TVA

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

June 17, 2011

10 CFR 50.4

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

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

Subject: **WATTS BAR NUCLEAR PLANT (WBN) – UNIT 2 – RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MANAGEMENT DESIGN ALTERNATIVE REVIEW (SAMDA) (TAC NO. MD8203)**

References:

1. NRC to TVA letter dated June 13, 2011, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Severe Accident Management Design Alternative Review - June 2011 (TAC No. MD8203)"

2. TVA to NRC letter dated May 25, 2011, "Watts Bar Nuclear Plant (WBN) - Unit 2 - Response to Request for Additional Information Regarding Severe Accident Management Design Alternative Review (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)"

The purpose of this letter is to provide clarifications to previous TVA responses provided in Reference 2 regarding the Severe Accident Management Design Alternatives (SAMDA) analysis. These clarifications stem from questions raised by the NRC staff in a telecon held on June 2, 2011, and subsequently documented by NRC in Reference 1. The enclosure provides these additional clarifications.

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In addition, Table 2.a.iv-4a is also included in the enclosure. This table shows the weighted averages of the release fractions for the four release categories. These weighted values were not used in the SAMDA assessment. The table presented differs in selected values from that previously submitted in Reference 3. The element headings had gotten out of order in the earlier submittal. This table is consistent with the data shown in Table 2.a.iv-4 (provided in this submittal) for each of the eleven cases.

This letter contains no new Regulatory Commitments.

If you have any questions, please contact Bill Crouch at (423) 365-2004.

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

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

Enclosure:

1. Clarifications to Previous TVA Responses to NRC Request for Additional Information

cc (Enclosure):

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ENCLOSURE

CLARIFICATIONS TO PREVIOUS TVA RESPONSES TO NRC REQUEST FOR ADDITIONAL INFORMATION

1. *Clarification 2*

   "The response does not clearly state how the unavailability of Unit 1 or shared components are accounted for in determining the annual averaged Unit 2 CDF and risk. Specifically, how is the potential higher unavailability of these items, during Unit 1 outages, incorporated?

   The response talks about tech spec requirements and that they use the Maintenance Rule data but that the maintenance rule data doesn't include unavailability when the item is not required. Take a simple example of a Unit 1 emergency diesel generator (EDG) which supplies power to the unit 1 shutdown board and is credited for unit 2 by cross-tying of the shutdown boards. The Unit 1 EDG has a listed unavailability due to testing and maintenance of 0.02 (based on the Tennessee Valley Authority (TVA) list of risk reduction worth (RRW), typical for EDGs), while Unit 1 is at power (say, for simplicity, 95 percent of the year). Thus, with Unit 1 at power for 0.95 yr, the Unit 1 EDG is unavailable for 0.02 x 0.95 yr = 0.019 yr. However, there is an additional 0.05 yr (the 5 percent of the time Unit 1 is not at power) when the Unit 1 EDG could be unavailable if needed for Unit 2, such that the unavailability of the Unit 1 EDG for use at Unit 2 ranges from 0.019 yr to 0.019 yr + 0.05 yr = 0.069 yr. The actual value would be somewhere in between 0.019 yr and 0.069 yr (e.g., if the Unit 1 EDG receives maintenance during half the time Unit 1 is not at power, then the unavailability of the Unit 1 EDG for Unit 2 would be 0.019 yr + [0.5][0.05 yr] = 0.044 yr).

   Verify that the unavailabilities being assumed for shared structures, systems, or components in the Unit 2 probable risk assessment evaluation used for severe accident mitigation design alternatives (SAMDAs) bound the expected unavailabilities once dual unit operation has begun."

   TVA RESPONSE

   As stated in TVA's response dated May 25, 2011, dual unit operation with controlling technical specifications (TS) from each unit will limit the outage time for common systems compared to single unit operation. As an example, two trains of Essential Raw Cooling Water (ERCW) must be operable during Modes 1, 2, 3, and 4 (per limiting condition for operation [LCO] 3.7.8), or within 72 hours the unit must begin the transfer to Mode 5. Currently, this LCO does not apply to single unit operation when in Mode 5 or 6. However, when dual unit operation begins, if one unit is in an outage (i.e., Mode 5 or 6), the LCO will apply to the unit that is in Modes 1, 2, 3, or 4. Therefore, the duration of such maintenance events while one unit is in an outage will be limited by the TS requirements on the non-outage unit. Using ERCW as an example, during a Unit 1 outage one train of ERCW may be made unavailable to perform strainer maintenance including sending divers into the strainer bay. The unavailability of the train during the performance of this inspection is accounted for in the PRA model for Unit 2.

   For each unit, all four emergency diesel generators (EDGs) are required operable during Modes 1, 2, 3, and 4 not just to be able to swap boards as stated above. For example, the Unit 1 shutdown boards supply common equipment such as the ERCW pumps which are required for Unit 2 operation and are therefore required to be operable during Unit 2 operation. While one unit is in an outage (i.e., Mode 5 or 6), the LCO for the EDG will apply to the unit that is in Modes 1, 2, 3, or 4. During Unit 1 only operation, TVA has chosen to perform EDG maintenance while the unit is on-line, not during outages. Therefore, the maintenance rule data collected reflected all of the maintenance performed on the EDG. The maintenance reflected in the PRA model includes times for corrective maintenance and the annual heat exchanger flush, 2-year, 4-year, 6-year and 12-year scheduled preventative maintenance. The PRA model has accounted for maintenance performed on the EDGs whether the unit is at power or not. TVA does not anticipate having a longer EDG outage while one unit is in refueling mode. For the shutdown boards, a short time for board maintenance is modeled, which will be limited by TS duration for these boards.

In the PRA model, maintenance is not considered for the 125V DC vital battery system because there is a spare vital battery and charger that may be substituted for any of the required vital batteries. This is true whether a unit is at power or in an outage. Each of the 120V AC vital instrument channels has access to a normal inverter or a spare inverter. Spare inverters are available and are used if maintenance is performed on the normal inverter; therefore, maintenance was not considered for these components in the PRA model. Again, this would be true if both units are on-line or Unit 1 is in an outage.

TVA believes the unavailability times used in the WBN CAFTA model are sufficient for proper decision-making with respect to the proposed SAMDA measures.

2. *Clarification 3.a*

"The 3rd issue raises the point of optimistically determined mission times for heat up calculations. In the last paragraph, TVA says that 24 hours was generally assumed. The facts and observations (F&O) proposed resolution is for TVA to make an explicit judgment of the adequacy of the assumptions and document this. Thus the issue is still open since those where 24 hours is not used may be optimistic and TVA has not specifically indicated that they have made the explicit judgment suggested. TVA notes however that the peer review concludes that this F&O is met.

Please clarify what is excluded by the term "generally" and provide a definitive statement that TVA has reviewed the analysis and finds it adequate."

TVA RESPONSE

Twenty four hours was used for most systems as a mission time in the PRA. The following functions had a mission time less than 24 hours: Emergency Boration (EB), electric power equipment related to 4-hour battery coping time, Residual Heat Removal (RHR), and Reactor Protection system, and Engineered Safety Feature Actuation System (ESFAS). The equipment used for EB is the same equipment used for other charging functions that have a mission time of 24 hours with the exception of manual valves. The manual valves were assumed to not have a dependency upon HVAC. The other equipment in the EB system was evaluated for HVAC dependence based upon the Chemical Volume and Control System (CVCS) 24 hour mission time and HVAC was a required dependency for the charging pumps. Equipment in the Electric Board Rooms was evaluated for HVAC dependency for a mission time of 24 hours. The mission time for RHR is 1 hour for injection and 23 hours for recirculation modes. The normal RHR cooldown function has a mission time of 20 hours. The RHR system was evaluated for HVAC dependence based upon a 24 hour mission time. The mission time for Reactor Protection System (RPS), ESFAS and instrumentation is 12 hours.

TVA has reviewed the three calculations referenced in the Finding, WBNOSG4-197, WBNOSG4-200, and WBNOSG4-242. WBNOSG4-197 evaluated ventilation in the Intake Pumping Station. The maximum design temperature for the electrical and mechanical equipment rooms as shown on environmental data drawing is 130°F. The temperature, assuming a loss of all ventilation and that the area heaters fail on during summer design conditions, stays below 130°F for 39 hours without operator intervention. There is no ventilation provided in the pump rooms. Therefore, based upon these calculations HVAC for the intake pumping station was not modeled in the PRA.

TVA Calculation WBNOSG4-200, "Transient Temperature Analysis of the 480 Volt Transformer and 125 Volt Battery Rooms," performed a series of analyses for the transformer rooms assuming degradation and the complete loss of ventilation to the rooms. Case 4 was the complete loss of ventilation coincident with a design basis event (DBE) loss of coolant accident (LOCA) with its associated boundary temperatures. The results showed that the peak temperature in each of the rooms was 122°F or less after 72 hours. In addition, the calculation provides a reference to electrical calculation WBPEVAR9104001, "Appendix R – Component Operability Evaluation After Heatup," that establishes that the transformers and associated equipment will continue to function fully loaded at an ambient temperature of 140°F. Thus, it can be concluded that this equipment will function as required and can be screened for HVAC dependencies.

The temperature in the 6.9 and 480V Shutdown Board Rooms on Elevation 757 of the Auxiliary Building was evaluated in WBNOSG4-242. Environmental Data Drawing 47E235-7 shows that the maximum temperature for these board rooms for any designed plant condition is 104°F, including a LOCA or high energy line break (HELB) inside containment. The temperature during a HELB does not impact the electric board rooms, and a loss of ventilation and cooling to the area is the limiting condition. The temperatures in the rooms during the first 24 hours following a loss of ventilation and cooling are listed in WBNOSG4-242. The temperature of Room 757-01, Aux Control Room, reaches the EQ drawing listed temperature of 104°F just over 21 hours into the event and peaks at 105.8°F. No equipment in this room is explicitly modeled in the PRA. Similarly, Room 757-24, 6.9 kV Shutdown Board Room B, exceeds 104°F by less than one degree. The room reaches 104°F 23 hours into the event. The calculation concludes that given the small temperature difference and the short duration that the temperature is above 104°F in a portion of the area, it was concluded that required equipment in the Shutdown Board Room will not fail due to environmental effects for 24 hours after an event resulting in a loss of ventilation.

Based upon the results of TVA's review, there is no indication that any changes will be developed which could substantially impact the SAMA evaluation.

3. *Clarification 5.a*

"This response states that the same data blocks were used in the SEQSOR emulator as in the SEQSOR code, except where processes or equipment that needed to be considered in the Unit 2 analysis were not included in the NUREG-1150 analysis. Please confirm that the statement concerning data blocks means that the same data in the data blocks were used."

TVA RESPONSE

It is confirmed that the data block structures and specific data used in the SEQSOR analysis documented in NUREG/CR-4551 were also used in the WBN Unit 2 SAMA evaluation. The exceptions to this, only to cover events not considered in the earlier work, are as noted in the earlier response; i.e., the three different containment responses (venting, late unfiltered vent, and for intact containments) and to represent the process of steam generator tube rupture scrubbing.

4. *Clarification 5.b*

"The RAI responses submitted by letter dated January 31, 2011, include source terms (Table 2.a.iv-4) and other release characteristics (Table 2.a.iv-5) for the 4 release categories. We now understand that these were not used to calculate the consequences but rather, the consequences were calculated for the dominant release category types that make up each release category, with these results weighted by the contribution from each release category type to the release category itself. These weighted release category consequences for the 4 release categories were then used to determine the benefit of each SAMDA.

Please indicate (1) how the values in these tables were developed and, (2) if they were used, in what way? Please confirm that the above understanding is correct, verifying that the values in the tables were not used in the benefit calculations. The standard SAMDA Safety Evaluation usually cites the early release tables that give the release fractions, and we need to qualify their use. Also, the standard SAMDA Safety Evaluation normally cites the release characteristics (release fractions and other items) used in the Level 3 analysis and makes a statement as to their reasonableness. Provide the source terms and the consequence results for the 11 release characteristics that were combined to produce the consequences for the 4 release categories."

TVA RESPONSE

The understanding expressed in paragraph one above is confirmed.

Tables 2.a.iv-4, 5, and 6 have been revised below to provide the source terms, release characteristics, and consequences for each of the 11 cases run to determine the Release Category consequences. Each of the 11 cases was evaluated separately, and the resulting consequences then were weighted by the relative frequencies of each case assigned to the same Release Category. Four cases were used for each of the Late and Early Release Categories, two cases for the small early release frequency (SERF) Release category, and one case for the Bypass Release category.

Table 2.a.iv-4a is also included below. This table shows the weighted averages of the release fractions for the four release categories. As previously noted, these weighted values were not used in the SAMA assessment. The table presented differs in selected values from that previously submitted; the element headings had gotten out of order in the earlier submittal. This table is consistent with the data shown in Table 2.a.iv-4 for each of the 11 cases.

Table 2.a.iv-4 - RAI Revised Source Terms for Eleven Release Category Cases

Case	Noble	I	Cs	Te	Ba	Sr	Ru	La	Ce	Frequency
Early 1A	8.5E-01	2.2E-02	1.5E-02	1.7E-02	9.1E-03	1.4E-02	9.5E-03	8.4E-03	9.2E-03	35.0%
Early 1B	8.5E-01	5.6E-03	6.6E-03	8.0E-03	7.2E-03	9.5E-03	7.8E-03	7.4E-03	7.2E-03	30.0%
Early 2A	8.5E-01	1.3E-01	7.1E-02	5.5E-02	1.8E-02	1.6E-02	1.0E-02	1.1E-02	1.9E-02	20.0%
Early 2B	8.5E-01	3.2E-01	1.7E-01	1.3E-01	3.4E-02	1.9E-02	1.1E-02	1.6E-02	3.7E-02	15.0%
Bypass	8.5E-01	9.0E-02	4.9E-02	3.6E-02	1.1E-02	1.1E-02	7.2E-03	7.5E-03	1.2E-02	100.0%
Late 1A	8.5E-01	1.1E-02	6.7E-03	7.1E-03	2.7E-03	4.6E-03	2.5E-03	2.3E-03	2.8E-03	6.6%
Late 1B	8.5E-01	5.3E-03	3.7E-03	5.5E-03	2.6E-03	4.7E-03	2.5E-03	2.3E-03	2.6E-03	30.0%
Late 2A	8.5E-01	7.4E-03	4.8E-03	6.0E-03	2.5E-03	4.6E-03	2.5E-03	2.2E-03	2.6E-03	3.4%
Late 2B	8.5E-01	1.7E-02	9.2E-03	9.3E-03	3.3E-03	4.8E-03	2.5E-03	2.5E-03	3.4E-03	60.0%
SERF 1	8.5E-03	2.4E-04	2.6E-04	2.9E-04	3.0E-04	3.4E-04	3.2E-04	3.1E-04	3.0E-04	80.0%
SERF 2	8.5E-03	2.7E-03	2.1E-03	1.8E-03	1.6E-03	1.5E-03	1.5E-03	1.5E-03	1.6E-03	20.0%

Table 2.a.iv-5 - RAI Revised Release Heights, Times and Energies for Eleven Release Category Cases

Release Category	Release Height (meters)	Warning Time (hours)	Release Time (hours)	Release Duration (hours)	Release Energy (megawatts)
Early 1A	10	8	10	2	28
Early 1B	10	8	10	2	28
Early 2A	10	8	10	2	28
Early 2B	10	8	10	2	28
Bypass	10	4	8	4	1
Late 1A	10	20	30	10	3.5
Late 1B	10	20	30	10	3.5
Late 2A	10	20	30	10	3.5
Late 2B	10	20	30	10	3.5
SERF 1	10	8	10	2	3.5
SERF 2	10	8	10	2	3.5

[a] These values were taken from similar accident scenarios given in NUREG/CR-4551.

Source (SAIC 2007)

Table 2.a.iv-6 - RAI Revised Doses and Economic Consequences for Eleven Release Category Cases

Case	Total Person-Rem	Economic Cost, $
Early 1A	1.00E+06	4.66E+09
Early 1B	7.81E+05	3.96E+09
Early 2A	1.76E+06	8.01E+09
Early 2B	2.35E+06	1.23E+10
Bypass	1.38E+06	5.31E+09
Late 1A	8.37E+05	2.97E+09
Late 1B	6.75E+05	2.77E+09
Late 2A	7.25E+05	2.83E+09
Late 2B	8.95E+05	3.45E+09
SERF 1	2.10E+05	2.96E+08
SERF 2	4.27E+05	1.74E+09

Table 2.a.iv-4a - RAI Revised Weighted Source Terms for Four Release Category Cases

Case	Noble	I	Cs	Te	Ba	Sr	Ru	La	Ce
Early	8.5E-01	8.3E-02	4.6E-02	3.9E-02	1.4E-02	1.4E-02	9.5E-03	9.8E-03	1.5E-02
Bypass	8.5E-01	9.0E-02	4.9E-02	3.6E-02	1.1E-02	1.1E-02	7.2E-03	7.5E-03	1.2E-02
Late	8.5E-01	1.3E-02	7.2E-03	7.9E-03	3.0E-03	4.7E-03	2.5E-03	2.4E-03	3.1E-03
SERF	8.5E-03	7.3E-04	6.3E-04	6.0E-04	5.6E-04	5.8E-04	5.5E-04	5.5E-04	5.6E-04

5. *Clarification 15*

"For SAMDA 47 - enhance screen wash system - TVA states the benefit is less than 1.6 percent CDF. Please provide the basis for this considering that the loss of CCW is a 10 percent contributor to CDF while loss of ERCW is a 6 percent contributor. As documented in an inspection report dated January 28, 2005, "Watts Bar NRC Integrated Inspection Report 05000390/2004005 and 05000391/2004005," Unit 1 had a series of debris and silting issues. While the screens themselves did not plug, some small lines after the screens were plugged."

TVA RESPONSE

The Traveling Screen common cause failure (CCF) Events and the Operator Action to clear screens prior to plant trip after plugging (DHAERCWS) are the dominant contributors to the Traveling Screen contribution to core damage frequency (CDF) importance. Independent Traveling Screen failure events contribute negligibly. The basic event Fussell-Vesely Importance (FVI) measures for the Traveling Screens are listed in the table below. Traveling Screen plugging is included in these CCF events. The sum of these FVI importance measures adds to less than 1.6 percent. The importance assigned to action DHAERCWS is minimal, largely because other actions are credited in the event ERCW fails; i.e., to align fire protection water to ERCW, or to align fire protection water directly to the 2A-A CCP pump.

NRC Inspection Report 05000390/2004005 dated January 28, 2005, documents the stated events that occurred at WBN Unit 1 in 2004 and 2005. This report refers to trouble with silting rather than debris blockage of the traveling screens, so it really does not apply to SAMDA 47.

The events observed applied to small lines to individual components; e.g., 1A-A CCP backup cooling line. Significant blockage of the traveling screens is reduced in frequency because the ERCW intake is at the inside of a river bend and there is a long channel normal to the river bend radius that leads to the intake. These historical events did not disable all ERCW flow, even to the individual components, either due to just partial blockage or because the lines cleared when flow was established. TVA has implemented corrective actions in response to these events.

Traveling Screen CCF Event Risk Fussell-Vesely (F-V) Importance to CDF

Event	FVI (% CDF)
U0_ERCW_TS_PL_CCF_1_2_3	0.0000
U0_ERCW_TS_PL_CCF_1_2_4	0.0000
U0_ERCW_TS_PL_CCF_1_3	0.0000
U0_ERCW_TS_PL_CCF_1_3_4	0.0000
U0_ERCW_TS_PL_CCF_2_3_4	0.0000
U0_ERCW_TS_PL_CCF_2_4	0.0000
U0_ERCW_TS_PL_CCF_ALL	0.0035
U0_ERCW_TS_PL_CCF_IE_1_2	0.0000
U0_ERCW_TS_PL_CCF_IE_1_2_3	0.0002
U0_ERCW_TS_PL_CCF_IE_1_2_4	0.0002
U0_ERCW_TS_PL_CCF_IE_1_3	0.0000
U0_ERCW_TS_PL_CCF_IE_1_3_4	0.0002
U0_ERCW_TS_PL_CCF_IE_1_4	0.0000
U0_ERCW_TS_PL_CCF_IE_2_3	0.0000
U0_ERCW_TS_PL_CCF_IE_2_3_4	0.0002
U0_ERCW_TS_PL_CCF_IE_2_4	0.0000
U0_ERCW_TS_PL_CCF_IE_3_4	0.0000
U0_ERCW_TS_PL_CCF_IE_ALL	0.0114
DHAERCWS (Operator Action)	0.0001
F-V Total	**0.0158**