UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 12, 2010

Mr. Ashok S. Bhatnagar
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and Construction
Tennessee Valley Authority
6A Lookout Place
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SUBJECT: WATTS BAR NUCLEAR PLANT, UNIT 2 – REQUEST FOR ADDITIONAL INFORMATION REGARDING LICENSEE'S FINAL SAFETY ANALYSIS REPORT AMENDMENT RELATED TO ELECTRICAL ENGINEERING SYSTEMS (TAC NO. ME2731)

Dear Mr. Bhatnagar:

By letters dated November 24, 2009, and January 11, 2010 (NRC Agencywide Documents Access and Management System Accession Nos. ML093370605 and ML100191686), the Tennessee Valley Authority (TVA) submitted Final Safety Analysis Report (FSAR) Amendment Nos. 95 and 97 for Watts Bar Nuclear Plant (WBN), Unit 2. The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the information provided by the TVA and finds that additional needed to complete the NRC staff review.

Thus, enclosed is a request for additional information (RAI) regarding electrical engineering systems for the FSAR Sections 8.1, 8.2, 8.3.1, 8.3.2, and 8.4 and Chapter 9, Section 9.5.3. The NRC staff's RAI seeks information on WBN Unit 2 as it relates to dual-unit operation of the facility. The NRC staff RAI addresses those areas that the NRC staff found differences in WBN Unit 2 from Unit 1 or the NRC staff found information lacking for the staff to reach a safety conclusion.

A response is required within 30 days of receipt of this letter.

If you should have any questions, please contact me at 301-415-6606.

Sincerely,

Joel S. Wiebe, Senior Project Manager
Watts Bar Special Projects Branch
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-391

Enclosure: RAI

cc w/encl: Distribution via Listserv

REQUEST FOR ADDITIONAL INFROMATION

WATTS BAR NUCLEAR PLANT, UNIT 2

FINAL SAFETY ANALYSIS REPORT AMENDMENT NOS. 95 AND 97

TENNESSEE VALLEY AUTHORITY

DOCKET NO. 50-391

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Section 8.1- Electric Power - Introduction

1. FSAR Section 8.1.5.3, "Compliance to Regulatory Guides and Institute of Electrical and Electronics Engineers (IEEE) Standards," states that WBN Unit 2 complies with Regulatory Guide (RG) 1.32, Revision 0, "Criteria for Power Systems for Nuclear Power Plants;" RG 1.81, "Shared and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants," Revision 1; IEEE Std 308-1971, "Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations," in meeting NRC regulations in Title 10, *Code of Federal Regulations* (10 CFR) Section 50, Appendix A General Design Criteria 5 and 17. FSAR Section 3.1.2 states that the preferred and emergency electric power systems are shared. Since NRC staff has not previously reviewed the capability of the preferred and emergency electric power systems for dual-unit operation, provide an executive summary of the analysis to support the following design requirements.

    a. A dual-unit trip as a result of abnormal operational occurrence
    b. Accident in one unit and concurrent shutdown of the second unit (with and without offsite power)
    c. Accident in one unit and spurious Engineered Safety Features actuation in the other unit (with and without offsite power)

2. Explain how the industry and WBN Unit 1 operating experience and the NRC generic communications have been reviewed and incorporated in the electrical design, maintenance, surveillance testing, and operations for WBN Unit 2.

ENCLOSURE

Section 8.2 - Offsite Power System

1. The common station service transformers (CSSTs) are described in Section 8.2.1.2 of the FSAR. It is stated that their calculated loading is well below their winding ratings for all conditions. FSAR page 8.1-13 Position C2 states, "The shared safety systems are designed so that one load group (Train 1A & 2A or Train 1B & 2B) can mitigate a design basis accident in one unit and accomplish an orderly shutdown of the other unit." These CSSTs are shared between the WBN Unit 1 and WBN Unit 2. In view of the WBN Unit 2 loads being applied to the CSSTs along with WBN Unit 1 loads, the NRC staff requests the following information:

   Provide an executive summary of the calculations and analyses that detail the loading for both units (or added loads of WBN Unit 2 to the existing loads of WBN Unit 1). Define the bounding conditions for maximum loading that demonstrate that the winding ratings are not exceeded. Provide a summary of the calculation that demonstrates the design margin in the CSSTs with a design-basis accident (DBA) in one unit and a concurrent shutdown of the other unit. The summary of the design calculations must include inputs, assumptions, and a summary of output results (with acceptance criteria) including any load creep for both units.

2. FSAR Section 8.2.1 states that to provide a stable voltage, CSSTs C and D have automatic high-speed load tap changers (LTCs) on each secondary, which adjust voltage based on the normally connected shutdown boards.

   Provide an executive summary of the calculations/analyses that details the plant loadflow/voltage studies and operations of the load tap-changing units including a detailed discussion of the control voltage setting, the voltage control band, the time-delays for LTC operation, etc. The summary of the calculations must include inputs, assumptions, and summary of the output results (with acceptance criteria).

3. FSAR Section 8.2.1 describes the 161 Kilovolt (kV) preferred offsite power supply from Watts Bar Hydro Plant Switchyard (WBHS) for dual-unit operation at the WBN. The FSAR states that transmission system studies were completed to show the adequacy and capability of one 161 kV line and one CSST for starting and running all required safety-related loads for a DBA in WBN Unit 1 and <u>no fuel load in WBN Unit 2.</u> Since WBN Unit 2 loads will be supplied from the same 161 kV preferred power supply, the staff requests the below listed information with regard to the adequacy and capability of the 161 kV preferred offsite power supply for dual-unit operation (DBA in one unit and a concurrent shutdown of the other unit).

   Provide a detailed discussion describing all such transmission system grid conditions and also describe in detail the operating characteristics of the offsite power supply at the WBHS (for dual-unit operation) including operating voltage range, post-contingency voltage drops (including bounding values and post-unit trip values), operating frequency range, etc. In addition, provide the design operating voltage range of the shutdown boards (minimum and maximum voltage) and how low the WBHS voltage can drop (assuming operation of LTCs) while still supplying the worst case shutdown board loading at the minimum design voltage of the shutdown boards. Also provide an executive summary of the grid studies completed for dual-unit operation including when the studies were completed. The summary of the grid studies must address dual-unit

operation, the transmission network interface available fault current changes, the impact on the switchyard and plant switchgear and cabling. The summary also must include the overall inputs, assumptions, and summary of the output results (with acceptance criteria).

Section 8.3.1 – Alternating Current (ac) Power Systems (Onsite)

1. FSAR Sections 8.2.2 and 8.3.1 describe the degraded voltage (27DAT, DBT, DCT) and loss of voltage relays (27LVA, LVB, LVC). The degraded-voltage relays as described in the FSAR have a voltage setpoint of 96 percent of 6.9 kV and a time delay of 10 seconds. FSAR Section 8.2.1 states that to provide a stable voltage, CSSTs C and D have automatic high-speed LTCs on each secondary, which adjust voltage based on the normally connected shutdown boards. The recent NRC Component Design Basis Inspections (CDBI) indicated issues associated with calculations to support the degraded voltage setpoints. In view of the CDBI findings, provide the below listed information with regard to WBN Unit 2.

   a. Provide an executive summary of the results of calculations/analyses which detail plant load flow and voltage drop studies, and operations of the load tap-changing units including a detailed discussion of the control voltage setting, the voltage control band, time-delays associated with LTC operation, etc. The summary of the calculations must include inputs, assumptions, and summary of the output results (with acceptance criteria).

   b. Provide a summary of the analyses (steady state and transient) that demonstrate that the above degraded voltage trip set points are adequate to protect all safety-related equipment required for design basis events and also to provide the required minimum voltage at the equipment terminal to start and run all loads consistent with the accident analysis assumptions without crediting the LTCs of the CSSTs.

   c. Provide executive summary of calculations/analyses for settings of the loss-of-voltage relays (27LVA, LVB, LVC) provided at 6.9 kV shutdown boards. The summary of the calculations should include criteria, assumptions, and output results.

2. According to the FSAR, Figure 8.1-2A, the CSSTs, C and D normally supply Train 'A' (1A and 2A) and Train 'B' (1B and 2B) shutdown loads, respectively relating to the two units. In case of loss of either CSST, the loads fed from the corresponding CSST shutdown buses are automatically transferred to other CSST via the automatic transfer scheme.

   Provide description of the automatic transfer scheme from normal to alternate source (whether fast – how many cycles etc.) as it relates to WBN Unit 2. Also, explain the transient behavior of loads that were already running on the shutdown boards.

3. FSAR, Table 8.3-3 shows sequence of loads applied following a loss of preferred (offsite) power (from the time of closing of the generator breaker connecting the diesel generator to the shutdown board). However, in Section 8.3.1.1 (under subheading "System Operation," it is stated that "The standby (onsite) power system's automatic sequencing logic is designed to automatically connect the required loads in proper sequence should the logic receive an accident signal prior to, concurrent with, or

following a loss of all nuclear units and preferred (offsite) power." Regarding the above statement with respect to WBN Unit 2, explain the design of the automatic sequencing logic.

4. In Section 8.3.1.1 of the FSAR (under the subheading "Equipment Capacities"), it is stated that "Tables 8.3-4 through 8.3-7 present the bus rating, connected load, and maximum demand load for each electrical distribution board in the standby (onsite) power system."

   Because of anticipated two-unit operation, the NRC staff requires the information on connected and maximum demand loads to assess the capacity and capability of the onsite distribution system for WBN Unit 2.

5. In Section 8.3.1.1 of the FSAR (under the subheading "Standby Diesel Generator Operation"), it is stated that "For test and exercise purposes, a diesel generator may be manually paralleled with a normal or alternate (offsite) power source. A loss of offsite power will automatically override the manual controls and establish the appropriate alignment."

   Regarding the above statement with respect to WBN Unit 2, please explain what is meant by "appropriate alignment."

6. In order to verify the adequacy of the diesel generator capacity stated in Section 8.3.1.1 of the FSAR for WBN Unit 2 loading, provide the following information:

   (a) Worst case expected diesel generator load profile (considering both auto and manual loads) during first 24 hours of accident occurring in one unit and shutdown of other unit and assuming single failure of one diesel generator or assuming single failure of "A" train or "B" train (two diesel generators of same train out).

   (b) Confirm factors such as cable losses, pump run-out conditions, power factor, off-nominal frequency and off-nominal voltage, motor efficiency, have been accounted for in the diesel generator load profile calculations.

7. In Section 8.3.1.2.3 of the FSAR (under the subheading "Underground Cable Installation"), it is stated that "Cables are designed to operate in wet conditions. The Class 1E cables required to operate the plant in the flooded condition are continuous or provided with a waterproof splice in a manhole. Cables have been tested at the factory by the manufacturer according to TVA specifications, which invoke Insulated Cables Engineers Association (ICEA, formerly IPCEA) standards for cables installed in wet environments." Clarify whether the WBN Unit 2 underground cables are designed for submerged or flooded conditions.

Section 8.3.2 – Direct Current (dc) Power Systems (Onsite)

1. On page 8.3-60 of the FSAR, a description is given on load assignments with respect to divisional requirements. The staff requests additional information on assignment of loads for maintaining separation between loads of different divisions and channels as follows:

a. Provide a detailed discussion on the divisional requirements (i.e., the requirements for two and four divisions of separation).

b. Describe the methodology that you used for distributing the nondivisional loads among the four channels.

FSAR page 8.3-64 states the following:

"A battery service test, conducted in accordance with the procedures of Section 6.6 of IEEE Standard 450-1980 or modified performance test based on Section 5.4 of IEEE 450-1995, is also used to test the batteries under conditions as close to design as practical."

a. In order to credit the modified performance test as a replacement for the service test, it must completely envelope the service test. Provide the duty cycle load profile for both the service and modified performance tests (in graphic form) to show that the modified performance test completely envelopes the service test for each of the vital and diesel generator (DG) system batteries' design duty cycles (i.e., DBAs, station blackout (SBO), and Appendix R).

b. The latest version of IEEE Standard 450 that is endorsed by the NRC is IEEE Standard 450-2002. The NRC has not endorsed IEEE Standard 450-1995. Provide the technical basis for selecting the IEEE Standard 450-1995 instead of the IEEE Standard 450-2002.

c. Clarify whether the battery service test(s) verify the design duty cycles for DBAs, SBO, and Appendix R scenarios.

2. FSAR page 8.3-66 states the following:

The 125V dc Class 1E electrical systems were designed, components fabricated, and are, or will be installed meeting the requirements of the NRC 10 CFR Part 50 Appendix A General Design Criteria, IEEE Standard 308-1971, NRC Regulatory Guides 1.6 (Revision 0) and 1.32 (Revision 0), and other applicable criteria as enumerated herein.

a. Explain how the system design meets the guidance provided in RG 1.32 and IEEE Standard 308-1971 with regard to sharing dc power sources at a multi-unit nuclear power plant site.

b. Provide an executive summary of the results of calculations used for determining the size of the inverters, chargers, batteries, and fuses (the scope of this request includes the normal and 125 Volt (V) DG battery systems). Include key inputs and assumptions and a discussion of margins in your response.

3. FSAR page 8.3-67 states the following:

The normal or preferred power source to each distribution board is from the battery charger, which is supplied from either one of two 480V ac shutdown distribution

boards. The battery serves as an emergency source in the event the battery charger source is lost or is inadequate for the load required. Table 8.3-12 provides maximum loading for each board for normal, loss of all ac power, and accident conditions.

After reviewing Table 8.3-12, the staff noticed that it does not include the maximum loading values for normal conditions. Provide the maximum loading values under normal conditions.

4. FSAR page 8.3-69 states the following:

"Seismic Category I(L) battery charger V is intended solely to maintain vital battery V in its fully charged state and to recharge it following its use or testing. At no time will battery charger V be used to supply vital battery system loads. The fifth battery charger does not supply dc system loads; therefore, the overvoltage and failure alarm relays do not serve any safety or protective function and consequently are not required for alarms."

   a. Describe how vital battery V and its associated components will be protected against potential overvoltage conditions when being used as a temporary replacement for vital battery I, II, III, or IV.

   b. Explain how the fifth battery is maintained in a fully charged state and its associated equipment is supplied power when used as a temporary replacement for vital battery I, II, III, or IV. In your response, include a discussion on the capability of the battery charger to recharge the battery and supply expected loads.

5. Provide the title for Section 8.3.2.5 of the FSAR (located on page 8.3-71).

6. FSAR page 8.3-72 states the following:

"The limiting conditions studies was the loss of offsite power concurrent with the failure of one battery. Table 8.3-13 shows the results of this study."

After reviewing the FSAR, the staff could not locate this Table. Provide the Table 8.3-13 (or the results of this study) for NRC staff review.

7. Provide the performance characteristic curves that illustrate the capability of the Class 1E Batteries to respond to and supply the most severe loading conditions at the plant. In your response, include the performance characteristic curves such as voltage profile curves, discharge rate curves, and temperature effect curves.

8. FSAR page 8.3-19 states the following:

"The diesel generator 125V dc battery system's chargers have the capacity to continuously supply all steady-state loads and maintain the batteries in the design maximum charged state or to fully recharge the batteries from the design minimum discharge state within an acceptable time interval, irrespective of the status of the plant during which these demands occur."

   a. Define the term "acceptable time interval."

9. FSAR page 8.3-19 states the following:

   "Each of the diesel generator battery system has sufficient capacity to supply required loads for the four-hour station blackout (SBO) period."

   Provide the technical basis for the 4-hour period and discuss in detail the required loads the DG battery system will be supplying during the four-hour SBO period.

Section 8.4 – Station Blackout

The staff review guidance on SBO (10 CFR 50.63) is given in NUREG 800, Chapter 8, Section 8.4. The NRC staff's review of FSAR Amendment Nos. 95 and 97 finds that they do not contain information on Section 8.4 for addressing an SBO event in WBN Unit 2. The NRC staff issued a safety evaluation (SE) report dated March 18, 1993, (TAC Nos. M68624 and M68625) and a supplemental SE dated September 9, 1993, on WBN compliance with 10 CFR 50.63. The NRC staff believes that the original review of WBN Unit 2 compliance with an SBO was performed under TAC No. M68625. Since WBN Unit 2 is now seeking an OL 17 years after the initial review for conformance to the SBO rule, the NRC staff requests that TVA update and/or validate the original information, or provide a new submittal on how WBN Unit 2 meets the SBO rule. TVA should also update FSAR Section 8.4 to include the relevant information on SBO. The information to be submitted to the staff on SBO for WBN Unit 2 should include the following:

1. The specified coping duration to withstand and recover from an SBO based on the factors listed in 10 CFR 50.63 and the expected frequency of grid-related loss of offsite power in the last 20 years.

2. Provide a summary of the strategies and analysis for coping with SBO for the specified duration. This discussion should provide sufficient information, including baseline assumptions, on the systems and equipment required for coping with an SBO for the specified duration without ac power for the following:

   a. The core and reactor system conditions and the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is covered and cooled. Discuss and provide information on RCS inventory taking into consideration shrinkage, leakage from pump seals, and inventory loss from letdown or other normally open lines.

   b. Discuss and provide information on the capacity of the condensate storage tank to ensure that there will be sufficient water inventory to remove decay heat during the specified SBO duration.

   c. Discuss and provide information on the compressed air capacity to ensure that air operated valves required for decay heat removal have sufficient reserve air and appropriate containment integrity will be maintained for the specified duration.

   d. Discuss and provide information on the adequacy of the battery capacity to support loads required for decay heat removal for the specified SBO duration and emergency diesel generator field flashing for recovering onsite power sources.

e. Discuss the integrity of electrical cabinets and provide information on the effects of the loss of ventilation to other equipment, such as the turbine driven emergency feed water pump, valves, the battery room and other equipment credited for mitigating an SBO event. Discuss and provide the information on the effects of loss of ventilation in all dominant areas of concern and on the equipment credited during an SBO event.

3. Provide information on site-specific procedures and training on the following:

   a. Coping with an SBO for the specified duration;

   b. Restoration of ac power following an SBO event of specified duration; and

c. Preparation for severe weather conditions to reduce the likelihood and consequences of loss of offsite power and to reduce the overall risk of an SBO event.

Section 9.5.3 – Lighting System

1. Provide a summary discussion of the typical luminance ranges for normal and emergency lighting in all areas/rooms of the plant to ensure that the functional capability of the lighting system design provides illumination level in accordance with the IESNA [Illuminating Engineering Society of North America] Lighting Handbook for Central Stations or NUREG 700. Discuss the technical basis if the design illumination levels are not in conformance with the guidelines of IESNA Lighting Handbook for Central Stations and NUREG 700.

   Section 9.5.3 of the WBN Unit 2 FSAR does not describe the illumination levels for the work areas or type of tasks in the Main Control Room (MCR), safety-related panels in the MCR and remote shutdown consoles. Provide a description of the illumination levels for normal lighting in these areas. Discuss the technical basis if the design illumination levels do not conform to the guidelines of IESNA Lighting Handbook for Central Stations or NUREG 700.

   Discuss if the emergency lighting in the MCR, safety-related panels in the MCR and remote shutdown consoles provides illumination levels in these areas equal to or greater than those recommended by the IESNA Lighting Handbook for Central Stations or NUREG 700 for at least 8 hours.

July 12, 2010

Mr. Ashok S. Bhatnagar
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Sincerely,

/RA/

Joel S. Wiebe, Senior Project Manager
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Enclosure: RAI
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