Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-133

July 15, 2015

10 CFR 50.90

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

Watts Bar Nuclear Plant Unit 1
Facility Operating License No. NPF-90
NRC Docket No. 50-390

Subject: **Watts Bar Nuclear Plant Unit 1 – Response to Request for Additional Information Related to Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08)**

References:
1. TVA Letter to NRC, "Application to Modify Watts Bar Nuclear Plant, Unit 1 Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08)," dated April 6, 2015 [ADAMS Accession No. ML15117A462]
2. NRC Electronic Mail to TVA, "Draft Request for Additional Information MF6153.docx," dated May 28, 2015

By letter dated April 6, 2015 (Reference 1), the Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) for the Watts Bar Nuclear Plant (WBN), Unit 1 to modify Technical Specification (TS) 3.8.1, "AC Sources – Operating," diesel generator (DG) steady state frequency acceptance criteria. Specifically, the LAR requests approval to revise the DG steady state frequency acceptance criteria to greater than or equal to (≥) 59.8 hertz (Hz) and less than or equal to (≤) 60.1 Hz. TVA had previously determined that the original DG frequency acceptance criteria of ≥ 58.8 Hz and ≤ 61.2 Hz was non-conservative.

By means of electronic mail message dated May 28, 2015, the Nuclear Regulatory Commission (NRC) provided a draft Request for Additional Information (RAI) (Reference 2). During a teleconference on June 18, 2015, the NRC provided further clarification of the staff's questions.

The enclosure provides TVA's response to the NRC's draft RAI, as clarified by the staff regarding the Reference 1 LAR.

Consistent with the standards set forth in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards consideration determination associated with the request provided in Reference 1.

Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosure to the Tennessee Department of Environment and Conservation.

There are no new regulatory commitments associated with this submittal. Should you have any questions or require additional information, please contact Gordon Arent at (423) 365-2004 or garent@tva.gov.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 15th day of July 2015.

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure: Watts Bar Nuclear Plant - Unit 1 - Response to Request for Additional Information

cc (Enclosure):

NRC Regional Administrator – Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant, Unit 1
NRC Project Manager – Watts Bar Nuclear Plant, Unit 1
Director, Division of Radiological Health – Tennessee State Department of Environment and Conservation

ENCLOSURE

WATTS BAR NUCLEAR PLANT - UNIT 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

BACKGROUND

By letter dated April 6, 2015, the Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) to modify the acceptance criteria for the diesel generator (DG) steady state frequency range provided in Technical Specification (TS) 3.8.1, "AC Sources – Operating," Surveillance Requirements (SRs) 3.8.1.2, 3.8.1.7, 3.8.1.9, 3.8.1.11, 3.8.1.12, 3.8.1.15, 3.8.1.19, and 3.8.1.21 for the Watts Bar Nuclear Plant (WBN) Unit 1 (Reference 1).

The WBN Unit 1 LAR is based on an approach similar to the WBN Unit 2 submittal, dated February 3, 2014, for response to NUREG-0847, Supplemental Safety Evaluation Report (SSER) 22, Open Item No. 32 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14038A079) (Reference 2). To support the WBN dual-unit operation with shared equipment, the DG voltage and frequency should be aligned for both units. The staff reviewed the LAR for Unit 1 and compared the information submitted for Unit 2 open item 32.

By means of electronic mail message dated May 28, 2015, the Nuclear Regulatory Commission (NRC) provided a draft Request for Additional Information (RAI) (Reference 3). During a teleconference on June 18, 2015, the NRC provided further clarification of the staff's questions.

The following provides TVA's response to the NRC RAIs as clarified:

NRC QUESTIONS

NRC Question 1

On page E-12 of Enclosure 1 it states "Only major pumps in safety significant systems were evaluated in detail, because, as summarized in Table 3, the speed, load, flow, and NPSH are minimally impacted (i.e.,0.3%)." However, staff notes that Table 3 summarizes flow rates only. Correct the statement to accurately reflect the record.

TVA Response to NRC Question 1:

TVA proposes a change to the LAR, Enclosure 1, page E-12, to revise the text as follows.

"Only major pumps in safety significant systems were evaluated in detail, because, as summarized in Table 3, the flow is minimally impacted (i.e., 0.3%)."

See Attachment 1 for the replacement page.

NRC Question 2

On page E-14 of Enclosure 1 it states "For 480 V motors, the speed reduction will be 0.3% to 0.63% due to greater voltage drop and higher rated motor slips." Please confirm a bounding analysis was performed to validate the speed changes for 480 V motors. Please provide the reference to support the statement that the speed reduction will be 0.3% to 0.63%.

TVA Response to NRC Question 2:

Appendix 4, "Motor Speed Evaluation," of calculation MDQ00299920110380, "Evaluation of the Impact of Diesel Generator (DG) Frequency and Voltage Limits," Revision 008 provides the basis for the subject statement. The subject calculation has been placed on the TVA *Sharepoint* website for access by the NRC staff for utilization during the course of their review.

NRC Question 3

On page E-14 of Enclosure 1, Section 3.2.4 it states "The increased speed during operation will result in increased flows which in turn increase suction side losses and reduces margin between available and required NPSH. The decreased speed will result in decreased flows which in turn decreases suction side losses and increases the margin between available and required NPSH."

The staff notes that the NPSH parameters in Table 4, on page E-15 are not consistent with the statement in Section 3.2.4 statement. Please provide an explanation of the specific variations in the NPSH parameters due to frequency variation (± 0.3%).

TVA Response to NRC Question 3:

To provide clarification of the terms "increased margin" and "decreased margin" with regard to net positive suction head required (NPSHr), Table 4 has been revised to delete the table column terms, because the terms "NPSHr (ft) (-0.3% speed)" and "NPSHr (ft) (+0.3% speed)" are not margins, but NPSHr values.

Revised Table 4, page E-15, reflecting the corrected text, is included in Attachment 1 to this enclosure. In addition, the basis for Table 4, calculation MDQ00299920110380, "Evaluation of the Impact of Diesel Generator (DG) Frequency and Voltage Limits," Revision 008 has been revised to reflect the column terms. TVA has placed the subject calculation on the TVA *Sharepoint* website for access and utilization by the staff during the course of their review activities.

NRC Question 4

On page E-16 of Enclosure 1, Table 5 provides a summary of 'effective' brake horsepower (BHP) at the allowable frequency range. The staff notes that at nominal frequency, the effective BHP is higher than the nominal HP for all motors except for the Containment Spray (CS) pump. The staff also notes a difference in BHP for the Centrifugal Charging (CC) pumps between the two units (Reference Table 5 in Enclosure 1 for Unit 2 SSER submittal). Please explain the reason for the differences.

TVA Response to Question 4:

In general, the motors in Table 5 of Enclosure 1 (Reference 1) were procured at a "Name Plate" (nominal) rating near their required horsepower operating load. This brought the "Rated" (effective) horsepower close to and in some cases greater than the "Name Plate" horsepower value. Additionally, due to certain pumps requiring higher brake horsepower (BHP) than originally anticipated, motors may be required to operate at a somewhat greater output than their "Name Plate" rating. It should be noted that, in general, the motors were procured to operate at 115% of their "Name Plate" value.

In the case of the Containment Spray System (CSS) pump motors, the motor "Name Plate" rating is significantly higher (i.e., over-sized) than actually required by the CSS pumps. This is the reason for the noted BHP difference between the CSS and the other pumps.

In the case of the Centrifugal Charging (CC) pumps, most of the information supporting both the WBN Unit 1 TS LAR and WBN Unit 2 submittal, respectively, came from calculation MDQ00299920110380, "Evaluation of the Impact of Diesel Generator (DG) Frequency and Voltage Limits." Revision 002 of the calculation provided the brake horsepower at 60.1 Hz; this value (699.17) was used in Table 5 of Enclosure 1 (Reference 2). In Revision 003 of the calculation (approved in December 2013) the brake horsepower was provided for a frequency of 60.2 Hz instead of the 60.1 Hz. When the WBN Unit 2 submittal was being developed, information was obtained from the calculation while it was being revised. A final consistency check of information contained in the WBN Unit 2 submittal did not identify the incorrect Table 5 values. WBN Unit 2 initiated Condition Report 1041928 in accordance with the TVA Corrective Action Program (CAP) to document the error in the WBN Unit 2 submittal.

It should be noted that the error does not impact nor affect the submittal conclusion, that is, the WBN Unit 2 equipment required to mitigate the effects of a loss of offsite power (LOOP) or loss of coolant accident (LOCA)/LOOP, and which are fed by the DGs, are capable of performing their intended functions for the evaluated frequency range.

NRC Question 5

On Page E-14 of Enclosure 1 it states "To support Westinghouse's DG frequency range evaluation, Flowserve, the ECCS [Emergency Core Cooling System] pump vendor provided input as to the expected performance of the Centrifugal Charging pumps and Intermediate Head Safety Injection pumps for continuous operation up to 30 days. Flowserve concluded that both pumps are expected to undergo minor cavitation damage, but would remain operational for the 30 days, with gradual decline in pump/power performance. Additional detail regarding the impact of minor cavitation damage on pump performance is provided in Flowserve Report GS-8236, Revision 3, 'Run-Out Flow Operation Capability Analysis' (Reference 18)."

Please submit the above referenced Flowserve Report.

TVA Response to NRC Question 5:

TVA has placed the subject Flowserve report on the TVA *Sharepoint* website for access and utilization by the staff during the course of their review activities.

NRC Question 6

Please provide basis/reference for the following statements:

a. *On page E-16 of Enclosure 1 it states "The BHP with a speed variation of ±0.3 will vary by 1.0%."*
b. *On page E-12 of Enclosure 1 it states "The stroke time will be less than 0.8% longer."*

TVA Response to NRC Question 6:

The reference for the statement on page E-16 associated with Question 6a from LAR section 3.2.5, "Effect on Motor Horsepower," is TVA calculation MDQ00299920110380, "Evaluation of the Impact of Diesel Generator (DG) Frequency and Voltage Limits," specifically page 15, section titled, "Pump Motor Horsepower."

The reference for the statement on page E-19 associated with Question 6b from LAR section 3.2.8, "Effect on Valve Operating Times," is TVA calculation MDQ00299920110380, "Evaluation of the Impact of Diesel Generator (DG) Frequency and Voltage Limits," specifically page 18, section titled, "Changes in Motor Operated Valves Opening / Closing Time."

TVA has placed the subject calculation on the TVA *Sharepoint* website for access and utilization by the staff during the course of their review activities.

REFERENCES

1. TVA Letter to NRC, "Application to Modify Watts Bar Nuclear Plant, Unit 1 Technical Specification 3.8.1 Regarding Diesel Generator Steady State Frequency (WBN-TS-13-08),” dated April 6, 2015 [ADAMS Accession No. ML15117A462]

2. TVA Letter to NRC, "Watts Bar Nuclear Plant (WBN) Unit 2 - Diesel Generator Frequency - Response to NUREG 0847 Supplemental Safety Evaluation Report (SSER) 22, Open Item 32," dated February 3, 2014 [ADAMS Accession No. ML14038A079]

3. NRC Electronic Mail to TVA, "Draft Request for Additional Information MF6153.docx," dated May 28, 2015

ENCLOSURE

WATTS BAR NUCLEAR PLANT - UNIT 1
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Attachment 1

Replacement Pages for TVA Letter dated April 6, 2015 (CNL-14-218)

Page E-12 of 57

Page E-15 of 57

For motors operating at +0.3% speed from nominal, this relationship equates to:

$$(1.010\ P/P_{SF})^2 * TR_{SF} = 1.020 * TR_{SF}$$

A 2.0% increase or decrease in heat rise would have insignificant impact on motor life. In the case of continuously operated 480 V environmentally qualified (EQ) motors, the 40 year qualified life of the motor is based on an insulation temperature rise of 105°C. Actual tested rise is ≤ 75°C. Therefore, there is more than sufficient margin in the windings. Refer to section 3.2.5 for the discussion regarding large motors.

3.2.3 Effect on Pump Flow

Pump speed is directly proportional to flow (Reference 13). Therefore, a 0.3% speed increase will result in slightly higher flows and 0.3% decrease will result in slightly lower flows. The flow is considered acceptable if they are equal to or greater than those used in the safety analysis. For the Steam Generator Tube Rupture Margin To Overfill Analysis, the higher pump flow rates associated with a + 0.3% motor speed increase was analyzed for the Centrifugal Charging Pumps (CCP) and Safety Injection (SI) Pumps.

For the long term mitigation of a LOOP/LOCA, the DGs supply the following major pumps:

- Auxiliary Feedwater (AFW) Pump
- Containment Spray (CSS Pump)
- Residual Heat Removal (RHR) Pump
- Safety Injection (SI) Pump
- Centrifugal Charging (CC) Pump
- Emergency Raw Cooling Water (ERCW) Pump
- Component Cooling Water System (CCS) Pump

The DGs also supply the following 480 V pump motors:

- Station Fire Pump
- Control Room Chilled Water Circulating Pump
- Shutdown Board Room Chilled Water Circulating Pump
- Electric Board Room Chilled Water Circulating Pump
- DG Day Tank Fuel Oil Transfer Pump
- Boric Acid Transfer Pump
- Thermal Barrier System Booster Pump
- AFW Pump Lubrication Oil Pump
- Spent Fuel Pool Pump
- ERCW Screen Wash Pump

Only major pumps in safety significant systems were evaluated in detail, because as summarized in Table 3, the flow is minimally impacted (i.e., 0.3%).

Pump flow will increase as follows:

$$Q_2 = (60.2/60.0) * Q_1, \text{ thus } Q_2 = 1.003 * Q_1$$

A 0.7% increase in NPSH margin (i.e., NPSHa – NPSHr) adds to the margin and does not require additional evaluation.

Table 4 - NPSH Evaluation

Pump	NPSHr (ft) at rated speed	NPSHr (ft) (-0.3% speed)	NPSHr (ft) (+0.3% speed)	NPSHa (ft)
Auxiliary Feed Water	25.0	24.8	25.2	28.33
Containment Spray	12.5	12.4	12.6	17.2
RHR [1]	12.0	11.9	12.1	13.12
Safety Injection	17.5	17.4	17.6	37.6
Centrifugal Charging	28.0	27.8	28.2	55.2
ERCW (submergence requirement)	6.04	5.99	6.07	12.07
Component Cooling - A Train	10.57	10.50	10.64	20.06
Component Cooling – B Train	17.38	17.26	17.50	24.88
Component Cooling - Pump 2A-A (8,444 gpm) [2]	29.25	29.05	29.45	29.57

[1] RHR Pump NPSH is most limiting when suction is aligned to the hot leg as analyzed for normal operation, as opposed to sump suction.

[2] The NPSH information provided here for CCS Pump 2A-A is for tornadic conditions. For any other conditions, NPSHa is an additional 8.904 feet higher.

As shown in Table 4, the NPSHa is greater than the NPSHr during operation in the range of 59.8 Hz to 60.2 Hz. Therefore, operation in a frequency range ≥ 59.8 Hz and ≤ 60.2 Hz would have no significant effect on pump NPSH.

3.2.5 Effect on Motor Horsepower

As shown in Table 2, the flow during pump operation at 59.8 Hz would be approximately 1% lower than at a frequency of 60.0 Hz. In addition, Tables 2 and 5 show that operation of pumps at 59.8 Hz results in reduced brake horsepower (BHP) for each pump. Therefore, operation in a frequency range ≥ 59.8 Hz and ≤ 60.1 Hz would have no significant effect on motor BHP.

In addition, also defined in Table 2, the brake horsepower at higher frequency will be 0.6% higher. Table 5 provides the BHP for the major pumps that would be supplied power by the DGs in the event of a LOOP/LOCA. The general acceptance criterion for horsepower is that the brake horsepower shall not exceed the motor nameplate rating times the motor service factor. Only major pumps in safety significant systems were evaluated, because, as shown in Table 2, the speed, load, flow, and NPSH are only impacted slightly (i.e., 0.2% to 0.6%). The Spent Fuel Pool pump motor and the high pressure fire protection pump motors operate at a horsepower that is less than their