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

October 17, 2011

10 CFR 50.34(b)
10 CFR 50.67
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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Chapter 15.5 Fuel Handling Accident (FHA) Dose Analysis**

References:
1. TVA letter to NRC dated September 23, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 - Final Safety Analysis Report (FSAR) - Chapter 15.5 Fuel Handling Accident (FHA) Dose Analysis"
2. TVA letter to NRC dated September 16, 2011, "Watts Bar Nuclear Plant (WBN) - Unit 2 - Revised Severe Accident Management Design Alternative Review (SAMDA) Response (TAC NO. MD8203)"
3. TVA to NRC letter dated January 31, 2011, "Watts Bar Nuclear Plant (WBN) - Unit 2 - Response to Request for Additional Information Regarding Severe Accident Management Alternative Review (TAC NO. MD8203)"

This letter provides revised FSAR descriptions to the Design Basis Accident (DBA) dose analyses submitted by Reference 1 and SAMDA results Table 5.c-1 revision. This table had been provided in Reference 2.

Clarifications are made to the text of FSAR Section 15.5.6 on the FHA to reflect the analysis of record. These revisions do not change the calculated dose results presented in the FSAR through Amendment 106 or provided in Reference 1. Enclosure 1 provides a discussion of the changes. The revised text will be incorporated in a future amendment of the FSAR.

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NRR

By an e-mail dated September 28, 2011, the NRC indicated that the information on dose risk and economic risk for Release Category 3 (Late) provided in revised Table 5.c-1 (Reference 2) appeared to be incorrect because it did not account for the revised benefit calculation methodology provided in response to RAI 5.f (Reference 3). Enclosure 2 provides the corrected table.

On October 11, 2011, the NRC verbally requested the submittal of the hourly meteorology data for the 20 year period of 1991 to 2010 and the associated ARCON96 data file. The NRC verbally requested a copy of the data files supporting the information provided in Reference 2 and Enclosure 2. Enclosure 3 provides optical media containing the requested data.

Enclosure 4 provides the new regulatory commitment in this letter.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 17th day of October, 2011.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

Enclosures:

1. WBN Unit 2 Discussion of FSAR Section 15.5 Changes
2. WBN Unit 2 – Revised SAMDA Table 5.c-1
3. Optical Media WBN Meteorological Data 1991 – 2011
4. Regulatory Commitment

cc (Enclosures):

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Enclosure 1

WBN Unit 2 Discussion of FSAR Section 15.5 Changes

The following provides a discussion of and correction to statements regarding mixing in the containment associated with the Regulatory Guide (RG) 1.25, "Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors (Safety Guide 25)," analysis in FSAR Section 15.5.6.3. A discussion of differences between the TVA analysis for the Fuel Handling Accident (FHA) utilizing the Alternate Source Term methodology and three regulatory positions in RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors" is also provided. The associated changes to FSAR Section 15.5.6 and associated Table 15.5-23 are included below.

FSAR Section 15.5.6 regarding the FHA contains the following statement: "For a FHA inside containment, no allowance has been made for possible holdup or mixing in the primary containment or isolation of the primary containment as a result of a high radiation signal from the monitors in the ventilation systems for the case where containment penetrations are closed to the Auxiliary Building."

The RG 1.25 analysis performed by TVA assumes the radioactive inventory from the damaged fuel assembly instantaneously mixes with a volume of air equal to ½ the upper compartment free volume. A 40-second release based on the purge system design flow rate of approximately 15,000 cfm is assumed to cover the period until the main control room isolation. The remaining inventory is released non-mechanistically within 2 hours of the start of the event. Thus there is no allowance taken for hold-up. The sentence will be revised as follows: "For a FHA inside containment, no allowance has been made for possible holdup in the primary containment or isolation of the primary containment as a result of a high radiation signal from the monitors in the ventilation systems for the case where containment penetrations are closed to the Auxiliary Building." These assumptions are in accordance with the positions in RG 1.25, thus the results presented remain valid and unchanged.

RG 1.183 Regulatory Positions C.4.1.2, C.4.1.4, and C.4.2.7 specify the use of dose conversion factors (DCF) for committed effective dose equivalent (CEDE) from Table 2.1 of Federal Guidance Report (FGR) 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," and deep dose equivalent (DDE) DCFs from Table III.1 of Federal Guidance Report 12, "External Exposure to Radionuclides in Air, Water, and Soil." The Total Effective Dose Equivalent (TEDE) is determined by adding the CEDE to the DDE. Regulatory Positions C.4.1.3 and C.4.2.6 of RG 1.183 also recommend a breathing rate of 3.5E-4 m^3/sec should be used when calculating the CEDE.

FENCDOSE is the TVA computer code used to calculate offsite dose consequences. The TEDE in FENCDOSE is calculated by multiplying the concentration by the DCFs from EPA-400-R-92-001, "Manual of Protective Action Guides and Protective Actions of Nuclear Incidents," May 1992," Table 5.1, "Dose Conversion Factors (DCF) and Derived Response Levels (DRL) for Combined Exposure Pathway During the Early Phase of a Nuclear Incident." This table represents a total exposure and combines the DDE and CEDE values into one DCF. It also accounts for dose due to ground deposition. The CEDE DCFs are provided in EPA-400-R-92-001, Table 5.4, "Dose Conversion Factors (DCF) and Derived Response Levels (DRL) for Doses Due to Inhalation," of the EPA document and are taken from Table 2.1 of FGR 11 but are multiplied by a breathing rate of 3.33E-4 m^3/sec instead of 3.5 E-4 m^3/sec. The DDE DCFs are from DOE/EH-0070 External Dose-Rate Conversion Factors for Calculation of Dose to the

Public, US Dept of Energy, 1988 report and are similar to but do not exactly match the values contained in Table III.1 of FGR 12.

COROD is the TVA computer code used to calculate control room dose consequences. The user's manual states that the TEDE is calculated by taking 100% of the gamma dose + 1% of the Beta dose + the concentration*DCFs from Table 5-4 of EPA 400-R-92-001. Table 5-4 is discussed above. RG 1.183 does not take into account Beta dose so including this factor is conservative. However, the gamma dose calculated would represent the DDE mentioned in RG 1.183. COROD calculates the gamma dose by using a point kernal integration method. FSAR Section 15.5.3 provides a discussion of the COROD calculation methods for control room dose.

Because of the differences between the TVA codes and the recommendation in RG 1.183 with respect to the breathing rate and the difference in the DDE DCF, a comparison of the FHA dose using the values specifically enumerated in RG 1.183 and the results from FENCDOSE and COROD was made. The comparison showed that COROD and FENCDOSE calculates at least a 23% higher TEDE value than a calculation utilizing the DCFs and breathing rates specified in RG 1.183. The higher values in the TVA FENCDOSE analysis for the offsite locations are the result of the consideration of the dose due to ground deposition and the higher values for Iodine isotopes than in the RG 1.183 DCF tables. The primary reason for the higher COROD result is due to the use of the point kernel integration for determining the gamma dose. Thus, the results provided in Reference 1 are conservative and meet the intent of RG 1.183.

The following two items will be added to the list of bases for the evaluation in FSAR Section 15.5.6.2

(12) The TEDE values for the Exclusion Area Boundary and Low Population Zone are calculated using dose conversion factors taken from EPA-400-R-92-001, "Manual of Protective Action Guides and Protective Actions of Nuclear Incidents," May 1992. A breathing rate of 3.33E-4 m^3/sec was used for calculating the TEDE.

(13) The TEDE values for the Main Control Room are calculated using 100% of the gamma dose calculated using a point kernel integration, 1% of the Beta dose, and conversion factors taken from EPA-400-R-92-001, "Manual of Protective Action Guides and Protective Actions of Nuclear Incidents," May 1992. A breathing rate of 3.33E-4 m^3/sec was used for calculating the TEDE. FSAR Section 15.5.3 provides a discussion of the COROD calculation methods for gamma and beta dose.

Item (11) will be revised as shown below

(11) The short-term (i.e., 0-2 hour) atmospheric dilution factors at the exclusion area boundary and low population zone given in Table 15A-2 are used. ~~The thyroid dose utilizes ICRP-30 [25] iodine dose conversion factors. Doses are based on the dose models presented in Appendix 15A.~~

Enclosure 1

WBN Unit 2 Discussion of FSAR Section 15.5 Changes

Revision to FSAR Section 15.5.6.3

Currently, FSAR Section 15.5.6.3 states:

> "The thyroid, gamma, and beta doses for FHAs in the Auxiliary and the open containment are given in Table 15.5-23 for the exclusion area boundary and low population zone. These doses are less than 25% of the 10 CFR 100.11 limits of 300 rem to the thyroid, and 25 rem gamma to the whole body and less than the 10 CFR 50.67 limit of 25 rem TEDE. These doses are calculated using the computer code FENCDOSE [16].
>
> "The whole body, beta, and thyroid doses to control room personnel from the radiation sources discussed above are presented in Table 15.5-23. The doses are calculated by the COROD computer code [17]. Parameters for the control room analysis are found in Table 15.5-14. The dose to whole body is below the 10 CFR 50 Appendix A, GDC 19 limit of 5 rem for control room personnel, and the thyroid dose is below the limit of 30 rem and the 10CFR 50.67 limit of 5 rem TEDE."

These paragraphs are rewritten to address the dose results associated with the RG 1.25 case and the RG 1.183 cases separately, because they have different acceptance criteria. In addition, a reference to Regulatory Position C.4.4 of RG 1.183 is added, because it modifies the offsite dose limits of 10 CFR 50.67.

> "The offsite doses were calculated utilizing FENCDOSE [16], while the control room doses were calculated utilizing the COROD computer code [17]
>
> "For the RG 1.25 case, the thyroid, gamma, and beta doses are given in Table 15.5-23 for the control room, exclusion area boundary, and low population zone. The whole body dose and the thyroid dose to the control room occupants are below the whole body limit established in 10 CFR 50 Appendix A, GDC 19 of 5 rem, and the thyroid dose limit of 30 rem. The doses at the exclusion area boundary and the low population zone are less than 25% of the 10 CFR 100.11 limits of 300 rem to the thyroid, and 25 rem gamma to the whole body.
>
> "For the RG .1.183 cases, the TEDE dose is given in Table 15.5-23 for the control room, exclusion area boundary, and low population zone. The dose to control room personnel is less than the limit of 10 CFR 50.67(b)(2)(iii) of 5 rem TEDE, and the dose to the exclusion area boundary and low population zone are less than the limit of 10 CFR 50.67(b)(2)(i) and (ii), as modified by Regulatory Position C.4.4 of Regulatory Guide 1.183 of 6.3 rem TEDE ."

Enclosure 1

WBN Unit 2 Discussion of FSAR Section 15.5 Changes

Revision to FSAR Table 15.5.23

Doses from Fuel Handling Accident Regulatory Guide 1.183 Analyses

FHA in Auxiliary Building (rem)*

	2 HR EAB	30 DAY LPZ	Control Room
TEDE	2.38E+00	6.66E-01	1.02-00

*The FHA in the Auxiliary Building results conservatively bound the FHA in containment with the containment open.

Enclosure 2

WBN Unit 2 – Revised SAMDA Table 5.c-1

Table 5.c-1. SAMA Model Release Categories, Frequencies, Doses, and Economic Costs

	Release Category 1 – LERF			Release Category 2 - BYPASS			Release Category 3 - LATE			Release Category 5 - SERF		
SAMA	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)
Base	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,614	3.84E-06	1.23E+00	$2,243
4	1.25E-06	3.70E+00	$7,929	3.45E-07	8.25E-01	$1,832	1.29E-05	1.40E+01	$41,231	3.81E-06	1.23E+00	$2,231
8	1.25E-06	3.71E+00	$7,963	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,608	3.82E-06	1.23E+00	$2,235
26	1.23E-06	3.65E+00	$7,827	3.50E-07	8.37E-01	$1,859	1.28E-05	1.40E+01	$40,944	3.81E-06	1.23E+00	$2,228
32	6.51E-07	1.93E+00	$4,134	3.50E-07	8.37E-01	$1,859	1.30E-05	1.41E+01	$41,506	2.36E-06	7.60E-01	$1,380
45	1.26E-06	3.72E+00	$7,970	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,586	3.83E-06	1.23E+00	$2,241
46	1.25E-06	3.70E+00	$7,924	3.49E-07	8.35E-01	$1,855	8.11E-06	1.36E+01	$39,797	3.77E-06	1.21E+00	$2,203
56	1.18E-06	3.48E+00	$7,459	3.50E-07	8.37E-01	$1,859	1.27E-05	8.82E+00	$25,891	3.21E-06	1.03E+00	$1,880
70	1.25E-06	3.70E+00	$7,936	3.48E-07	8.33E-01	$1,850	1.30E-05	1.38E+01	$40,449	3.79E-06	1.22E+00	$2,214
71	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,614	3.84E-06	1.23E+00	$2,243
87	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,592	3.83E-06	1.23E+00	$2,242
93	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	6.65E+00 ~~1.42 E+01~~	$16,060 ~~41,618~~	3.84E-06	1.23E+00	$2,243
101	6.14E-07	1.82E+00	$3,896	3.50E-07	8.37E-01	$1,859	1.32E-05	1.44E+01	$42,256	3.84E-06	1.23E+00	$2,243
103	5.20E-07	1.54E+00	$3,299	3.42E-07	8.17E-01	$1,816	9.85E-06	1.07E+01	$31,464	1.49E-06	4.79E-01	$871
109	6.43E-07	1.90E+00	$4,078	3.50E-07	8.37E-01	$1,859	1.26E-05	1.37E+01	$40,212	3.84E-06	1.23E+00	$2,243
110	9.51E-07	2.82E+00	$6,037	3.50E-07	8.37E-01	$1,859	1.31E-05	1.43E+01	$41,825	3.84E-06	1.23E+00	$2,243
112	1.26E-06	3.72E+00	$7,971	3.42E-07	8.18E-01	$1,816	1.30E-05	1.42E+01	$41,614	3.84E-06	1.23E+00	$2,243
136	1.25E-06	3.71E+00	$7,954	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,611	3.82E-06	1.23E+00	$2,234
156	1.19E-06	3.53E+00	$7,568	3.50E-07	8.37E-01	$1,859	9.70E-06	1.06E+01	$30,988	3.44E-06	1.11E+00	$2,011
176	1.14E-06	3.37E+00	$7,227	2.72E-07	6.50E-01	$1,445	1.05E-05	1.14E+01	$33,523	3.46E-06	1.11E+00	$2,025

Enclosure 2

WBN Unit 2 – Revised SAMDA Table 5.c-1

Table 5.c-1. SAMA Model Release Categories, Frequencies, Doses, and Economic Costs (Continued)

SAMA	Release Category 1 - LERF			Release Category 2 - BYPASS			Release Category 3 - LATE			Release Category 5 - SERF		
	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)	Freq (per yr)	Dose Risk (man - rem/yr)	Economic Risk ($/yr)
191	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,614	3.84E-06	1.23E+00	$2,243
215	1.16E-06	3.44E+00	$7,369	3.50E-07	8.37E-01	$1,859	7.78E-06	8.47E+00	$24,856	3.18E-06	1.02E+00	$1,860
226	1.16E-06	3.44E+00	$7,369	3.50E-07	8.37E-01	$1,859	7.78E-06	8.47E+00	$24,856	3.18E-06	1.02E+00	$1,860
255	1.05E-06	3.10E+00	$6,651	1.88E-07	4.50E-01	$1,001	1.05E-05	1.14E+01	$33,373	3.47E-06	1.12E+00	$2,026
256	9.42E-07	2.79E+00	$5,978	2.63E-07	6.28E-01	$1,396	9.77E-06	1.06E+01	$31,211	2.88E-06	9.26E-01	$1,682
276	1.25E-06	3.70E+00	$7,926	3.48E-07	8.32E-01	$1,849	1.30E-05	1.41E+01	$41,368	3.81E-06	1.23E+00	$2,231
279	1.25E-06	3.71E+00	$7,954	3.50E-07	8.35E-01	$1,856	1.28E-05	1.39E+01	$40,768	3.80E-06	1.22E+00	$2,223
280	1.25E-06	3.71E+00	$7,954	3.50E-07	8.35E-01	$1,856	1.28E-05	1.39E+01	$40,768	3.80E-06	1.22E+00	$2,223
282	1.25E-06	3.71E+00	$7,965	3.42E-07	8.18E-01	$1,816	1.30E-05	1.42E+01	$41,614	3.83E-06	1.23E+00	$2,238
285	1.25E-06	3.70E+00	$7,936	3.49E-07	8.34E-01	$1,852	1.30E-05	1.42E+01	$41,605	3.74E-06	1.20E+00	$2,186
292	5.97E-07	1.77E+00	$3,788	3.50E-07	8.37E-01	$1,859	1.29E-05	1.41E+01	$41,266	2.03E-06	6.54E-01	$1,189
295	1.26E-06	3.72E+00	$7,971	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,614	3.89E-09	1.25E-03	$2
299	1.23E-06	3.64E+00	$7,803	3.50E-07	8.37E-01	$1,859	1.19E-05	1.30E+01	$38,156	3.71E-06	1.19E+00	$2,169
300	1.25E-06	3.70E+00	$7,936	3.49E-07	8.34E-01	$1,852	1.30E-05	1.42E+01	$41,604	3.78E-06	1.22E+00	$2,209
303	1.25E-06	3.71E+00	$7,964	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,589	3.84E-06	1.23E+00	$2,243
304	1.25E-06	3.71E+00	$7,964	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,589	3.84E-06	1.23E+00	$2,243
305	9.06E-07	2.68E+00	$5,749	3.50E-07	8.37E-01	$1,859	1.29E-05	1.40E+01	$41,199	3.84E-06	1.23E+00	$2,243
306	9.07E-07	2.68E+00	$5,755	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,563	3.79E-06	1.22E+00	$2,218
307	1.26E-06	3.72E+00	$7,969	3.50E-07	8.37E-01	$1,859	1.30E-05	1.42E+01	$41,605	3.84E-06	1.23E+00	$2,243

Enclosure 3

WBN Unit 2 – Optical Media WBN Meteorological Data 1991 – 2010

The following files are provided on optical media

- ARCON 96 Data 1991-2010
- Hourly Meteorological Data (NRC Format) 1991-2010
- SAMDA MACCs Computer Code Output

Enclosure 4

Regulatory Commitment

1. The revised text will be incorporated in Amendment 107 of the FSAR.