (2-8 hr).	2. The volume of steam released in Unit 1 reflects the use of the replacement steam generators (RSGs). The volume of steam release in Unit 2 reflects the use of the original steam generators (OSGs). The volumes are from TVA calculation WBNTSR080, Revision 8.
3. Primary coolant activity is based on ANSI/ANS 18.1, 1984 and is given in UFSAR Table 11.1-7.	3.	3.
4. The tritium source term is based on two (2) Tritium Producing Burnable Absorber Rods (TPBAR) failures.	4. Unit 2 analysis is based on the standard core and did not consider TPBAR failure	4. Unit 2 will not produce tritium.
5. The Unit 1 secondary coolant steam activity released for the realistic case is in Table 11.1-7. The activity was ratioed up to 1% failed fuel for the conservative case.	5. The Unit 2 secondary coolant activity released is in Table 11.1-7. The activity was ratioed up to the TS limit of 0.1 uCi/gm dose equivalent I-131 for the conservative case.	5. The secondary coolant activity released in Unit 2 reflects the use of the OSGs. For conservatism, the specific secondary coolant activity for Unit 1 is used for Unit 2 because the Unit 1 specific secondary coolant activity bounds the Unit 2 specific secondary coolant activity. The volume of Unit 2 coolant released is in Item 2 above.
6. The meteorology for the Exclusion Area Boundary (EAB) and the Low Population Zone are in Table 15A-2.	6.	6.

7. The control room parameters are in Table 15.5-14. One Control Room Emergency Ventilation System (CREVS) is in operation.	7. The atmospheric dispersion coefficients for Unit 2 control room are: Interval — sec/m^3 0 – 2 h — 2.87E-3 2 – 8 h — 2.46E-3 8 – 24 h — 1.14E-3 1 – 4 d — 7.55E-4 4 – 30 d — 6.22E-4	7. The Unit 2 atmospheric dispersion coefficients are based on the Unit 2 release location at the Unit 2 vent valve stacks and the Emergency Control Room Intake. The Unit 2 atmospheric dispersion coefficients are from TVA calculation WBNTSR080, Revision 8 and WBNAPS3104, Revision 2. The accident releases terminate at 8 hours.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.2 Waste Gas Decay Tank Rupture		
1. The parameters for the realistic and RG 1.24 analyses of the Waste Gas Decay Tank (WGDT) rupture are in Table 15.5-3.	1. There are no revised Unit 2 parameters because the Waste Gas System is common to Units 1 and 2.	1.
2. The radiation source terms for the RG 1.24 analysis are in Table 15.5-4. The reactor has been operating at full power with 1% defective fuel for the RG 1.24 analysis.	2.	2.
3. The tank rupture is assumed to occur immediately upon completion of the waste gas transfer, releasing the entire contents of the tank through the Auxiliary Building (AB) vent to the outside atmosphere. The assumption of the release of the noble gas inventory from only a single tank is based on the fact that all gas decay tanks will be isolated from each other whenever they are in use	3.	3.
4. The short-term (i.e., 0-2 hour) dilution factor at the EAB given in Table 15A-2 is used to evaluate the doses from the released activity.	4.	4.
5. Parameters for the control room analysis are found in Table 15.5-14.	5.	5.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.3 LOCA		
1. The analysis is based on RG 1.4. The parameters used for this analysis are in Table 15.5.6. In addition, an evaluation of the dose to control room operators and an evaluation of the offsite doses resulting from recirculation loop leakage are presented.	1.	1.
2. The Containment Building Ice Condenser removal efficiency for elemental and particulate iodine is in Table 15.5.7. There is no removal of organic iodine by the Ice Condenser.	2.	2.
3. The time dependent Emergency Gas Treatment System (EGTS) flow rates for the Unit 1 CLB are in Table 15.5.8. These flow rates correspond to postulated single failure of one train of EGTS with a 250 cfm steady state exhaust concurrent with a LOCA. Table 15.5-8A flow rates are as a result of an alternate single failure scenario resulting in one pressure control train in full exhaust to the shield building exhaust stack while the other train remains functional. Both EGTS fans are in service until operator action is taken to place one fan in standby between one and two hours post accident. The Unit 1 exhaust flow rate to the outside environment at one hour post accident is 957 cfm. At this time one EGTS fan is placed in standby. The exhaust flow rate to the outside environment then becomes 694 cfm.	3. The time dependent EGTS flow rates for Unit 1 and 2 corresponding to postulated single failure of one train of EGTS with a 250 cfm steady state exhaust concurrent with a LOCA are in Table 15.5.8. Table 15.5-8A flow rates are as a result of an alternate single failure scenario resulting in one pressure control train in full exhaust to the shield building exhaust stack while the other train remains functional. Both EGTS fans are in service until operator action is taken to place one fan in standby between one and two hours post accident. The Unit 2 exhaust flow rate to the outside environment at one hour post accident is 832 cfm. At this time one EGTS fan is placed in standby. The exhaust flow rate to the outside environment then becomes 604 cfm.	3. The time dependent EGTS flow rates for Unit 1 and 2 are revised to reflect 1 and 2 hour operator action to correct the EGTS operation to a single fan. The EGTS is modeled as 2 trains with appropriate recirculation/ exhaust based on revised flow calculations. The EGTS is assumed to have a PCO control loop single failure at the beginning of the accident such that a maximum two train occurs at the beginning of the accident until operator action is credited in turning off one fan between 1 and 2 hours. The Unit 1 and Unit 2 EGTS flow rates are based on separate analyses of ventilation system calculations reflecting the physical differences between the units.

4. Based on RG 1.4, a total of 100% of the noble gas core inventory and 25% of the core iodine inventory are assumed to be immediately available for leakage from the primary containment. Of the halogen activity available for release, it is further assumed that 91% is in elemental form, 4% in methyl form, and 5% in particulate form. The core inventory of iodines and noble gases is attached (Table 15.1-4 revised).	4. The Unit 2 core inventory of iodines and noble gases is in Table 15.1-5.	4. The Unit 1 source terms are based on a tritium core where the Unit 2 source terms are based on a standard core.
5. The tritium source term is based on the failure of two (2) TPBARs	5. The Unit 2 analyses did not consider TPBARs.	5. Unit 2 will not be licensed for tritium production.
6. The parameters used in the analysis of recirculation loop leakage following a LOCA are in Table 15.5-12.	6.	6.
7. The meteorology for the EAB and the Low Population Zone are in Table 15A-2.	7.	7.
8. The control room parameters are in Table 15.5-14.	8.	8.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.4 Steam Line Break		
1. The parameters for the Main Steam Line Break (MSLB) are in Table 15.5-16.	1. Steam releases provided in Unit 2 Table 15.5-16 are different than values for Unit 1.	1. Unit 2 steam release values are different than Unit 1 values since the Unit 1 steam generators have been replaced by different models. See item 7 below.
2. The primary to secondary leakage rate for the MSLB accident was determined to be 1 gallon per minute (gpm) for the faulted steam generator loop and 150 gallons per day (gpd) for each un-faulted steam generator.	2.	2.
3. The two methods of determining the resultant dose for MSLB are: a. a pre-accident iodine spike where the iodine level in the reactor coolant spiked upward to the maximum allowable limit of 21 μCi/gm I-131 dose equivalent just prior to the initiation of the accident, and b. the reactor coolant at the maximum steady state I-131 dose equivalent of 0.265 μCi/gm with an accident initiated iodine spike consisting of a 500 times increase on the rate of iodine release from the fuel	3. For Unit 2 the maximum allowable dose equivalent I-131 value is 14 μCi/gm.	3. A TS change is being processed to change the Unit 1 dose equivalent I-131 from 21 μCi/gm to 14 μCi/gm. This change is necessary since the I-131 dose equivalent conversion factors were changed from ICRP-2 values to RG 1.109 values. The Unit 1 TS require that RG 1.109 be used to determine dose equivalent I-131.
4. The reactor coolant system (RCS) letdown flow is 124.39 gpm.	4.	4.
5. The RCS letdown demineralizer efficiency is assumed to be 1.0 for iodines.	5.	5.
6. ANSI/ANS-18.1-1984 spectrum was used and scaled up to 0.265 or 21 μCi/g equivalent iodine.	6. For Unit 2 the ANSI/ANS-18.1-1984 spectrum was used and scaled up to 0.265 or 14 μCi/g equivalent iodine.	6. See discussion in item 3.

7. Steam generator secondary inventory released as steam to the atmosphere is in Table 15.5-16.	7. Steam generator secondary coolant inventory released as steam to the atmosphere is: a) total from the faulted steam generator: b) (0-30 mins) 96,100 lbm c) total from the non-defective steam generators (0-2 hr), 433,079 lbm d) total from the non-defective steam generators (2-8 hr), 870,754 lbm	7. The volume of steam released in Unit 1 reflects the use of the RSGs. The volume of steam release in Unit 2 reflects the use of the OSGs. The volumes are from TVA calculation WBNAPS3077, Revision 13.
8. Iodine partition coefficients from steaming of steam generator water: a. non-defective steam generators initial inventory and primary-to-secondary leakage - 0.01; and b. faulted steam generator initial inventory and primary-to-secondary leakage - 1.0	8.	8.
9. The meteorology for the Exclusion Area Boundary (EAB) and the Low Population Zone are in Table 15A-2.	9.	9.
10. The control room parameters are in Table 15.5-14.	10. The atmospheric dispersion coefficients for Unit 2 are: sec/m^3 0 – 2 h 2.87E-3 2 – 8 h 2.46E-3 8 – 24 h 1.14E-3 1 – 4 d 7.55E-4 4 – 30 d 6.22E-4	10. The Unit 2 atmospheric dispersion coefficients are based on the Unit 2 release location at the Unit 2 vent valve stacks and the Emergency Control Room Intake. The Unit 2 atmospheric dispersion coefficients are from TVA calculation WBNTSR080, Revision 8, and WBNAPS3104, Revision 2.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.5 Steam Generator Tube Rupture		
1. Table 15.5-18 summarizes the parameters used in the Steam Generator Tube Rupture (SGTR) analysis. The SGTR thermal and hydraulic analysis documents use WBN specific parameters and actual operator performance data.	1. The Unit 2 secondary side mass releases from the ruptured steam generator are: 0 – 2 hours 103,300 lbm 2 – 8 hours 32,800 lbm The Unit 2 secondary side mass releases from the intact steam generator are: 0 – 2 hours 492,100 lbm 2 – 8 hours 900,200 lbm The primary coolant mass released total and flashed are 191,400 and 10,077.2 lbm, respectively.	1. The Unit 2 secondary side mass releases from the ruptured and intact steam generator and primary coolant are based on an RCS with the OSGs from TVA calculation WBNTSR008, Revision 13.
2. Two cases were analyzed. Case 1: The primary side activity release was determined by using maximum TS limit design reactor coolant activities and an iodine spike immediately after the accident that increases the iodine activity in the reactor coolant by a factor of 500 times the iodine production rate necessary to maintain a steady state concentration of 0.265 µCi/gm of dose equivalent I-131. Case 2: The initial reactor coolant activity is at 21 µCi/gm of I-131 equivalent due to a pre-accident iodine spike caused by an RCS transient. For both cases, the secondary side releases were determined using expected secondary side activities, based on ANSI/ANS-18.1-l984 as modified for WBN, and on a 150 gpd/steam generator primary-to- secondary-side leakage.	2. For Unit 2 the maximum allowable dose equivalent I-131 value is 14 µCi/gm	2. A TS change is being processed to change the Unit 1 dose equivalent I-131 from 21 µCi/gm to 14 µCi/gm. This change is necessary since the I-131 dose equivalent conversion factors were changed from ICRP-2 values to RG 1.109 values. The Unit 1 TS require that RG 1.109 be used to determine dose equivalent I-131.
3. The tritium source term was based on the failure of two TPBARs.	3. The Unit 2 analyses did not consider TPBARs.	3. Unit 2 will not be licensed for tritium production.

4. Credit was taken for flashing of the primary coolant, but "scrubbing" of the iodine in the rising steam bubbles by the water in the steam generator was conservatively neglected.	4.	4.
5. A partition factor of 100 was applied to iodine in the remaining unflashed coolant which will boil.	5.	5.
6. The atmospheric diffusion coefficients (χ/*Q*,) for the EAB and LPZ are in Table 15A-2.	6.	6.
7. The χ/*Q* values were based on release from the top of the main steam valve vault. The control room parameters are in Table 15.5-14.	7. The Control Building atmospheric dispersion coefficients for Unit 2 are: sec/m^3 0 – 2 h 2.87E-3 2 – 8 h 2.46E-3 8 – 24 h 1.14E-3 1 – 4 d 7.55E-4 4 – 30 d 6.22E-4	7. The Unit 2 atmospheric dispersion coefficients are based on the Unit 2 release location at the Unit 2 vent valve stacks and the Unit 2 control room air intake on the east side of the control building. The Unit 2 atmospheric dispersion coefficients are from TVA calculation WBNTSR008, Revision 13, and WBNAPS3104, Revision 2.

Unit 1 CLB parameter	Revised Unit 2 Parameter	Basis for Change
15.5.6 Fuel Handling Accident		
1. The parameters used for this analysis are listed in Table 15.5-20. The bases for the RG 1.25 evaluations are: a. In the Regulatory Guide 1.25 analysis the accident occurs 100 hours after plant shutdown. Radioactive decay of the fission product inventory during the interval between shutdown and placement of the first spent fuel assembly into the spent fuel pit is taken into account; and b. In the RG 1.25 analysis damage was assumed for all rods in one assembly.	1.	1.
2. The assembly damaged is the highest powered assembly in the core region to be discharged. The values for individual fission product inventories in the damaged assembly are calculated assuming full-power operation at the end of core life immediately preceding shutdown. Nuclear core characteristics used in the analysis are given in Table 15.5-21.	2.	2.
3. The radial peaking factor is 1.65.	3.	3.
4. All the gap activity in the damaged rods is released to the spent fuel pool and consists of 10% of the total noble gases and radioactive iodine inventory in the rods at the time of the accident with the following gap percentage exceptions which are based on NUREG/CR 5009 as appropriate: 14% of the Kr-85, 5% of the Xe-133, 2% of the Xe-135, and 12% of the I-131.	4.	4.

5. Noble gases released to the spent fuel pool are released through the Shield Building vent to the environment.	5.	5.
6. The iodine gap inventory is composed of inorganic species (99.75%) and organic species (0.25%).	6.	6.
7. The spent fuel pool decontamination factors for the inorganic and organic iodine are 133 and 1, respectively.	7.	7.
8. All iodine escaping from the pool is exhausted to the environment through charcoal filters. A filter efficiency of 99% is used for elemental and organic iodine for the ABGTS filters and 90% for inorganic iodine and 30% for organic iodine for the purge air exhaust filters.	8.	8.
9. No credit is taken for natural decay either due to holdup in the Auxiliary Building or after the activity has been released to the atmosphere.	9.	9.
10. The short-term (i.e., 0-2 hour) atmospheric dilution factors at the EAB and low population zone given in Table 15A-2 are used. The Control Building dilution factors are in Table 15.5-14	10.	10.
11. Two TPBARs in the assembly are assumed to break and release the entire contents of tritium. All of the tritium is conservatively assumed to evaporate into the air.	11. The Unit 2 analyses did not consider TPBARs.	11. Unit 2 will not be licensed for tritium production.

Unit 1

TABLE 15.1-4

CORE AND GAP ACTIVITIES
BASED ON FULL POWER OPERATION FOR 1,000 DAYS
FULL POWER: 3,565 MWt

Isotope	Curies/Assembly	Total Curies in Core
Kr-83m	6.37E+04	1.23E+07
Kr-85m	1.39E+05	2.69E+07
Kr-85	4.56E+03	8.81E+05
Kr-87	2.71E+05	5.23E+07
Kr-88	3.82E+05	7.38E+07
Kr-89	4.72E+05	9.10E+07
Xe-131m	4.94E+03	9.54E+05
Xe-133m	3.01E+04	5.8E+06
Xe-133	9.74E+05	1.88E+08
Xe-135m	1.86E+05	3.59E+07
Xe-135	2.57E+05	4.96E+07
Xe-138	8.24E+05	1.59E+08
I-131	4.67E+05	9.01E+07
I-132	6.79E+05	1.31E+08
I-133	9.74E+05	1.88E+08
I-134	1.08E+06	2.08E+08
I-135	9.12E+05	1.76E+08

Unit 2

TABLE 15.5-16

PARAMETERS USED IN STEAM LINE BREAK ANALYSIS

	Analysis Value
Steam Generator Tube Leak Rate	
Faulted Steam Generator	1 gpm
Per Intact Steam Generator	150 gpd
Iodine Partition Factor	
Faulted Steam Generator	1
Intact Steam Generator	100
RCS Letdown Flow Rate	124.39 gpm
Steam Releases	
Faulted Steam Generator (0-30 minutes)	96,100 lbm
Three Intact Steam Generators (0-2 hours)	433,079 lbm
Three Intact Steam Generators (2-8 hours)	870,754 lbm

REFERENCES

Section 15.5.1 - Loss of AC Power to the Plant Auxiliaries – TVA Calculation WBNTRS080 R8
Section 15.5.2 – Waste Gas Decay Tank Rupture – TVA Calculation WBNTRS064 R9
Section 15.5.3 - Loss of Coolant Accident – TVA Calculations TIRPS197 R21 (offsite) and TIRPS198 R23 (control room operator)
Section 15.5.4 – Main Steam Line Break – TVA Calculation WBNTRS077 R13
Section 15.5.5 – Steam Generator Tube Rupture – TVA Calculation WBNTRS008 R13
Section 15.5.6 – Fuel Handling Accident – TVA Calculation WBNTRS009 R12