TVA

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March 31, 2011

10 CFR 2.201

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

Sequoyah Nuclear Plant, Units 1 and 2
Facility Operating License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **Response to Non-Cited Violations 05000327, 05000328/2010005-03, "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), "Sequoyah Nuclear Plant - NRC Integrated Inspection Report 05000327/2010005, 05000328/2010005," 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) 05000327, 05000328/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations," regarding Sequoyah Nuclear Plant (SQN), Units 1 and 2. The NCV addressed issues regarding the design basis of the degraded voltage protection equipment. In Reference 2, the Tennessee Valley Authority (TVA), requested that the response date for potential challenge of the Reference 1 NCV be extended to March 31, 2011.

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TVA has completed a review of the concerns and issues regarding the design of degraded voltage protection at SQN, Units 1 and 2, expressed by the NRC in Reference 1. On the basis of that review, as provided for in Section 2.3.2, "Non-Cited Violation," of the NRC Enforcement Policy, TVA contests Non-Cited Violation 05000327, 050003228/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations." 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

cc (Enclosure):

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

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

NRC INTEGRATED INSPECTION REPORT 05000327/2010005, 05000328/2010005
REPLY TO NOTICE OF A NON-CITED VIOLATION

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

NRC INTEGRATED INSPECTION REPORT 05000327/2010005, 05000328/2010005
REPLY TO NOTICE OF A NON-CITED VIOLATION

I. Introduction

In a letter dated January 28, 2011, the Nuclear Regulatory Commission (NRC) issued Non-Cited Violation (NCV) 05000327, 05000328/2010005-03, "Failure to Use Worst Case 6900 VAC Bus Voltage In Design Calculations," regarding Sequoyah Nuclear Plant (SQN), Units 1 and 2. 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 SQN, Units 1 and 2. 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 SQN, Units 1 and 2, is unjustified. The NRC's concerns in this regard, although not clearly expressed in the Inspection Report 05000327/05000328-2010005, were reflected in the discussions between NRC inspectors and TVA staff during the 2010 SQN Component Design Basis Inspection (CDBI), by NRC management during the CDBI inspection exit teleconference on December 17, 2010, and during a public meeting between NRC staff 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:

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

II. Challenge to the Use of 10 CFR Part 50, Appendix B, Criterion III, "Design Control" as the Basis for Non-Cited Violation 05000327, 05000328/2010005-03

Restatement of Non-Cited Violation

A restatement of the subject NCV from NRC Inspection Report 05000327, 05000328/201005 is as follows.

> <u>Enforcement:</u> *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. Sequoyah TS Section 3.3.14-2, "Loss of Power Diesel Generator Start instrumentation," table 3.3.14-2 specifies the 6900 VC emergency bus undervoltage (degraded) relay trip setpoints to be as follows: Nominal Trip Setpoint 6456 V, Allowable Values ≤ 6522.5 V and ≥6403.5 V. Contrary to the above, since at least Sept 2006, the licensee failed to assure that applicable regulatory requirements for undervoltage (degraded) voltage protection, including those prescribed in TS 3.3.14-2, were correctly translated into design calculation, SQNETAPAC, "AC Auxiliary Power System Analysis", Revision 36, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. Specifically, the licensee used the input value of 6558 VAC which was higher than the maximum value of 6522.5 VAC specified in TS. Because this finding is of very low safety significance and was entered into the licensee's corrective action program as PER 297671 this violation is being treated as a NCV, consistent with the NRC Enforcement Policy. This finding is identified as NCV 05000327, 05000328/2010005-03, Failure to Use Worst Case 6900 VAC Bus Voltage in Design Calculations. URI 05000327, 328/2010007-01, 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 SQN 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 of the basis for the NCV, the NRC stated:

> *The degraded voltage relay settings at Sequoyah are in accordance with TS Table 3.3.14-2 which states the values to be as follows: Nominal Trip Setpoint 6456 V, Allowable Values ≤ 6522.5 V and ≥6403.5 V.*

In addition, the NRC stated that:

> *The inspector reviewed licensee calculation of record, SQNETAPAC, "AC Auxiliary Power System Analysis," Rev. 36, which evaluated transient motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA). This calculation used the degraded voltage pick-up setpoint of 6558 VAC as the point to analyze post LOCA load motor starting. This voltage of 6558 VAC used in the calculation was non-*

conservative with respect to the voltage specified in TS which specified a maximum value of 6522 VAC.

Finally, the NRC concluded:

Contrary to the above, since at least Sept 2006, the licensee failed to assure that applicable regulatory requirements for undervoltage (degraded) voltage protection, including those prescribed in TS 3.3.14-2, were correctly translated into design calculation, SQNETAPAC, "AC Auxiliary Power System Analysis", Revision 36, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition. Specifically, the licensee used the input value of 6558 VAC which was higher than the maximum value of 6522.5 VAC specified in TS.

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 systems, structures and components (SSCs) 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 *in addition to* 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 SQN (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 Allowable Values 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 separate portion of the calculation whose purpose was to confirm that, for circumstances not linked to specific expected post-accident voltage 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 SQNETAPAC, Revision 36 to SQN TS Table 3.3-14 Allowable Values

The discussion in NRC Inspection Report 05000327, 05000328/201005 associated with the NCV refers to the SQN calculation SQNETAPAC, Revision 36, "Auxiliary Power Systems." SQNETAPAC, Revision 36 is a design calculation and, as demonstrated below, is related to the TS values referenced in the NCV in that it provides an input to calculations that specifically derive the TS values. From the standpoint of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," SQNETAPAC, Revision 36 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 SQNETAPAC in July 2002 and the purpose of SQNETAPAC, as stated in Section 1 of Revision 36 of the calculation, is "to analyze and document the acceptability of the plant AC Auxiliary Power Distribution System (APS)."

As such, SQNETAPAC is a summary calculation that captures in one source updated power system analyses associated with the overall design and operation of the Auxiliary Power System at SQN without repeating the detailed analytical basis from key documents. SQNETAPAC accomplishes its purpose by directly including selected portions of supporting documents as well as by incorporating those same documents in their entirety by reference. More specifically, SQNETAPAC incorporates the following types of information both by quoting in part and by reference to specific supporting documents:

- High Level Design Criteria: (Sections 1.2, 1.3 and 1.4)
- Detailed Design Requirements and Design Acceptance Criteria (Section 3)
    - The design input requirements, including referenced regulatory related requirements, for degraded voltage protection are carried forward from Calculation SQN-EEB-MS-TI06-0008, "Degraded Voltage Analysis," which is discussed in further detail in Section II below.
- Design Assumption (Section 4)
- Special Requirements/Limiting Conditions (Section 5)
- Computations and Analyses (Section 6)
- Summary of Results (Section 8)
- Conclusions (Section 9)

The relationship between SQNETAPAC, Rev 36 and the TS Table 3.3-14 Allowable Values is most directly found in Section 6.1, "Degraded Voltage Analysis," of SQNETAPAC, Rev. 36. The purpose of the Degraded Voltage Analysis is stated in Section 6.1.1:

This section of the calculation will evaluate the adequacy of the degraded voltage protection scheme at Sequoyah Nuclear Plant. The degraded voltage protection scheme, as discussed in this calculation, includes the first level undervoltage relays and associated time delays (Loss of Voltage, LOV) and the second level undervoltage relays and associated time delays (Degraded Voltage, DV) on the safety related 6.9kV Shutdown Boards.

This analysis methodology comes from SQN-EEB-MS-TI06-0008, which has been superseded by this calculation, and IEEE Std 741-1997, reference 2.8-6.

This analysis will provide analytical proof that the Degraded Voltage Protection Scheme Relay Settings are adequate using the voltage limitations of the SQN safety related APS to establish analytical limits and safety limits which will define the settings of the relays.

Section 6.1.2, "Explanation," of SQNETAPAC identifies key concepts of supporting analyses necessary to establish the design of the degraded voltage protections scheme, including the Degraded Voltage Relay setpoints (both dropout and reset), and ultimately the TS Table 3.3-14 values. Specifically, Section 6.1.2 documents the need to establish by analysis the "Minimum Operating Voltage," the "Minimum Starting Voltage," and the "Transient Voltage."

The Minimum Operating Voltage is defined as:

Operation of the auxiliary power system under the most severely loaded steady-state (running) conditions, with the safety-related bus voltage 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" ....

The Minimum Starting Voltage is defined as:

Operation of the auxiliary power system under the most severely loaded steady state (running) conditions, with the safety-related bus voltage as low as possible while keeping all connected safety related motors terminal voltages adequate to start the motor.

The Transient Voltage is defined as:

Operation of the auxiliary power system under transient (starting) conditions, with the safety-related bus voltage equivalent to having the minimum allowable switchyard voltage. The minimum switchyard voltage should consider anticipated worst-case system operating conditions in accordance with the Transmission System Study - Grid Voltage Study...

With these analytical concepts, TVA established the performance requirements associated with the Degraded Voltage Relay dropout and reset setpoints respectively. For the Degraded Voltage Relay dropout setpoints, Section 6.1.2.1 of SQNETAPAC, Rev. 36 states:

The lower boundary of the dropout setting for the degraded voltage relay should be greater than the Minimum Operating Voltage.

With regard to the Degraded Voltage Relay <u>reset</u> setting, Section 6.1.2.1 states:

While keeping the tightest possible tolerance between the nominal dropout and reset setpoints, the upper boundary of the reset setting should be less than the worst case Transient Voltage. If this cannot be met then the Transient Voltage must recover above the upper boundary prior to the expiration of the lower boundary of the accident time delay relay. The upper boundary of the reset setting shall be evaluated against the Minimum Starting Voltage to ensure that motors and motor-operated valves have adequate starting voltage.

The Minimum Operating Voltage value is established as 6400 V for the 6900 V Shutdown Boards in SQNETAPAC, Revision 36, Section 6.1.4., "Minimum Operating Voltage." (This value was derived in Attachment 1 of SQN calculation SQN-EEB-MS-TI06-0008, "Degraded Voltage Analysis," Revision 0, which is incorporated as a reference in SQNETAPAC, Revision 36.) Consistent with the definition of Minimum Operating Voltage in Section 6.2 of the calculation, the value of 6400 V at the Shutdown Board envelopes the running voltage requirements of all safety related motors.

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</u> reliably transfer 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 3.3-14 values referred to in the NCV are the 6.9 kV Shutdown Board - Degraded Voltage - Voltage Sensor Nominal Trip Setpoint and Allowable Value. The Nominal Trip Setpoint is 6456 V and the Allowable Values are $\leq$ 6522.5 and $\geq$6403.5V. These values are associated with the Degraded Voltage Relay dropout setpoint and encompass a nominal setpoint and calculated allowable TS values for the lower dropout setting and upper dropout setting. These values <u>do not include</u> the reset setpoint for the Degraded Voltage Relays.

The current TS Allowable Values were calculated in TVA calculation SQN 27 DAT, Revision 5, Section D.V. The Allowable Value for the Lower Safety Limit (i.e., the lower dropout value) for Degraded Voltage Transfer to the onsite AC power source, the Emergency Diesel Generators (EDGs), is calculated with the 6400 V Minimum Operating Voltage from SQNETAPAC, Revision 4, as the input safety limit value. SQN 27 DAT, Revision 5 calculated the lower and upper Allowable Values of 6403.5 V and 6522.5 V respectively based on relay loop performance parameters that affect instrument accuracy. The upper Allowable Value of 6522.5 V was approved by the NRC in License Amendments Nos. 311 and 300 for SQN, Units 1 and 2, respectively on September 14, 2006. The lower Allowable Value of 6403.5 V was approved by the NRC in License Amendment Nos. 182 and 174 for SQN, Units 1 and 2, respectively on May 24, 1994.

As illustrated by the above discussion, from the standpoint of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," SQNETAPAC, Revision 36, and related calculation SQN 27 DAT 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 3.3-14 Values and SQNETAPAC, Revision 36, Motor Starting Analyses

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 3.3.14-2, were correctly translated into design calculation, SQNETAPAC, "AC Auxiliary Power System Analysis", Revision 36, which evaluated motor starting voltages at the beginning of a design basis loss of coolant accident (LOCA) concurrent with a degraded grid condition.*

TVA's position is that, while the TS are regulatory requirements, they are not design related requirements and, in the case of the Minimum Starting Voltage analysis in Section 6.1.4.2 of SQNETAPAC, Revision 36, use of the TS values as inputs to the design analyses would contradict the underlying purpose of this analysis.

The voltage performance of the 6.9 kV system under design basis accident conditions is evaluated in Section 8.4, "Transient Voltage Analysis," of SQNETAPAC Revision 36. That portion of the calculation demonstrates that under a design basis worst case loading voltage transient with minimum anticipated grid voltage (capability), and considering the entirety of the non-safety related offsite power system, 6.9 kV Shutdown Board voltage recovers to essentially 100% of bus nominal values within 10 seconds of initiation of the transient.

Separately, the analysis in Section 6.1.4.2 of SQNETAPAC, Revision 36, 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. As such, TVA selected an analytical value that was well below the expected post design basis accident recovery value (i.e., expected voltage performance while acknowledging that the entire offsite power supply is non-safety related). TVA selected the upper value of the Degraded Voltage Relay reset setpoint as providing insight into Auxiliary Power System performance under these conditions. TVA did not select values below this because of the limited circumstances in which such analyses would be valuable.

Specifically, with regard to the NRC's assertion that the analysis should have used the TS Allowable Value of 6522 V (or a voltage value within the range of TS Allowable Values) for this analysis, if such a value were used, it would simply demonstrate that the Degraded Voltage Relay would dropout, and within the uncertainty of the analytical assumptions, would transfer the power supply for the 6.9 kV Shutdown Boards to the EDGs. TVA did not select any other values within the range of Degraded Voltage Relay dropout and reset settings for similar reasoning that there was limited usefulness to the insight such analyses would provide. Consequently, use of the Degraded Voltage Relay upper reset value (6558 V) is consistent with confirming the minimum starting voltage performance envelope for safety related motors with minimum offsite power capacity and capability. As such, there is no inconsistency with TVA's minimum starting voltage analysis and the requirements of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," to assure that applicable regulatory requirements are correctly translated into specifications, drawings, procedures, and instructions.

Furthermore, there is no conflict between TVA's minimum starting voltage analysis and Appendix B, Criterion III. This is 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, including the methodology and assumptions for a minimum starting voltage analysis, is that which is presented in SQNETAPAC, Revision 36. As further discussed below, the methodology and assumptions for the minimum starting voltage analysis contained in SQNETAPAC, Revision 36, are the same as those contained in SQN-EEB-MS-TI06-0008 which was provided to the NRC on March 29, 1994 in support of SQN License Amendments Nos. 182 and 174. To have altered the assumptions regarding the minimum starting voltage would have conflicted with the approved current licensing basis - which could have posed a legitimate basis for an Appendix B, Criterion III, "Design Control," citation.

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

During the course of the SQN CDBI 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 SQN. In addition to the NRC concerns regarding the methodology for performing minimum starting voltage analyses discussed above, the NRC also expressed concerns about the analytical consideration given to the automatic Load Tap Changers associated with the Common Station Service Transformers.

The following discussion presents an evaluation of SQN's degraded voltage protection current licensing basis in an effort 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 staff 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 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 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 SQN is presented below.

SQN Degraded Voltage Protection Current Licensing Basis

As discussed in the recently issued draft RIS 2011-XX, "Adequacy of Station Electrical Distribution System Voltage," dated January 12, 2011, the NRC's regulatory actions associated with degraded voltage protection 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 SQN 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 and includes 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 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 guidance). The EDS Clearinghouse guidance was developed by the industry in response to NRC issues during Electrical Distribution System Functional Inspections (EDSFI) in the late 1980s and early 1990s. The EDS Clearinghouse guidance summarized existing NRC requirements for degraded voltage protection 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 10CFR50, Appendix A, General Design Criterion (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, the 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 guidance 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 out.

The EDS Clearinghouse recommended the lower boundary of the Degraded Voltage Relay 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. For SQN, TVA developed calculation SQN-EEB-MS-TI06-0008, Degraded Voltage Analysis, Revision 0 which incorporated the EDS Clearinghouse guidance by reference. In SQN-EEB-MS-TI06-0008, with respect to the Degraded Voltage Relay dropout setting, TVA stated in Section 4.2 of the calculation:

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 in criteria 4.1.a.

Where Criteria 4.1.a stated:

Operation of the auxiliary power system under steady-state ***<u>(running)</u>*** *conditions, with the safety-related bus voltage 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").* [emphasis added]

With respect to the reset setpoint, the calculation states in Section 4.3:

An upper boundary should also be established for the reset setting of the degraded voltage relay. The tightest possible tolerance should be employed between the nominal dropout and reset setpoints. The upper boundary of the reset setting should be equal to the nominal setpoint plus all tolerances from any errors in accordance with TI-28. Margin should exist between the upper boundary of the reset setting and the safety bus voltage equivalent to having the minimum allowable switchyard voltage during anticipated worst-case system operating conditions.

Attachment 1 of SQN-EEB-MS-TI06-0008, Rev. 0 establishes the minimum operating voltage for the 6.9 kV Shutdown Boards as 6400 V and Section 5.1 of that calculation concludes that, at this voltage, all connected safety-related loads have an acceptable operating voltage for all accident and operating conditions. The actual setpoint values for the degraded voltage protection relays were established in TVA setpoint calculation SQN 27 DAT, "Demonstrated Accuracy Calculation," as revised, in Section D, " Accuracy Calculations Index and Calculations," Subsection V.

Submittal of TVA Degraded Voltage Methodology for NRC Review - 1993

In a letter dated October 1, 1993, TVA applied for an amendment to Facility Operating Licenses DPR-77 and DPR-79 for SQN, Units 1 and 2 in part to revise the setpoints and time delays for the 6.9 kV Shutdown Board degraded voltage instrumentation. In the "Reason for Change" section of the application, TVA stated:

> *TVA, along with other participating industry members, has been working with the Electrical Distribution System Clearinghouse to establish guidelines for degraded-voltage analyses and the process required to establish proper degraded-voltage setpoints and time delays. The guidelines established by this effort have been applied to the SQN degraded-voltage design through detailed TVA analysis and have resulted in the need to modify the loss-of-power instrumentation functions. This analysis is documented in TVA Calculations SQN-EEB-MS-TI06-0008, 27 DAT, and DS-1-2 and is available for NRC review at the SQN site. The proposedTS changes and modifications will provide the ability to utilize the alternate feeder breakers to supply the 6.9-kV shutdown boards and incorporate all loss-of-power instrumentation functions into the TSs.*

In this submittal, TVA identified to the NRC the specific calculations which documented the methodology, assumptions and analyses on which the current TVA SQN degraded voltage protection relaying scheme is based. More importantly, in a letter dated March 29, 1994, TVA replied to an NRC Request for Additional Information (RAI) on the pending license amendment request. Two things are of note from TVA's RAI response:

- None of the NRC questions expressed concern with the fundamental methodology of the design analysis, and
- TVA submitted TVA calculation SQN-EEB-MS-TI06-0008 directly to the NRC thus removing any barrier to a thorough NRC review to TVA's methodology.

NRC Licensing Conclusions Regarding TVA Degraded Voltage Methodology

Subsequently, on May 24, 1994, the NRC issued license amendments 182 and 174 for SQN, Units 1 and 2 respectively which approved the proposed setpoints. In the Safety Evaluation (SE) for the license amendment, the NRC stated:

> *The staff has reviewed the new calculations and is satisfied that the new proposed setpoints are adequate for supplying all shutdown loads under degraded voltage conditions.*

And,

> *The staff has reviewed the licensee's calculations to determine if at the proposed trip values and allowable values for the undervoltage relay settings adequate voltage can be provided at the terminals of all engineered safety features (ESF) equipment to perform safety functions and time delay would not exceed the maximum time delay that is assumed in the accident analyses in the final safety analysis report (FSAR). The staff has concluded that the proposed trip values and time delays for the undervoltage relays will protect the Class 1E equipment from sustained degraded voltages under accident and*

other conditions and that the proposed scheme conforms to the Branch Technical Position (BTP) PSB-1. These changes are, therefore, acceptable.

And,

The staff has determined that the proposed changes are consistent with a conservative methodology and are acceptable from the standpoint of nuclear safety.

Analysis of License Amendment Nos. 182 and 174 Regulatory Implications

The licensing process interaction between TVA and the NRC during the review and approval of SQN License Amendment Nos. 182 and 174 has several significant implications to the subject NCV and on overall resolution of this matter.

- TVA provided NRC licensing reviewers direct access to the complete design calculational basis, including the fundamental purpose of the design, the design requirements of the degraded voltage protections system, the methodology by which TVA evaluated the acceptable performance of the proposed design, and the analyses by which TVA developed the specific TS values associated with this function.

- The NRC explicitly acknowledged reviewing TVA's calculation. Neither the SE nor the RAI questions documented in the March 29, 1994, response identified:
    - Any caveats on the depth of NRC's review
    - Any deficiencies or defects in TVA's understanding of the regulatory requirements
    - Any deficiencies or defects in TVA's methodology used to address the regulatory requirements, or
    - Any specific NRC expectations regarding the analysis of motor starting capabilities.
- The methodology submitted by TVA to support the amendment <u>did not</u> contain the Minimum Starting Voltage analysis contained in the current SQNETAPAC, Revision 36. Consequently, the minimum starting voltage analysis was not a part of the NRC's basis for approval of TVA's proposed degraded voltage protection relay design including part of the NRC's basis for concluding that the degraded voltage protection scheme conformed to BTP PSB-1.

  As a result, NRC's implication in the NCV that TVA had an obligation to use what the NRC refers to as "worst case 6900 VAC bus voltage" in its design calculation for minimum starting voltage is not grounded in the licensing basis of the plant. Thus, it is not logical to conclude that by performing the minimum starting voltage analysis in a manner that it did (using the upper value of Degraded Voltage Relay reset), that TVA failed to properly translate regulatory requirements into plant procedures and specifications when no such regulatory requirement is documented in SQN's licensing basis.

- The NRC made an explicit finding that TVA's proposed degraded voltage protection scheme conformed to BTP PSB-1 which was the only existing consolidated set of regulatory expectations for degraded voltage protection that existed at the time.

  (TVA acknowledges that BTP PSB-1 does not constitute regulatory requirements as BTP PSB-1 is incorporated into the NRC's Standard Review Plan which constitutes review guidance for NRC staff.)

Additional Licensing Basis Documents Regarding Sequoyah Degraded Voltage Protection

Amendments 219 and 209 - 1996

By letter dated December 8, 1995, TVA submitted additional modifications to the design and provided a revised degraded voltage sensor Allowable Value for the reset. The NRC approved the proposed changes in a letter dated March 1, 1996, in which it also issued Amendment 219 and 209 to the SQN, Unit 1 and 2, licenses. In the SE for Amendment Nos. 219 and 209, the NRC repeated, nearly verbatim, their finding from the SE for Amendment 182 and 174. Specifically, the NRC stated:

> *The staff has reviewed the licensee's calculations to determine if at the proposed trip values and allowable values for the undervoltage relay settings adequate voltage can be provided at the terminals of all engineered safety features equipment. Adequate voltage is necessary to perform safety functions and to ensure that the time delay would not exceed the maximum time delay that is assumed in the accident analyses in the final safety analysis report. The staff has concluded that the proposed trip values and time delays for the undervoltage relays will protect the Class 1E equipment from sustained degraded voltages under accident and other conditions and that the proposed scheme conforms to the Branch Technical Position PSB-1. These changes are, therefore, acceptable.*

Amendments 311 and 300 - 2006

By letter dated September 30, 2004, TVA submitted TS Change No. 04-01 to, in part, add an upper Allowable Value for voltage sensors for degraded voltage consistent with Technical Specification Task Force (TSTF) Item-365. This change deleted the previous Allowable Value that had been associated with degraded voltage relay reset and replaced it with the Allowable Value of 6522.5 V that is associated with the upper limit of Degraded Voltage Relay dropout setting. The calculation that established the Allowable Value of 6522.5 V was SQN 27 DAT, Revision 5. In a letter dated May 25, 2006, TVA responded to the NRC's January 13, 2006, request for additional information and provided a detailed delineation of the SQN 27 DAT, Revision 5, analysis for the upper and lower Allowable Values. The NRC approved the proposed change in Amendment Nos. 311 and 300 to the SQN TS on September 14, 2006.

Resolution of NRC Generic Letter 89-10 Issue Regarding Degraded Voltage Motor Operated Valves (MOV) Starting

In NRC Inspection Report 50-327/97-18 and 50-328/97-18 dated February 19, 1998, the NRC addressed resolution of a number of TVA Actions Items associated with resolution of issues regarding Generic Letter 89-10 on MOV performance. In the NRC Inspection Report, the NRC stated the following with regard to MOV performance under degraded operating conditions:

> *In reviewing TVA's calculations for block valves 2FCV-68-332 and 2FCV-68-333, the inspectors questioned the degraded voltage values used in the capability calculations. For MOVs that did not actuate automatically in response to a design accident, TVA assumed that the grid voltage supplied to the 480 V bus would be at about 100 percent rather than at the degraded grid setpoint of 93.5 percent. This assumption was based on Sequoyah's use of automatic tap changers. Details of the licensee's bases were evaluated by the NRC Office of Nuclear Reactor Regulation (NRR), Electrical Engineering Branch, and the*

assumption was determined acceptable. The evaluation was documented in a docketed NRC memorandum from J. Calvo to R. Wessman, dated February 12, 1998.

While the issue of crediting automatic load tap changes in evaluating plant response to degraded voltage conditions was not explicitly raised in the subject NCV, the issue was raised on numerous occasions during the SQN CDBI inspection period, during the CDBI exit meeting, and during the March 11, 2011, public meeting. The February 12, 1998 NRC memorandum referenced in Inspection Report 50-327/97-18 and 50-328/97-18 concluded that for circumstances where MOVs needed to start and operate after an accident starting transient is over, it was appropriate to allow consideration of the steady state voltage attained due to automatic load tap changer action in ensuring that adequate voltage was available for the affected MOVs.

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 the NCV is not consistent with essential purpose of that regulatory requirement and is not consistent with the facts associated with TVA's control of the design of the degraded voltage protection scheme at SQN. 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 TS Allowable Values for dropout rather than the 6558 V 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 staff's position in the NCV which conflicts with the NRC's previous position in License Amendment Nos. 182 and 174 regarding conformance of the design to applicable NRC requirements, 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 SQN 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 the NRC reviewed and approved provisions of the SQN current licensing basis.