UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
245 PEACHTREE CENTER AVENUE NE, SUITE 1200
ATLANTA, GEORGIA 30303-1257

June 27, 2011

EA-11-144

Mr. R. M. Krich
Vice President, Nuclear Licensing
Tennessee Valley Authority
1101 Market Street, LP 3R-C
Chattanooga, TN 37402-2801

SUBJECT: RESPONSE TO DISPUTED NOTICE OF VIOLATION (EA-11-144)

Dear Mr. Krich:

This is in response to your letter dated March 31, 2011, regarding the Non Cited Violation (NCV) 05000390/2010005-03, "Failure to Use Worst Case 6900 Vac Bus Voltage in Design Calculations" dated January 28, 2011. The NCV was identified during an inspection of a previous unresolved item related to degraded voltage protection at the Watts Bar Unit 1 facility.

In your response, TVA disputed the NCV primarily for the following reasons:

1. The NRC's position associated with the NCV concerning degraded voltage protection was not consistent with Watt Bar Unit 1 licensing basis, and the approach TVA used in addressing degraded voltage protection was, in fact, appropriate.

2. The potential re-analysis of plant loading calculations that would be required in response to the NCV should be processed by the NRC through the backfit process as described in 10 CFR 50.109.

3. The violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," associated with the degraded voltage issue and related calculation was not consistent with the essential purpose of the regulation.

After review and consideration of TVA's response, the NRC has concluded that for the reasons presented in the enclosure to this letter, a violation of 10 CFR 50 Appendix B, Criterion III, "Design Control" did occur. The NCV has been re-characterized to clearly describe the issue, the performance deficiency, and the applicable regulation. The revised Green NCV is included in the enclosure. Consequently, you are required to initiate corrective actions to address the performance deficiency.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of

NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Should you have any questions concerning this letter, please contact Mr. Binoy Desai, at (404) 997-4519.

Sincerely,

/RA/

Joel T. Munday, Director
Division of Reactor Safety

Docket No.: 50-390
License No.: NPF-90

Enclosure:
NRC Evaluation and Conclusion

cc w/encl: See page 3

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NRC EVALUATION AND CONCLUSION

INTRODUCTION

The NRC identified Non-Cited Violation (NCV) 0500090/2010005-03, "Failure to Use Worst Case 6900 Vac Bus Voltage in Design Calculations" during an inspection conducted between October 1 and December 31, 2010, at the Watts Bar Unit 1 facility near Spring City, TN. TVA disagreed with the NCV in a letter dated March 31, 2011.

A. A revised description of the violation is provided below:

The stated purpose of calculation WBN-EEB-MS-TI-06-0029, "Degraded Voltage Analysis," was to evaluate whether the Watts Bar auxiliary power system complies with NRC Branch Technical Position PSB-1 and to [confirm] the basis for degraded voltage set points and time delays. The cover sheet of the calculation states that "the calculation determines the voltage on each board to ensure that the voltage level is adequate to allow required safety electrical equipment and devices to successfully complete their required safety function, and to ensure that the duration of the degraded voltage at a given level does not result in the thermal degradation or damage of any equipment." Revision 31 of this calculation was an action related to a corrective action document (PER 211179) which addressed a potential problem with the upper and lower limits of degraded voltage relays (DVR) and the loss of voltage relays which were determined by calculation WBPE2119202001, "6.9kV Shutdown and Logic Boards' Under Voltage Relays Requirements / Demonstrated Accuracy Calculation."

The requirements for degraded voltage protection originate from the requirements of 10 CFR 50, Appendix A, "General Design Criteria (GDC) 17." Following the July 1976, event at Millstone involving degraded voltage conditions in the plant auxiliary systems, the NRC required all licensees to install degraded voltage protection systems as described in NRC Letter dated June 2, 1977, "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors." Further, in Generic Letter (GL) 79-36, "Adequacy of Station Electric Distribution Systems Voltages," the NRC required all licensees, including Watts Bar, to review the electric power systems to determine analytically if, assuming all onsite sources of AC power are not available, the offsite power system and the onsite distribution system is of sufficient capacity and capability to automatically start as well as operate all required safety loads. NRC Branch Technical Position PSB-1, which the licensee is committed to, states, in part, that the selection of undervoltage and time delay setpoints for the DVRs shall be determined from an analysis of the voltage requirements of the Class 1E loads. The primary purpose of this requirement is to provide assurance that safety-related equipment has adequate voltage when energized from the offsite or onsite power supply. The DVR settings at Watts Bar are in accordance with TS Table 3.3.5-1 which states the values to be as follows: Allowable Value ≥6570 Vac, Trip Setpoint between ≤6606 Vac and ≥6593 Vac.

The licensee used a bus voltage of 6672 Vac for motor starting calculations which is higher than the TS allowable value (6570 Vac). The team noted that 6672 Vac is non-conservative with respect to the lowest voltage that could occur on the safety buses without transfer to the diesel generators based on Technical Specification setpoints. For example, the team estimated that the DVR could reset as low 6588Vac during transient conditions, such as when starting large motors, and would not dropout unless voltage dipped below the

analytical limit of 6555 Vac during relative steady state conditions, such as when starting small motors. The licensee's failure to perform the analysis at the lower values prompted a concern that postulated voltages in the range between <6672 Vac and >6555 Vac might not be adequate for the equipment to perform its required safety function under required degraded voltage scenarios.

Additionally, the team noted that the licensee credited a non safety-related automatic load tap transformer when determining minimum voltage to safety-related equipment during degraded voltage scenarios. In Section 6.1.2 of calculation WBN-EEB-MS-TI-06-0029, the licensee identified two essential raw cooling water (ERCW) strainer motors that would not have adequate running voltage with the minimum expected worst case grid voltage afforded by the DVRs. The calculation credited the use of an automatic load tap changer transformer (LTC) to raise the voltage level to an acceptable value for the ERCW strainer motors. The team determined that because the LTC(s) was not safety-related and is subject to operational limitations and credible failures, it cannot be relied upon to ensure adequate voltage to safety-related components during degraded voltage events. ERCW strainer motor failures that coincide with excessive debris would be mitigated by actions that include (1) a high strainer differential pressure alarm in the main control room, and (2) the licensee's capability to backwash the strainers.

The team determined that the calculation, which evaluated LOCA block loading and steady-state operation (running and starting) of motors, was inadequate because of (1) the licensee's failure to perform analyses at the minimum voltage afforded by the DVR and (2) the licensee's crediting of non safety-related equipment to restore voltage during a degraded voltage event.

B. TVA disputed the NCV for the following reasons:

1. The NRC's position associated with the NCV concerning degraded voltage protection was not consistent with Watt Bar Unit 1 licensing basis, and the approach TVA used in addressing degraded voltage protection was, in fact, appropriate.

2. The potential re-analysis of plant loading calculations that would be required in response to the NCV should be processed by the NRC through the backfit process as described in 10 CFR 50.109.

3. The violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," associated with the degraded voltage issue and related calculation was not consistent with the essential purpose of the regulation.

NRC's evaluation of the licensee denial is discussed below.

NRC EVALUATION

The NRC carefully reviewed TVA's response and concluded that a violation 10 CFR 50, Appendix B, Criterion III, "Design Control" occurred. This determination is based on the following:

1. In its letter of March 31, 2011, TVA disagreed with the NRC position and NCV related to TVA's approach to addressing degraded voltage protection. Specifically, TVA disagreed

with the NRC statement requiring evaluation by TVA of post LOCA motor starting using the most limiting voltage afforded by the degraded voltage relay rather than the 6672 Vac currently used in the design calculation and suggested that it was not in accordance with their licensing basis. TVA stated that the NRC position in the NCV conflicts with the NRR Branch Technical Position PSB-1 and that the approach taken by TVA was in fact appropriate.

The requirements for degraded voltage protection originate from the requirements of 10 CFR 50, Appendix A, "General Design Criteria (GDC) 17." Following the July 1976, event at Millstone involving degraded voltage conditions in the plant auxiliary systems, the NRC required all licensees to install degraded voltage protection systems as described in NRC Letter dated June 2, 1977, "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors." Further, in Generic Letter (GL) 79-36, "Adequacy of Station Electric Distribution Systems Voltages," the NRC required all licensees, including Watts Bar, to review the electric power systems to determine analytically if, assuming all onsite sources of AC power are not available, the offsite power system and the onsite distribution system is of sufficient capacity and capability to automatically start as well as operate all required safety loads.

For plants under construction, the requirements of the June 2, 1977, letter and staff guidance described in GL 79-36 were incorporated in NUREG-0800, "Standard Review Plan (SRP) for the Review of Safety Analysis Reports for Nuclear Power Plants," Appendix 8-A, "Branch Technical Position (BTP) PSB-1: Adequacy of Station Electric Distribution System Voltages," Rev. 2 (07/1981) which is part of the licensing basis for the Watts Bar Nuclear Plant. SRP BTP PSB-1 Position 1.a states that the selection of undervoltage and time delay setpoints for the degraded voltage relays shall be determined from an analysis of the voltage requirements of the Class 1E loads.

At Watts Bar Unit 1, calculation WBN-EEB-MS-TI06-0029 is one of the design calculations of record for loading calculations and degraded voltage protection. This calculation was intended, in part, to demonstrate that the design of the Watts Bar Auxiliary Power System was in conformance with BTP PSB-1.

The NRC reviewed calculation WBN-EEB-MS-TI06-0029 and determined that for certain instances, TVA utilized a non-conservative approach. For motor starting voltage calculations, TVA analyzed motors at a higher voltage (6672 Vac) than was afforded by the degraded voltage relays, which have a Technical Specification Allowable value of 6570 Vac. The higher voltage used by TVA was derived from the analysis used to optimize system voltage considering the minimum anticipated range of offsite voltage, and adjusted by operation of load tap changers of the transformers. This analysis was done in accordance with BTP PSB-1, Position 3 and is intended to ensure adequate voltage to system auxiliaries during all modes of operation, and to minimize the probability of losing offsite power following a unit trip, as required by GDC 17. The TVA methodology of assuming minimum expected grid voltage (established by administrative controls) and proper operation of transformer automatic load tap changers is acceptable for the purpose of optimizing system voltages for normal operation. However, these assumptions are not appropriate for evaluating the adequacy of the degraded voltage relay setpoints with respect to (1) the starting and running voltage requirements of Class 1E motors, and (2) the minimum voltage requirements for the most limiting safety-related component as delineated in by BTP PSB-1 Position 1.a. The setpoint of the degraded voltage relays is lower than the voltage used in

the WBN system voltage optimization calculation and does not satisfy the BTP staff position 1.a (i.e., selection of undervoltage and time delay setpoints for the degraded voltage relays shall be determined from an analysis of the voltage requirements of the Class 1E loads).TVA determined that, during steady state loading conditions, certain Class 1E motors would not have adequate voltage if safety bus voltage declined to a value just above the setpoint of the degraded voltage relay as defined in Technical Specification. This condition was justified and considered acceptable by crediting the minimum expected (administratively controlled) grid voltage, and voltage improvement afforded by transformer load tap changers. Since voltage afforded by the degraded voltage relay undervoltage setpoint was not shown to be adequate to satisfy the voltage requirements of Class 1E motors, the calculation did not satisfy its stated objective of demonstrating conformance to BTP PSB-1 and 1977 NRC letter staff position B.1.a. Thus, Watts Bar Unit 1 does not meet the GDC 17 requirements regarding capacity and capability of electric power supplies for nuclear power plants to assure that fuel design limits are not exceeded in the event of anticipated operational occurrences and that the core is cooled in the event of postulated failures.

The voltage requirements of Class 1E loads for various accident and non-accident operating conditions including motor starting transients should be established. These requirements should be used to determine the setpoint of the degraded voltage relays. Loadflow and voltage drop studies for steady state operation and motor starting transients should validate the minimum acceptable grid voltage and the adequacy of the degraded voltage relay setpoints including time delays. The TS values should validate the design parameters established by the above analyses. Thus, the analyses should determine the worst case voltage afforded by the safety-related undervoltage protection configuration as required by BTP PSB-1. Watts Bar Unit 1 should not rely on administrative controls or non-safety voltage regulation equipment to mitigate voltage deficits. As a result, TVA's methodology was not in agreement with the BTP PSB-1.

2. In its letter dated March 31, 2011, TVA states that there are no specific requirements in NRC regulations regarding the method for evaluating the degraded voltage protection system and that NRC has accepted TVA's approach in the calculation and its conformance to BTP, PSB-1 in numerous safety evaluation reports. TVA also suggested that the potential re-analysis of the plant loading calculations that would be required in response to the NCV should be processed by the NRC through the backfit process as described in 10 CFR 50.109.

   It should be noted that the staff's review of the conclusions of analyses used to support license amendment requests should not be construed as the staff's acceptance or approval of specific methodologies or detailed calculations to support license amendments. Specifically, the positions taken in the March 31, 2011, letter detail methodologies whereby voltage requirements of Class 1E equipment may be satisfied by administratively controlled voltage and non-safety related load tap changers, in lieu of automatic protection afforded by the safety-related degraded voltage relays. These positions were not stated in previous license amendment applications or their supporting calculations, and were not accepted in NRC SERs.

   For example, the NRC reviewed the SER dated January 23, 2002, regarding the degraded voltage relay time delay setpoint change. The change was intended to provide additional time for the automatic LTCs to improve voltage to avoid spurious separation from offsite

power. This SER did not evaluate the minimum required voltage to safety-related equipment. The "increased operating margin" referred to in Section 1.0 of the SER was operating margin relative to acceptable grid voltages to avoid grid separation. Section 2.0 of the SER was a description of the Watts Bar electrical distribution system. The third paragraph of Section 3.0 states that the proposed design would provide additional operating margin to compensate for postulated degraded voltage. This is further clarified in the next paragraph that states that the new time delay would "eliminate unnecessary electrical transients associated with the automatic transfer from the preferred power supply to the EDGs", i.e., spurious grid separation. The SER does not state that the purpose of the additional time delay is to provide improved voltage for safety-related equipment. The SER refers to the ETAP (electrical engineering software) runs that show that the time delay change will not affect equipment operability, including starting and running of motors. It does not credit the revised time delay or the voltage improvement afforded by the LTCs for this conclusion but simply states that the operability of safety-related equipment is not adversely affected by the change. In conclusion, the SER does not credit the LTCs to assure the minimum voltage required for equipment to meet its intended safety functions but allows a longer operation at a previously established minimum voltage to preclude spurious grid separation. Therefore, the SER does not provide a licensing basis for crediting administratively controlled switchyard voltage or LTCs when establishing minimum voltage requirements of safety-related equipment in design calculations.

As discussed earlier, the requirements for degraded voltage protection originated from the requirements of GDC 17. Branch Technical Position PSB-1 set forth an acceptable method for complying with the regulations and demonstrating that the applicable setpoints and time delays are adequate to ensure that all safety-related loads are protected and all required safety-related loads have the required minimum voltage at the component terminal to start and run to support a worst-case design basis event (DBE) without any credit for administratively controlled voltage.

The staff has determined that 10 CFR 50.109, “Backfitting” is not applicable to the NCV because the technical position is consistent with previously issued regulations and communications.

3. TVA questioned the use of 10 CFR Part 50, Appendix B, Criterion III, “Design Control,” as the basis for the NCV. The licensee stated that this citation was not consistent with the essential purpose of the regulation as the licensee viewed it as circular logic. TVA stated that as written, the NCV implied that TVA should have used values which were derived from the design basis (i.e. TS) as input requirements to the design basis calculation which itself is the basis from which the TS are derived.

   The NRC determined that calculation WBN-EEB-MS-TI06-0029 was subject to the quality assurance requirements of 10 CFR50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Processing Plants” because it affects the ability of safety-related components to perform their design basis function. The stated purpose of calculation WBN-EEB-MS-TI-06-0029, “Degraded Voltage Analysis,” was to evaluate whether the Watts Bar auxiliary power system complies with NRC Branch Technical Position PSB-1 and to [confirm] the basis for degraded voltage set points and time delays. Pertaining to the Green NCV, the calculation provides assurance that safety-related motors would have adequate starting voltages if the DVR were to reset during degraded voltage events. The cover sheet of the calculation states that “the calculation determines the voltage on each board to

ensure that the voltage level is adequate to allow required safety electrical equipment and devices to successfully complete their required safety function, and to ensure that the duration of the degraded voltage at a given level does not result in the thermal degradation or damage to any equipment." It is the staff's position that calculation WBN-EEB-MS-TI06-0029 establishes the design basis of the plant and should be used as an input to the TS value for degraded voltage relay settings. As such, the criteria listed in 10 CFR50, Appendix B, "Design Control" is applicable. The NRC restated the violation, as shown below, to better describe the requirements that were not met.

10 CFR 50, Appendix B, Criterion III, Design Control, states, in part, that measures shall be established to assure that applicable regulatory requirements and the design basis for structures, systems, and components are correctly translated into specifications, drawings, procedures, and instructions.

Contrary to the above, the licensee failed to assure that regulatory requirements of GDC -17 and staff positions described in NRC letter, "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors," dated June 2, 1977, were correctly translated into documents used to establish degraded voltage relay setpoints. Specifically, TVA design calculation WBN-EEB-MS-TI-0600029, "Degraded Voltage Analysis," Revision 31, used to support the Technical Specifications degraded voltage setpoints (TS Section 3.3.5-1, "Loss of Power Diesel Generator Start Instrumentation," Table 3.3.5-1, Item 2 specifies the 6900 VC emergency bus undervoltage (degraded) relay trip setpoints to be as follows: "Allowable Value, ≥ 6570 Vac, Trip Setpoint, ≤ 6606 Vac and ≥ 6593 Vac"), credited administrative measures and non safety-related voltage regulation equipment to ensure adequate voltage to all Class 1E equipment, in lieu of demonstrating that the setpoints for the degraded voltage relays specified in Technical Specifications (Allowable Value of 6570 Vac) provided adequate voltage to safety-related equipment.

NRC Conclusion

Based on additional inspection and review of the licensee's letter of March 31, 2011, disputing the NCV, the NRC concludes that: 10 CFR Part 50, Appendix B, Criterion III, "Design Control," and the licensee's commitment to GL 79-36, "Adequacy of Station Electric Distribution Systems Voltage," and staff positions established in NRC letter dated June 2, 1977, "Statement of Staff Positions Relative to Emergency Power Systems for Operating Reactors," are the appropriate requirements for this issue. Specifically, the licensee's failure to adequately check the adequacy of design for the operation of safety-related equipment during degraded voltage conditions constitutes a violation of 10 CFR Part 50, Appendix B, Criterion III, "Design Control." Additionally, the staff has determined that 10 CFR 50.109, "Backfitting" is not applicable to the violation because no new requirements are being imposed on TVA. Therefore, the violation occurred as stated in the revised Green NCV.