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10 CFR 2.201

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

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

Subject: **Response to Non-Cited Violations 05000390/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations"**

References:
1. Letter from NRC (Eugene F. Guthrie) to TVA (R. M. Krich), "Watts Bar Nuclear Plant - NRC Integrated Inspection Report 05000390/2010005," dated January 28, 2011
2. Letter from TVA (R. M. Krich) to NRC "Request for Extension for Time to Respond to Non-Cited Violations 05000327, 05000328/2010005-03, 'Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations' and 05000390/2010005-03, 'Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations,'" dated February 25, 2011

In Reference 1, the Nuclear Regulatory Commission (NRC) issued Non-Cited Violation (NCV) 05000390/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations," regarding Watts Bar Nuclear Plant (WBN), Unit 1. The NCV addressed issues regarding the design basis of the degraded voltage protection equipment. In Reference 2, TVA requested that the response date for potential challenge of the Reference 1 NCV be extended to March 31, 2011.

TVA has completed a review of the concerns and issues regarding the design of degraded voltage protection at WBN, Unit 1, expressed by the NRC in Reference 1.

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the NRC Enforcement Policy, TVA contests Non-Cited Violation 05000390/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculation." The basis for TVA's denial of the subject NCV is provided in the Enclosure.

There are no commitments associated with this letter.

If you have any questions in this matter, please contact me at 423-751-3628.

Respectfully,

R. M. Krich

Enclosure

cc:

NRC Director, Office of Enforcement
NRC Regional Administrator - Region II
NRC Senior Resident Inspector - Watts Bar Nuclear Plant

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT, UNIT 1

NRC INTEGRATED INSPECTION REPORT 05000390/2010005
REPLY TO NOTICE OF A NON-CITED VIOLATION

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR, PLANT UNIT 1

NRC INTEGRATED INSPECTION REPORT NO. 05000390/2010005
REPLY TO NOTICE OF A NON-CITED VIOLATION

I. Introduction

In a letter dated January 28, 2011, the Nuclear Regulatory Commission issued Non-Cited Violation (NCV) 05000390/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage In Design Calculations," regarding Watts Bar Nuclear Plant (WBN), Unit 1. The NCV addressed issues regarding the design basis of the degraded voltage protection equipment. In the letter, the NRC stated:

> *If you contest any NCV in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001; with copies to the Regional Administrator, Region II; the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001; and the NRC Resident Inspector . . .*

Based on the issuance date of the letter, the 30-day response date to contest the NCV was February 27, 2011. By letter dated February 25, 2011, the Tennessee Valley Authority (TVA) requested an extension of the date for contesting the NCV until March 31, 2011.

TVA has conducted a review of the NCV and of apparent NRC concerns regarding the design of the degraded voltage protection at WBN, Unit 1. Based on that review, TVA contests the NCV for the reasons discussed in detail in this response.

In addition to contesting the NCV, TVA considers that the NRC's apparent position regarding the adequacy of the design and licensing basis for degraded voltage protection at WBN, Unit 1 is unjustified. The NRC's concerns in this regard, although not clearly expressed in the inspection report 05000390/2010005, were reflected in the discussions between NRC inspectors and TVA staff during the 2010 WBN Component Design Basis Inspection (CDBI), by NRC management during the CDBI inspection exit teleconference on December 16, 2010, and during a public meeting between NRC and TVA on degraded voltage protection issues in Rockville, Maryland on March 11, 2011.

TVA is firmly committed to fully understanding and resolving NRC's concerns regarding degraded voltage protection. However, TVA's position is that the issues should be resolved in a manner that implements both existing regulatory requirements (such as 10 CFR Part 50, Appendix B, Criterion III, Design Control) and existing regulatory processes (such as the reactor oversight process, enforcement process, and backfit process) in a credible manner that allows for a clear understanding of the technical issues and the associated regulatory framework.

TVA's response to the NCV and the apparent underlying technical and regulatory concerns are presented below in two separate elements:

- Disputes the use of 10 CFR Part 50, Appendix B, Criterion III, "Design Control" as the basis for the NCV, and
- Disputes the NRC's apparent concerns regarding the adequacy of the WBN current licensing basis for degraded voltage protection.

II. Disputing the Use of 10 CFR Part 50, Appendix B, Criterion III, "Design Control" as the Basis for Non-Cited Violation 05000390/2010005-03

Restatement of Non-Cited Violation

A restatement of the subject NCV from NRC Inspection Report 05000390/2010005 is as follows.

> *Enforcement: 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. This appendix also states in part that measures shall be established for the selection and review for suitability of application of processes that are essential to the safety-related functions of the structures, systems, and components. Watts Bar 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."*
>
> *Contrary to the above, since at least December 2001, the licensee failed to assure that applicable regulatory requirements for undervoltage (degraded) voltage protection, including those prescribed in TS 3.3.5-1, item 2, were correctly translated into design calculation, WBN-EEB-MS-TI-06-0029, "Degraded Voltage Analysis," Revision 31, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. Further, the process used by the licensee for the selection of input voltage value in the design calculation was non-conservative with respect to the TS. Specifically, the licensee used the input value of 6672 VAC which was higher than the maximum value of 6606 VAC specified in TS. This did not result in a loss of function of safety-related loads.*
>
> *Because this finding is of very low safety significance and was entered into the licensee's corrective action program as PER 296306 this violation is being treated as a NCV, consistent with the NRC Enforcement Policy. This finding is identified as NCV 05000390, 2010005-:"Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations." URI 05000390/2010008-02,"Worst Case 6900 VAC Bus Voltage in Design Calculations" is closed.*

Summary of TVA Basis for Denial of Enforcement Against Criterion III, "Design Control"

TVA disputes the use of 10 CFR Part 50, Appendix B, Criterion III, "Design Control" as the basis for the NCV. TVA's dispute is based on what TVA views as a fundamental misapplication of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," to the specific facts regarding the design of degraded voltage protection features at WBN and the associated Technical Specification (TS) values. TVA is specifically concerned with the NRC's discussion of the relationship between the TS requirements and the design calculation referenced in the NCV.

In the NRC's discussion for the basis of the NCV, the NRC stated:

> *The degraded voltage relay 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.*

In addition, the NRC stated that:

The inspector reviewed licensee calculation of record WBN-EEB-MS-TI-06-0029, "Degraded Voltage Analysis," Rev. 31, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. This calculation used the degraded voltage setpoint of 6672 V to analyze post LOCA load motor starting. This voltage of 6672 VAC used in the calculation was non-conservative with respect to the voltage specified in TS which specified a maximum value of 6606 VAC.

Finally, the NRC concluded:

Contrary to the above, since at least December 2001, the licensee failed to assure that applicable regulatory requirements for undervoltage (degraded) voltage protection, including those prescribed in TS 3.3.5-1, item 2, were correctly translated into design calculation, WBN-EEB-MS-TI-06-0029, "Degraded Voltage Analysis," Revision 31, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. Further, the process used by the licensee for the selection of input voltage value in the design calculation was non-conservative with respect to the TS. Specifically, the licensee used the input value of 6672 VAC which was higher than the maximum value of 6606 VAC specified in TS. This did not result in a loss of function of safety-related loads.

With respect to the referenced requirements of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," the regulations state in part:

Measures shall be established to assure that applicable regulatory requirements and the design basis, as defined in § 50.2 and as specified in the license application, for those structures, systems, and components to which this appendix applies are correctly translated into specifications, drawings, procedures, and instructions.

The regulations in 10 CFR Part 50, Appendix B, Criterion III create an expectation that implementing documents used at the plant (i.e., specifications, drawings, procedures and instructions) should accurately reflect the design basis for the associated Structure, System or Component (SSC) and the regulatory requirements for the SSC. The NCV confuses the fact that the design basis of the SSC is developed in part based on regulatory design requirements and the fact that the design basis then gives rise to certain operational limits which may themselves be established as regulatory requirements via a condition of the operating license. For example, the design basis of an SSC may be developed in part based on applicable regulatory requirements such as those contained in 10 CFR 50, Appendix A, General Design Criteria (GDC) or other applicable design oriented sections of 10 CFR Part 50. The GDC in such instance as this example are binding regulatory requirements with regard to the design of the facility.

In addition to regulatory requirements related to the design of the SSC, 10 CFR 50.36 requires the development of TS which "will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto..." Within the TS, 10 CFR 50.36 requires the inclusion of limiting conditions for operation which are "the lowest functional capability or performance levels of equipment required for safe operation of the facility." The analyses from which the TS are derived include analyses which form, or support, the design basis (since 10 CFR 50.34 requires that the final safety analysis report include information that presents the design bases). The TS are binding regulatory requirements insofar as these are imposed as an Appendix of the facility operating license and they are <u>in addition to</u> the regulatory requirements on which the design was based.

The NRC appears to have mischaracterized the relationship between the design basis for the degraded voltage protection system at WBN (which incorporates design-related regulatory requirements) and the TS Allowable Values which are derived from the design basis. Simply stated, the NCV could be read to imply that TVA should have used values which are derived *from* the design basis (i.e., the TS Allowable Values) as input requirements *to* the design basis calculation - which is itself the basis from which the TS are derived. TVA views this essentially circular logic as inconsistent with the purpose of 10 CFR Part 50, Appendix B, Criterion III, "Design Control."

Alternatively, the NRC's NCV discussion may be read to imply that TVA should have used the TS Allowable Values as input to a portion of the calculation whose purpose was to confirm that, for circumstances not linked to specific expected post-accident conditions and for stressed grid voltage conditions not specifically linked to any particular failure mode, individual loads powered from the auxiliary power system would have sufficient voltage to start without tripping protective devices and without causing the degraded voltage protection system to transfer from the preferred offsite power system to the onsite AC power system. As discussed below, it is difficult to understand the logic of evaluating the ability to start motors under conditions in which the expected effect will be to cause degraded voltage relays to dropout and, with some likelihood, cause the Auxiliary Power System to transfer to the onsite power source.

Relationship of Calculation WBN-EEB-MS-TI06-0029, Revision 31 to TS 3.3.5 Allowable Values

The discussion in NRC Inspection Report 05000390/201005 associated with the NCV refers to the WBN calculation WBN-EEB-MS-TI06-0029, Revision 31, "Degraded Voltage Analysis." WBN-EEB-MS-TI06-0029 is a design calculation and, as demonstrated below, is related to the TS values referenced in the NCV in that it provides an input (analytical limit) to calculations that specifically derive the TS values. From the standpoint of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," WBN-EEB-MS-TI06-0029, and related calculations discussed below, are the means by which the *regulatory requirements* regarding the design of the degraded voltage protections system are *translated* into *specifications* - in this case, the TS themselves.

TVA first issued WBN-EEB-MS-TI06-0029 in 1992 and the purpose of WBN-EEB-MS-TI06-0029 is stated in Section 1 of Revision 31 of the calculation:

1.1 *The purpose of this calculation is to demonstrate that the Watts Bar Auxiliary Power System complies with NRC Branch Technical Position PSB-1 and to establish the basis for the degraded and loss of voltage relay setpoints and their associated time delays.*
1.2. *Ensure that the voltage level is adequate to allow required safety electrical equipment and devices to successfully complete their safety function.*
1.3. *Ensure that the duration of the degraded voltage at a given voltage level does not result in thermal degradation or damage of any equipment.*

WBN-EEB-MS-TI06-0029 is the design calculation for the degraded voltage protection system at WBN. As the design basis calculation, it captures the design related regulatory basis for the degraded voltage protection scheme. For degraded voltage protection design, there are no explicit requirements in 10 CFR Part 50, nor is there illuminating guidance in an existing regulatory guide. Thus, the reference to NRC Branch Technical Position (BTP) PSB-1 constitutes the effective regulatory design requirements for this system. The relationship between WBN-EEB-MS-TI06-0029, Revision 31 and the TS Table 3.3.5-1 Allowable Value and

Trip Setpoints is found in Section 5.1 of the calculation "Second Level Undervoltage (Degraded Voltage) Relay Dropout Setpoint."

A lower boundary should be established for the dropout setting of the degraded voltage relay. The lower boundary should be greater than the minimum safety bus voltage established below. The nominal setpoint of the dropout setting should be equal to the lower boundary plus all tolerances from potential transformer (PT) ratio and burden errors, setpoint drift errors, and any other errors in accordance with TVA Technical Instruction TI-28 (reference 2.13).

The minimum safety bus voltage is selected by evaluating operation of the auxiliary power system under steady-state (running) conditions, with the 6.9kV Shutdown Boards voltages as low as possible while still keeping all connected safety-related loads within their rated operating voltage range (within ANSI C84.1 utilization voltages, range "B", reference 2.14).

5.1.1. The loads evaluated are safety-related loads required for Unit 1 design basis event, safety injection phase A or B. which would be used in normal operation and/or initiated upon an accident signal. Load types considered are motor loads including vendor package loads, 120VAC motor control circuits, and MCC 120VAC distribution panel loads. The acceptance criteria and means of evaluation is as follows:

5.1.1.1.The lowest possible voltage at the 6.9kV Shutdown Boards without tripping (actuating) the Degraded Voltage Relay is 6555 volts. (Sec. 3.9). The voltage at the various 480V class 1E boards is evaluated at 6555V based on this relay setting at the 6.9kV Shutdown Board and the maximum steady state loading (Normal Operation loading) conditions to ensure that the minimum steady-state running voltage requirements to distribution board and connected equipment are maintained. Starting of motors is evaluated at voltage based on the upper reset setpoint operational limit of the degraded voltage relays. Starting at a lower voltage could result in dropping out the degraded voltage relays and not being able to reset them prior to disconnection and transfer to the emergency diesel generators. This approach is consistent with the guidelines given in IEEE 741-1997, reference 2. 12.

The degraded voltage protection relay system operates to provide two distinct functions. One function of the degraded voltage protection relays is to ensure that the Auxiliary Power system <u>does reliably transfer</u> from the offsite power supply to the onsite power supply under conditions which are indicative of a sustained degraded voltage condition on the offsite power supply. The design requirement to have the Degraded Voltage Relay dropout setting linked to the Minimum Operating Voltage ensures that the Auxiliary Power System <u>does not transfer</u> from the offsite power supply to the onsite power supply <u>except</u> under voltage conditions which are indicative of a sustained degraded voltage condition, that is, to ensure it does not prematurely transfer from an offsite power supply that is sufficiently reliable to supply safety related loads under normal and accident conditions.

Because the Degraded Voltage Relays are equipment required for the safe operation of the plant, values associated with the Degraded Voltage Relay dropout setting are included in the TS. The TS Table 3.3.5-1 values referred to in the NCV are the 6.9 kV Emergency Bus Undervoltage (Degraded Voltage) Bus Undervoltage Allowable Value (≥6570V) and Trip Setpoints (≥ 6593 and ≤6606V). These values are associated with the Degraded Voltage Relay dropout. These values <u>do not include</u> the reset setpoint for the Degraded Voltage Relays. The current TS Trip Setpoints were calculated in TVA calculation WBPE2119202001. The TS voltage values (Allowable Value and Trip Setpoint) are unchanged from the values issued in the TS when the WBN, Unit 1 Operating License was issued on February 7, 1996.

As illustrated by the above discussion, from a 10 CFR Part 50, Appendix B, Criterion III, consideration, WBN-EEB-MS-TI06-0029, Revision 31, and related calculation WBPE2119202001 are the means by which the *regulatory requirements* regarding the design of the degraded voltage protections system are *translated* into *specifications.*

Relationship of TS Table 3.3.5-1 Allowable Values and Calculation WBN-EEB-MS-TI06-0029, Revision 31 Analysis of Motor Starting

In the NCV, the NRC stated that TVA:

> *failed to assure that applicable regulatory requirements for undervoltage (degraded) voltage protection, including those prescribed in TS 3.3.5-1, item 2, were correctly translated into design calculation, WBN-EEB-MS-TI-06-0029, "Degraded Voltage Analysis," Revision 31, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. Further, the process used by the licensee for the selection of input voltage value in the design calculation was nonconservative with respect to the TS. Specifically, the licensee used the input value of 6672 VAC which was higher than the maximum value of 6606 VAC specified in TS. This did not result in a loss of function of safety-related loads.*

TVA's position is that, while the TS are regulatory requirements, they are not design related requirements and, in the case of the analysis of motor starting capability in Section 6.2 of WBN-EEB-MS-TI06-0029, use of the TS values as inputs to the design analyses would be inconsistent with the stated purpose of that analysis.

The analysis in Section 6.2 of WBNEEBMSTI060029, Revision 31 provides insight to TVA as to the ability of the Auxiliary Power System to provide sufficient starting capacity for safety related motors for circumstances in which the offsite power supply may be under sustained degraded voltage conditions (whether post design basis accident or for other, unspecified circumstances). The approach to the analysis in Section 6.2 is identified in Section 5.2 which states:

> *The safety bus voltages associated with the upper boundary of the reset setting are evaluated to ensure adequate operation of the auxiliary power system under steady state (starting) conditions and recovery (running) voltage conditions.*

This portion of the calculation was added in WBN-EEB-MS-TI06-0029, Revision 30, which was issued in January 2001. The "post LOCA" motor starting analysis referred to in the NCV was a confirmatory evaluation performed over and above the design basis which existed when the NRC had previously found the degraded voltage protection scheme in conformance with PSB-1 (see discussion of NUREG-0847 and supplements in Section II). Revision 31 of WBN-EEB-MS-TI06-0029 explicitly indicates the reason for not performing the motor starting confirmatory calculation at voltage values similar to those of the degraded voltage setpoint (dropout):

> *Starting of motors is evaluated at voltage based on the upper reset setpoint operational limit of the degraded voltage relays. Starting at a lower voltage could result in dropping out the degraded voltage relays and not being able to reset them prior to disconnection and transfer to the emergency diesel generators.*

To elaborate, the circumstances under which the voltages may have degraded so far below the minimum grid operational voltage are varied. If the bus voltage is degraded in a situation where a safety injection signal and block start of accident loads have caused the voltage to drop below the degraded voltage dropout setpoint (but not below the loss of voltage setpoint) but then, due to unspecified failure mechanisms, recover to a level well below 100% nominal, the Degraded Voltage Relay may or may not have reset. Evaluating motor starting under such a non-mechanistic scenario (i.e., by evaluating at a voltage below the relay reset setpoint) provides very little useful confirmatory insight into the capability of the auxiliary power system. For that reason, TVA elected to use the value 6672 V AC (which bounds the Degraded Voltage Relay reset of 6681 V AC) rather than a lower value, which as stated in the calculation, would likely simply demonstrate that the Degraded Voltage Relays would dropout.

Furthermore, there is no conflict between TVA's minimum starting voltage analysis and Appendix B, Criterion III because there are no specific requirements in the NRC regulations regarding the method for evaluating the competing degraded voltage protection system requirement to provide protection to safety related equipment under degraded voltage conditions and to support an onsite and offsite power system that meets the performance requirements of GDC-17, "Electric Power Systems." Thus, TVA's design basis for the degraded voltage protection scheme, including the methodology and assumptions for a minimum starting voltage analysis, is that which is presented in WBN-EEB-MS-TI06-0029, Revision 31.

As a result, TVA's position is that the NRC's assertion that TVA failed to properly incorporate TS requirements into the design calculation (i.e, specifications, instructions, drawings or procedures) is unjustified.

III. Disputing the NRC's apparent concerns regarding the adequacy of the WBN current licensing basis for degraded voltage protection

During the course of the WBN Component Design Basis Inspection, including the pre-exit and exit meetings and at a public meeting with the NRC on March 11, 2011, the NRC referred to concerns regarding various aspects of the current licensing basis for degraded voltage protection at WBN. In addition to the NRC concerns regarding the methodology for performing minimum starting voltage analyses discussed above, the NRC expressed concerns about the analytical consideration given to the installed automatic high-speed Load Tap Changers associated with the Common Station Service Transformers.

TVA is presenting an evaluation of the degraded voltage protection current licensing basis to address what appear to be NRC's underlying concerns. Reinforcing TVA's perspective that the NRC's concerns are fundamentally grounded in the current licensing basis was a discussion provided by the NRC at the 2011 Regulatory Information Conference (RIC) on March 9, 2011. At the RIC technical session on degraded voltage issues, the NRC confirmed a recent trend in enforcement actions regarding degraded voltage protection systems (consistent with the recently issued draft Regulatory Issue Summary (RIS) 2011-XX, "Adequacy of Station Electrical Distribution Systems," dated January 12, 2011). In discussing the background for the enforcement trend, the NRC acknowledged that, because degraded voltage protection requirements are not grounded in typical regulatory hierarchy, the licensing basis from plant to plant is quite variable. The NRC did acknowledge that understanding the degraded voltage protection requirements and commitments for any one plant requires a thorough review of the plant specific current licensing basis. The NRC indicated that a thorough review of any one plant's current licensing basis documentation can be time consuming.

TVA agrees that a thorough review of the current licensing basis for a specific issue can be resource intensive in many cases. However, TVA's position is that such a review is warranted in this case in order to establish the clearest shared understanding between the NRC and TVA of the complex technical and regulatory issues related to the NCV. TVA's analysis of the degraded voltage protection system licensing history at WBN is presented below.

WBN, Unit 1 Degraded Voltage Protection Current Licensing Basis

As discussed in the recently issued draft Regulatory Issue Summary (RIS) 2011-XX, "Adequacy of Station Electrical Distribution System," dated January 12, 2011, the NRC's regulatory actions associated with degraded voltage protection essentially began in the wake of the degraded voltage event at Millstone Station in July 1976. The history of all of the NRC's regulatory actions between the Millstone event and the development of the current WBN degraded voltage protection licensing basis in the early 1990's is not presented here. The draft RIS provides an overview of the early years of generic regulatory oversight for this issue, including reference to the issuance of Branch Technical Positions (BTP) of the Standard Review Plan, PSB-1, Revision 0, which was issued in July 1981.

Development of TVA Degraded Voltage Protection Design Calculations

In the early 1990's, TVA developed a methodology for selecting Degraded Voltage Relay (DVR) setpoints based on the recommended guidelines that were issued as DMEDS 9211-01/HEE, EDS Clearinghouse Recommendations and Guidance Concerning Settings of Second Level Undervoltage Protection, dated November 20, 1992 (hereafter referred to as EDS Clearinghouse). The EDS Clearinghouse guidance was developed by the industry in response to NRC issues during Electrical Distribution System Functional Inspections in the late 1980s and early 1990s. The EDS Clearinghouse guidance summarized existing NRC requirements for degraded voltage protections as follows:

> Branch Technical Position PSB-1 is a principal source of NRC Staff technical guidance in this area. The document is included as a "reference" in the NRC Temporary Instruction for EDSFIs TI 2515/107, pg. 4. The only NRC regulation referenced in PSB-1 is 10 CFR 50, Appendix A, General Design Criteria (GDC) 17, "Electric Power Systems." However, GDC 17 does not specifically address degraded grid voltage issues.

With regard to motor starting voltage under accident conditions, the EDS Clearinghouse stated:

> "Licensees should be able to establish adequate terminal voltages of accident loads under auxiliary system transient conditions (such as motor starting transients) without tripping of protective devices such as overcurrent relays, thermal overloads, circuit breakers and fuses. We recommend that licensees perform analyses to ensure that during worst case motor transients with bus voltage equivalent to the minimum switchyard voltage during anticipated worst case system operation; (i) the bus voltage will not drop below the dropout setting of the relay during the transient or (ii) if the bus voltage drops below the dropout setting of the relay during the transient, it will recover above the reset setting of the relay prior to the relay timing out."

With regard to proper setting of degraded voltage relay setpoints, specifically, relay dropout setpoints, the EDS Clearinghouse guidance stated:

> "When considering the dropout setting of the relay, we recommend lower and upper boundaries be established. The lower boundary is the value that is equivalent to the minimum voltage at the safety related buses to ensure adequate downstream terminal voltage for steady state operation of accident loads. In our view, transient conditions of accident loads need not be considered to establish the lower boundary of the relay setting. If the bus is operating at a voltage level that is at the lower boundary of the dropout setting, then any transients applied to the bus, such as a motor start, will:
>
> a. cause the relay to dropout,
> b. begin the time delay to separate the safety bus from the grid,

c. where the bus voltage is already below the reset setting of the relay, it will not recover to a sufficient level to reset the relay following the motor transient. Therefore, the bus will separate from the grid, and

d. energize the EDGs, initiate load shedding and resequencing accident loads onto the bus.

When establishing the lower boundary of the dropout setting, we recommend that the "enveloping component of the accident loads be identified. Once the enveloping component is identified, the minimum bus voltage to supply adequate terminal voltage to the enveloping component for the worst case "steady state" operating scenario should be calculated. When the lower boundary for steady state operation of accident loads has been determined, we recommend sufficient margin be added to this value to establish the lower end of the relays allowable tolerance band for technical specification purposes."

With regard to the factors to be considered when identifying the minimum voltage for starting motors, the EDS Clearinghouse provided the following recommendations on this subject:

> "In our view, transient conditions of accident loads need not be considered to establish the lower boundary of the relay setting. If the bus is operating at a voltage level that is at the lower boundary of the dropout setting, then any transients applied to the bus, such as a motor start, will ... cause the relay to dropout..."
>
> "Licensees should be able to establish adequate terminal voltages of accident loads under auxiliary system transient conditions (such as motor starting transients) without tripping of protective devices ... We recommend that licensees perform analyses to ensure that during worst case motor transients with bus voltage equivalent to the minimum switchyard voltage during anticipated worst case system operation: (i) the bus voltage will not drop below the dropout setting of the relay during the transient or (ii) if the bus voltage drops below the dropout setting of the relay during the transient, it will recover above the reset setting of the relay prior to the relay timing our."

The EDS Clearinghouse recommended the lower boundary of the DVR Dropout setting to be calculated based on:

> "...the value that is equivalent to the minimum voltage at the safety related buses to ensure adequate downstream terminal voltage for steady state operation of accident loads."

TVA applied the recommendations of the EDS Clearinghouse by developing plant specific design calculations.

WBN-EEB-MS-TI06-0029 as the Degraded Voltage Protection Design Basis

For WBN, TVA developed calculation WBN-EEB-MS-TI06-0029, Revision 0 which was issued in March 1992. Unlike SQN, TVA's calculation for degraded voltage analysis for WBN did not reference the EDS Clearinghouse guidance as a source document. Rather, WBN-EEB-MS-TI06-0029, Revision 0 cited NRC Branch Technical Position (BTP) PSB-1 as a source of design input. Between the issuance of Revision 0 of WBN-EEB-MS-TI06-0029 in March 1992 and the issuance of NRC's NUREG-0847, "Safety Evaluation Report related to the Operation of Watts Bar Nuclear Plants, Units 1 and 2," Supplement 20 in February 1996, WBN-EEB-MS-TI06-0029 remained the design basis calculation for the degraded voltage protection scheme although it was revised from time to time to account for plant design changes during construction. Of particular note relative to NCV 05000390/2010005-03, WBN-EEB-MS-TI06-0029, Revision 0 does not contain an explicit evaluation of single motor starting capability as currently exists in Revision 31. The section of WBN-EEB-MS-TI06-0029 (Section 5.2) which states

"The safety bus voltages associated with the upper boundary of the reset setting are evaluated to ensure adequate operation of the auxiliary power system under steady state (starting) conditions and recovery (running) voltage conditions."

was added in Revision 30 of the calculation issued in January 2001. The motor starting analysis referred to in the NCV was a confirmatory evaluation performed over and above the design basis which existed when the NRC found the degraded voltage protection scheme in conformance with PSB-1. However, as listed below, the NRC found the degraded voltage protection approach at WBN in conformance with Branch Technical Position PSB-1.

NRC Licensing Conclusions Regarding TVA Degraded Voltage Methodology

As part of the its review of TVA's application for an operating license for WBN, the NRC issued NUREG-0847, "Safety Evaluation Report related to the Operation of Watts Bar Nuclear Plants, Units 1 and 2," including numerous supplements. In NUREG-0847 and supplements, the NRC found TVA's degraded voltage protection scheme in conformance with PSB-1:

WBN 1982 SER:

> *"...in IEEE Standard 308-1974, which states that preferred offsite and the standby onsite emergency power supplies shall not have a common mode failure between them. The positions that the staff have developed are being used in the evaluation of electrical power designs for operating plants, and CP and OL applications. The applicant was made aware of these positions, which have been incorporated into SRP Appendix 8A as BTP PSB-1. The applicant documented that the Watts Bar design will be modified as shown on FSAR Figure 040.62-1 to meet BTP PSB-1. By letter dated October 9, 1981, the applicant provided additional descriptive information to support the conclusion that the Watts Bar design, once modified, will be in conformance with positions B-1 and B-2 of BTP PSB-1. The staff concludes that the proposed design meets BTP positions and is acceptable. In addition, design implementation will be verified as part of the site visit/drawing review. In regard to positions 3 and 4, the applicant has documented that the auxiliary power system meets these positions and that the analyses will be verified in the preoperational testing program. This meets the staff positions and is acceptable, pending verification of the analyses. The staff will verify the test results."*

WBN 1982 SER, SER Supplement 7, dated September 1991:

> *"In the SER, the staff stated that it would verify the adequacy of the applicant's analysis regarding compliance with Branch Technical Position (BTP) PSB-1 once the preoperational test was completed. The staff noted that the preoperational test has shown that the Watts Bar design conforms with BTP PSB-1 (see Inspection Report 50-390/84-90, dated February 11, 1985). The staff is still evaluating the status of this issue and will update the status in a future SSER."*

WBN 1982 SER, SER Supplement 13, dated April 1994:

> *"In the SER, the staff stated that it would verify the adequacy of the applicant's analysis regarding compliance with BTP PSB-1 once the preoperational test was completed. The staff had confirmed that a preoperational test had shown that the Watts Bar design conforms with BTP PSB-1 (see Inspection Report 50-390/84-90, dated February 11, 1985). Hence, Confirmatory Issue 28 was resolved. However, due to design changes, the results obtained from the previous test are no longer valid and the applicant is performing preoperational tests again. The staff will review this issue when it inspects the applicant's preoperational test program."*

WBN 1982 SER, SER Supplement 14, dated December 1994:

"The material that follows revises the discussion in SSER 13.

(1) Allowable Technical Specification Limits for the Inverse Time Delay Relay. In SSER 13, the staff stated that Technical Specifications should require, for example, that the capability of the relays not to trip when subjected to a voltage of 75 percent for 30 seconds be demonstrated. The staff implied that this had been included in the draft Technical Specifications. This statement was wrong. Instead, the staff required that the setpoints and allowable values for the load-shed and diesel start relays be included in the plant's Technical Specifications to resolve the concerns."

WBN 1982 SER, SER Supplement 20, dated February 1996:

In SSER 13, the staff stated that Confirmatory Issue 28 was resolved on the basis of a preoperational test documented in Inspection Report 50-390/84-90, dated February 11, 1985. However, the staff stated that the results obtained from that test were no longer valid since TVA was reperforming the preoperational tests. The preoperational test was conducted by TVA and reviewed by the staff in Inspection Reports 50-390/95-22 (September 8, 1995) and 50-390/95-77 (December 6, 1995). This update does not change the staff's conclusion regarding Confirmatory Issue 28.

Additional Licensing Basis Documents Regarding WBN Degraded Voltage Protection

WBN License Amendment 36 - 2002

Since issuance of the Facility Operating License in 1996, TVA has obtained only one amendment to the TS related to the degraded voltage protection scheme for WBN. The license amendment is relevant to concerns expressed by the NRC during the WBN CDBI inspection and at the March 11, 2011 public meeting on degraded voltage protection issues. The particular concern, as best understood by TVA, relates to the "crediting" of automatic load tap changers in analyses related to degraded voltage protections designs. This Enclosure does not include a detailed technical discussion regarding the appropriate consideration for any feature of the non-safety related offsite power system including automatic, high speed load tap changers. However, it should be noted that to the extent that voltage recovery following a voltage transient is influenced by many features of the offsite power system, the performance of automatic load tap changers in establishing Degraded Voltage Relay time delay settings cannot be separated from the performance of those tap changers in evaluating dynamic voltage performance on the distribution system.

By letter dated May 14, 2001, TVA requested an amendment to the WBN TS to revise the Trip Setpoint and Allowable Value for Table 3.3.5-1, Function 2(b), 6.9 kV Emergency Bus Undervoltage (Degraded Voltage) - Time Delay, as follows:

- The Trip Setpoints were revised from: > 5.84 sec and < 6.16 sec to > 9.73 sec and < 10.27 sec.
- The Allowable Value was revised from > 5.7 sec and < 6.3 sec to > 9.42 sec and < 10.49 sec.

As reason for the change, TVA stated:

WBN design modification (DCN D-50565-A) would change the setpoint of the degraded voltage relay timers from a nominal 6 seconds to 10 seconds to relax the offsite power criteria. The primary purpose of this change is to provide the plant additional operating margin by allowing additional time for the automatic load tap changers (LTCs) on the Common Station Service Transformers C and D (0-XFMR-200-C/CSST and 0-XFMR-200-D/CSST) to compensate for postulated degraded voltage conditions on the WBN 161 kV Off-Site Power Grid.

In the application, TVA presented additional information regarding the analyses of on-site distribution system performance that had been conducted to support the proposed amendment, including consideration of the role of the automatic load tap changers.

On January 23, 2002, the NRC issued Amendment 36 to the WBN TS and approved the proposed changes. In the safety evaluation (SE) accompanying the amendment, the NRC stated:

> The design modification would change the setpoint of the degraded voltage relay timers from a nominal 6 seconds to 10 seconds to relax the offsite power criteria. The primary purpose of this change is to provide the plant additional operating margin by allowing additional time for the automatic LTCs on the CSSTs. C and D to compensate for postulated degraded voltage conditions on the 161 kV off-site power grid.
>
> Recent analysis of the offsite grid indicates that due to future grid loading projections (within about 2 years), voltage fluctuations on the grid could unnecessarily challenge the EDGs and associated equipment if the current time delay settings are maintained. The longer time delay setpoint would relax the present offsite power criteria by allowing a more severe worst case degraded voltage condition on the 161 kV grid to be accommodated by the CSST C and D LTCs. This extended time delay would eliminate an unnecessary electrical transient associated with the automatic transfer from the preferred offsite power supply to the EDGs when a degraded voltage condition of less than 10 seconds is experienced. Consequently, challenges to equipment associated with the actuation of breakers, shedding of loads, starting of the EDGs, etc., would also be reduced or eliminated.
>
> The analysis was performed using the Electrical Transient Analyzer Program. The software includes the capability to analyze the electrical auxiliary power system for loading, short-circuit currents, running voltages, and starting voltages. The calculations demonstrated the ability of the offsite power system to start and operate all required loads for a worst case DBE without transferring to the EDGs. Increasing the delay time from 6 to 10 seconds will not change the voltage recovery profile. The lower boundary dropout and the upper reset setpoint of the degraded voltage relays remains unchanged. Analyses have shown that operating equipment, such as motors, would not be damaged and would accelerate back to rated speed, thus ensuring their continued availability to perform their intended safety function. Specifically, the analysis demonstrated that the required safety-related equipment in operation at the time a degraded voltage condition occurred would continue to operate throughout the 10-second delay. If the degraded voltage condition cleared during this time period, the voltage would return to nominal levels and be available for equipment required to perform safety functions. Calculations demonstrated that the automatic LTCs remain capable of regulating the 6.9 kV shutdown board voltage within the present voltage relay setpoints. The LTCs will restore 6.9 kV shutdown board voltage for a safety injection signal with a simultaneous worst case grid drop before the degraded

voltage relays actuate to transfer power supply to the EDGs. Engineered safeguard motors will have sufficient voltage available at the terminals to ensure proper starting and operation, when supplied by offsite power. Maximum loading on transformers, distribution system cables, and 6900 V and 480 V boards is bounded by current analyses and remains below component ratings. If the degraded condition still existed at the end of the 10-second time period, transfer to the EDGs would occur and the voltage would recover to an acceptable level. In either case, acceptable voltage levels would be available for equipment to respond in a timely manner if called upon to perform a safety function.

IV. Conclusion

As discussed in Section II of this enclosure, TVA's position is that the NRC's use of 10 CFR Part 50, Appendix B, Criterion III, Design Control in issuing NCV 50-390/2010005-03 is not consistent with essential purpose of that important regulatory requirement and is not consistent with the facts associated with TVA's control of the design of the degraded voltage protection scheme at WBN, Unit 1. Accordingly, TVA denies the subject NCV.

As discussed in Section III of this enclosure, TVA understands that the NRC is currently giving additional focus to degraded voltage protection issues at nuclear power plants. While the NRC has attempted to explain its current concerns through numerous vehicles including through individual inspection activities, a limited number of plant specific backfits, and issuance of draft RIS 2011-XX, the technical and regulatory concerns of the NRC remain unclear.

To respond to the NRC's expectations in the NCV that TVA evaluate post LOCA motor starting using the Degraded Voltage Relay dropout value rather than the 6672 V AC currently in the design, TVA would have to modify the fundamental design documents of the facility which constitutes a change to the facility design. To the extent that such a modification would be made in response to the NRC's position in the NCV which conflicts with the NRC's previous position in NUREG-0847 and related supplements regarding conformance of the design to Branch Technical Position PSB-1, TVA's position is that such a modification would constitute a backfit. Accordingly, should the NRC seek to pursue the issues regarding the adequacy of the WBN degraded voltage protection system design, TVA requests that the NRC treat the matter in accordance with the provisions of 10 CFR 50.109, "Backfitting."

TVA does not take any position in this denial of the subject NCV regarding whether such a backfit would be eligible for the exceptions to the backfit analysis and documentation provisions of 10 CFR 50.109. However, TVA notes that in the draft RIS, the NRC uses language regarding degraded voltage analysis requirements and limitations that do not exist in any previous regulatory requirement or guidance documents on this subject and which now directly conflict with NRC reviewed provisions of the WBN current licensing basis.