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

August 22, 2011

10 CFR 50 Appendix I
10 CFR 51.92

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 – Response to Request for Additional Information on the Determination of the 50 Mile Population Dose**

References:

1. TVA letter to NRC dated February 15, 2008, "Watts Bar Nuclear Plant (WBN) – Unit 2 – Final Supplemental Environmental Impact Statement for the Completion and Operation of Unit 2"
2. TVA letter to NRC dated July 28, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Results from Cost-Benefit Analysis of Radwaste System Enhancements"
3. Draft U.S. NRC Regulatory Guide 1.111 Revision 1, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactor," draft dated July 1977
4. U.S. NRC Regulatory Guide 1.109 Revision 1, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," dated October 1977

The purpose of this letter is to respond to a verbal request for additional information from the NRC staff on the need to provide additional conservatism in the calculation of the 50 mile population dose through the inclusion of terrain adjustment factors. The population dose is discussed in Chapter 11 of the Final Safety Analysis Report (FSAR), Section 3.13 of the Final Supplemental Environmental Impact Statement (FSEIS) (Reference 1), and was used in Reference 2 to determine the potential benefit of various modifications to the WBN radwaste processing systems. The enclosure provides the basis for concluding that the current FSAR and FSEIS population dose values are adequate and conservative.

There are no new commitments in this letter.

If you have any questions, please contact Bill Crouch at (423) 365-2004. I declare under penalty of perjury that the foregoing is true and correct. Executed on the 22nd day of August, 2011.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

Enclosure: X/Qs for Routine Releases

cc (Enclosure):

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Enclosure

TVA Letter Dated August 22, 2011
X/Qs for Routine Releases

NRC asked if terrain adjustment factors were applied to the X/Q values used to determine the total population dose within 50 miles of the site and if not why not.

Response:

TVA uses the Gaseous Effluent Licensing Code (GELC) computer code to calculate X/Q and D/Q values as well as the offsite dose due to routine releases for the WBN site. GELC uses a Gaussian straight-line trajectory model to determine the dispersion characteristics based on wind speed and atmospheric stability. During licensing of Unit 1, terrain adjustment factors (TAF) were developed and used to account for topography and diurnal related factors in determining the dose to the maximum exposed individual. These factors were applied to the receptors within approximately 5 miles of the plant as shown in FSAR Table 3.11-8. TVA developed these TAFs using the variable trajectory computer code MESOPUFF II to calculate X/Q's for the same near site locations. MESOPUFF II was the code used by EPA at the time for determining dispersion coefficients. The TAFs were calculated by dividing the MESOPUFF II X/Q values by the GELC X/Q values. The GELC X/Q values were then multiplied by the appropriate ratio. If the ratio was less than one, the multiplier was set to one.

TAFs were not applied to the X/Q values used for determining the 50-mile total population dose for licensing Unit 1. Licensing submittals for Unit 2 were developed on the same basis as Unit 1, and TAFs were not used in determining the 50-mile population dose.

For determining population doses to the 50-mile population around the plant, a circle with a radius of 50 miles around the plant is divided into 22.5 degree sectors centered on the 16 main compass points. Each compass sector is then broken down into 10 elements. The midpoint distance of each element from the site is determined and ranges from 0.8 miles to 45 miles. Dispersion factors are calculated for the midpoint of each sector element. For each of these sector elements, an average dose is calculated and then multiplied by the population in that sector element. The average dose is determined by multiplying the maximum individual dose for the sector by a ratio of the average ingestion rates to the maximum ingestion rates for each age group. The doses are then multiplied by the fraction of the population belonging to each age group in that sector element. The 50-mile population dose for a given organ (thyroid and total body) is the sum of the population doses for each age group and pathway over all sector elements. This is done in accordance with the methodology that is recommended in Regulatory Guide 1.109 (Reference 4).

TAFs for all 50-mile receptors were evaluated using the same technique used for near the plant receptors to determine if the use of TAFs was warranted in determining the population doses. MESOPUFF II runs were made for all 160 receptors within 50 miles of the plant. As shown in FSAR Table 11.3-8, TAFs with values greater than one were calculated for most receptors within the low population zone (i.e., within approximately 5 miles of the site). Four of 16 elements with centers located at 7.5 miles from the site had TAF values greater than 1.0. Once the distance from the plant exceeded 7.5 miles, the X/Q values from MESOPUFF II were equal to or lower than the X/Q values calculated by GELC. The MESOPUFF II X/Q values for receptors 30 or more miles from the plant were approximately two to three orders of magnitude lower than the values calculated by GELC. Less than two percent of the total 50 mile population resides within 10 miles of the site. Chattanooga and Knoxville, where most of the population within 50 miles of the WBN site resides, are located about 50 miles from the plant.

Enclosure

TVA Letter Dated August 22, 2011
X/Qs for Routine Releases

Dose to the Projected Population in 2040
within 50 Miles of Watts Bar Nuclear Plant

Analysis	Total Body Dose (person-rem)	Thyroid Dose (person-rem)
Current FSAR Source Term & X/Q values	6.68	13.0
Current FSAR Source Term & Highest X/Q values from MESOPUFF II or GELC	6.98	13.8
Current FSAR Source Term & MESOPUFF II X/Q	1.86	4.35
Actual 2010 Source & MESOPUFF II X/Q	8.70E-02	8.95E-02

Four separate cases were considered. The first is the current FSAR and FSEIS analysis using X/Qs calculated by GELC. The second case uses the highest X/Q value from either MESOPUFF II or GELC with the FSAR Chapter 11 source term. The third case shows the results for the FSAR source term with X/Q values from MESOPUFF II, a variable trajectory code. Reference 3 states that the preferred model is one that among other attributes best simulates atmospheric transport in the region of interest. MESOPUFF II is a more physically realistic model than GELC. The last case presented shows the projected 50-mile population dose using the actual plant releases for 2010.

These evaluations show that the 50 mile population doses as presented in the FSAR are sufficiently conservative, and no additional correction factors (i.e., near site TAFs) need to be included. In regard to the specific need to include terrain adjustment factors, Reference 3 states the following: "adjustments to Equation (3) may be necessary to prevent misrepresentation of actual atmospheric transport and diffusion characteristics that could result in **substantial** underestimates of actual exposure to an individual or population" (emphasis added). A comparison of case 2 to case 1 shows that there is not a substantial underestimate of the population dose. Case 3 shows the FSAR results do not underestimate the dose but have significant margin for the given source term. The conclusions from the cost benefit analysis (Reference 2) remain valid and no additional enhancements need to be considered. The more accurate X/Qs for case 3 would have allowed gaseous releases to have been screened out in the cost benefit study and no enhancements would have needed to be considered. The last case shows the actual margin in the FSAR (case 1) analyses. The current FSAR and FSEIS population dose values are adequate and conservative and do not need to be revised to include TAFs for the receptor locations out to 50 miles.