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

ENCLOSURE 3

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 182 TO FACILITY OPERATING LICENSE NO. DPR-77

AND AMENDMENT NO. 174 TO FACILITY OPERATING LICENSE NO. DPR-79

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 50-328

## 1.0 BACKGROUND

By application dated October 1, 1993, the Tennessee Valley Authority (TVA or the licensee) proposed amendments to the Technical Specifications (TS) for Sequoyah Nuclear Plant (SQN) Units 1 and 2. The proposed changes would revise the setpoints and time delays for the auxiliary feedwater (AFW) loss of power and 6.9 kv shutdown board loss-of-voltage and degraded-voltage instrumentation. These proposed changes also revise the description, total number of channels, channels to trip, minimum channels operable, actions, trip setpoints, allowable values, channel checks, and channel functional test requirements for loss-of-power instrumentation.

In the supplemental letter dated March 28, 1994, the licensee supplied clarifying information that did not change the initial proposed no significant hazards consideration determination.

## 2.0 INTRODUCTION

The loss-of-voltage and degraded-voltage protection are provided to 6900-volt shutdown boards to ensure adequate voltage is available to the safety-related loads. A loss-of-voltage or a sustained degraded-voltage condition will start the emergency diesel generator (EDG) that will be connected to the shutdown board after tripping normal and alternate feeders and shedding the major loads. After the EDG has been tied to the shutdown board, the loss-of-voltage relays continue to provide the load-shed functions and subsequent resequencing of the loads onto the EDG if necessary.

After the EDG has connected to the shutdown board and the load sequencing interval has been achieved, the loss-of-voltage, load-shed function on the 6.9 kv shutdown board initiates a motor-driven AFW pump start. In addition, the load-shed actuation immediately activates a turbine-driven AFW pump start. The reactor coolant pumps would not be available to provide forced coolant flow in the event of loss of voltage, but the turbine-driven AFW pumps start to initiate natural circulation and heat removal in the reactor coolant system via the steam generators. The AFW pumps provide sufficient heat-removal capability to prevent the pressurizer from filling during design-basis accidents.

TVA has been working with the Electrical Distribution System (EDS) Clearinghouse to establish guidelines for degraded-voltage analyses. The guidelines were developed by the EDS by reviewing all inspection findings and enforcement actions from the Electrical Distribution System Functional Inspections (EDSFIs) that were conducted by the NRC at the operating plants. The guidelines established by this effort have been applied to the SQN loss-of-power and degraded-voltage analysis and have led to changes of loss-of-power and degraded-voltage instrumentation. The purpose of these proposed changes is to ensure that the adequate voltage is available to the safety-related loads.

3.0 EVALUATION

The following proposed changes pertain to both Unit 1 and 2 TS unless otherwise stated.

Change 1: Item 6.e of TS Table 3.3-3 would be revised to reflect the use of a 2-out-of-3 voltage sensor logic for detecting loss of power. These sensors initiate load-shedding and subsequent AFW pump start through two separate timing relays with a one-out-of-two logic scheme. In addition, the Functional Unit column heading would be changed from "Station Blackout ..." to "Loss of Power Start" to avoid confusion with the "station blackout" terminology associated with the 10 CFR 50.63 requirements. Also, new action requirement would be incorporated and a footnote added to clarify that this requirement only applies to shutdown board instrumentation on the same unit.

Change 2: Item 7.a of TS Table 3.3-3 would be revised to reflect the use of a two-out-of-three voltage sensor logic for detecting loss of voltage on the 6.9 kv shutdown boards. These sensors start the EDG and initiate load-shedding through two separate timing relays with one-out-of-two logic scheme. This would be accomplished by having one requirement for the voltage sensors and another requirement for the timers. The applicable modes would also be expanded to indicate that the associated EDG is required to be operable in Modes 5 and 6. The applicable action requirement would be revised to correspond with this design change and the exclusion of the provisions to TS 3.0.4 would be deleted.

The major changes would remove the normal feeder loss-of-voltage relays on the 6.9 kv shutdown board and modify the load-shedding and EDG start relays on the 6.9 kv shutdown board to a two-out-of-three logic scheme. This requires installing three new solid-state voltage sensors on the shutdown board bus and two electronic-timing relays to actuate load-shedding and EDG start for loss-of-voltage conditions. The loss-of-power start requirements for the AFW pumps would be altered because the same instrumentation for load-shedding performs this function. In addition, the load-shed actuation immediately initiates a turbine-driven AFW pump start. The proposed change that makes the "Minimum Channels Operable" column the same as "Total Number of Channels" column has been incorporated to clarify that operability of all channels is required for continued power operation.

The addition of the footnotes described in Change 1 would clarify that only the conditions for the shutdown boards associated with the same unit apply to

the operability of this instrumentation. This clarification removes the potential to declare the AFW loss-of-power start instrumentation inoperable for a given unit when only the instrumentation of the opposite unit is inoperable.

The addition of Modes 5 and 6 described in Change 2 to the applicable modes for operability would specify the conditions when these functions are required to support safety functions. The footnote addition to the Modes 5 and 6 requirement would clarify that the loss-of-power instrumentation associated with a 6.9 kv shutdown board is required to be operable when the affected EDG is required to be operable. The TS 3.0.4 exclusion would be included to allow changes between Modes 5 and 6 when the action does not require a shutdown and would allow indefinite operation in these modes.

These proposed changes are consistent with the guidance in Generic Letter (GL) 87-09 and the latest version of the improved TS (NUREG-1431). Therefore, they are acceptable. In addition, the editorial changes associated with these changes are acceptable.

Change 3: Items 7.b.1 and 7.b.2 of TS Table 3.3-3 would be revised to include Modes 5 and 6 as applicable modes when the associated EDG is required to be operable. In addition, Items 7.b.2 and 7.b.3 would be revised to reflect consistent instrumentation descriptions and the minimum channels operable would be revised to be consistent with the action requirements.

Change 4: Table notation footnotes for TS Table 3.3-3 would be updated to reflect the conditions when the loss-of-power instrumentation is required to be operable in Modes 5 and 6. An exclusion to the provisions of TS 3.0.4 was also proposed.

These changes are similar in nature to Change 1 and Change 2 and for the same reason are acceptable.

Change 5: Action 34 of TS Table 3.3-3 would be revised to provide an interval that has a low probability for requiring an EDG start and that will allow for repairs. Action 34 requires entry into the actions for an inoperable EDG if instrumentation is not restored within this interval.

Presently, Action 34 requires SQN station to enter a 48-hour EDG TS action for one inoperable channel and an 8-hour shutdown board TS action for more than one inoperable channel. Also, existing Action 35, which is being amended in this TS amendment, applies a requirement to enter a 72-hour EDG TS action for one or more inoperable channels. Since Action 34 is more restrictive than the actions associated with the inoperability of the EDG itself, it has been revised to apply the appropriate actions to take for loss-of-power instrumentation inoperability.

The proposed Action 34 allows 6 hours to repair one inoperable channel and 1 hour to repair more than one inoperable channel, after which the associated EDG actions for inoperability must be entered. This actions allows sufficient time to make most repairs of failures and takes into account the low probability of an event requiring an EDG start during this time interval. For

one inoperable channel, the loss-of-power instrumentation functions remain fully operable. These actions for the loss-of-power instrumentation, are consistent with the latest version of the improved TS (NUREG-1431) and, therefore, are acceptable.

Change 6: Action 35 of TS Table 3.3-3 would be revised to provide the same basis and time intervals for loss-of-power instrumentation inoperability associated with AFW pump start as are required for load-shedding and EDG start in Action 34. Action 35 requires entry into the actions for an inoperable AFW pump if instrumentation is not restored within this interval.

Proposed Action 35 provides similar changes for the AFW loss-of-power start function as Action 34 described in Change 5 with the exception that the associated AFW pump is declared inoperable instead of the EDG. The loss of load-shed function is not worse than the loss of the associated AFW pump. The present action for the AFW loss-of-power instrumentation allows 48 hours to repair a single inoperable channel; however, no provision exists for maintenance activities to restore the inoperable channels if more than one channel are inoperable. This would require possible unit shutdown and unnecessary entries into TS 3.0.3, and would not be consistent with the actions associated with load-shed functions that utilize the same relays. Therefore, this action is acceptable.

Change 7: Item 6.e of TS Table 3.3-4 would be revised to reflect the design changes and functional unit description change described in Change 1 for Item 6.e of TS 3.3-3. New trip setpoints and allowable values have also been proposed.

Change 8: Item 7.a of TS Table 3.3-4 would be revised to reflect the design changes described in Change 2 for Item 7.a of TS Table 3.3-3. New trip setpoints and allowable values have also been proposed.

Change 9: Item 7.b of TS Table 3.3-4 would be revised to reflect the trip setpoints and allowable values for the design changes to the degraded-voltage instrumentation.

The present design utilizes (1) two undervoltage relays set at 70 percent of nominal voltage to initiate the motor-driven AFW pump start after the EDG has tied to the shutdown board after 1.5 seconds and (2) two additional relays also set at 70 percent of nominal voltage to initiate load-shedding after 5 seconds and start the turbine-driven AFW pump for loss-of-voltage protection. Both sets of relays work on a one-out-of-two logic for actuation. Degraded-voltage protection is provided by three voltage sensors set at 95 percent of nominal voltage in a two-out-of-three logic arrangement that feeds two 5-minute, two 10-second, and two 30-second timers. These timer sets are arranged in a one-out-of-two logic with the 5-minute timers providing EDG start and load-shed initiation, the 10-second timers providing load-shedding if a safety-injection signal is active, and the 30-second timers providing a degraded-voltage annunciation in the main control room. These functions will also operate regardless of the power feed (normal, alternate, or emergency) to the shutdown board.

An additional undervoltage scheme is presently provided on the supply side of the normal-feeder breaker to the 6.9 kv shutdown board. This scheme utilizes three voltage sensors set at 80 percent of nominal voltage in a two-out-of-three logic arrangement and feeds two 0.5-second timers in a one-out-of-two logic scheme. This relaying trips the normal feeder breaker if it is closed.

In the proposed changes for the degraded-voltage scheme, the numbers and the actuation logic for the relays would not be changed; however, interlocks would be added, outputs revised, and the degraded voltage-sensor setpoint would be reduced from 95 percent to approximately 93.5 percent of nominal voltage. The original calculations (95 percent degraded voltage setpoints) did not assume any load diversity factor and, therefore, were very conservative. Degraded voltage relays set at 95 percent may cause spurious plant trips. The licensee has performed new calculations using load diversity factors at the 480 volt shutdown boards. Based on new calculations, new setpoints were calculated to be a 93.5 percent. 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. For the degraded-voltage sensors, a 6456 volt (93.5 percent) setpoint is assigned with a minimum dropout voltage of 6403.5 volts and a maximum reset voltage of 6626.5 volts. The load-shedding function resulting from a degraded-voltage condition, would be disabled when the EDG is tied to the shutdown board without the normal or alternate feeder connected. The tripping function for the normal and alternate feeder during a degraded-voltage condition would still be generated by the load-shedding instrumentation, but would no longer include the additional trip actuation directly from the degraded voltage relay outputs. In addition, the degraded-voltage electro-pneumatic timers would be converted to electronic type.

The loss-of-voltage relaying on the 6.9 kv shutdown board would be converted from two pairs of undervoltage relays to three solid-state voltage sensors. They would be set at 80 percent of nominal voltage, in a two-out-of-three logic arrangement instead of the previous one-out-of-two logic. These sensors would feed two pairs of electronic timers with each pair using a one-out-of-two logic scheme. The timer would initiate the EDG and motor-driven AFW pump and load-shedding at 1.25 seconds. For loss-of-voltage relaying, a setpoint of 5520 volts (80 percent) or more with an allowable value of 5472 volts or more was assigned to the voltage sensors.

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.

Change 10: Item 10 of TS Table 3.3-5 would be revised to incorporate the functional unit description change described for Item 6.e of TS Table 3.3-3.

This change is editorial in nature and is, therefore, acceptable.

Change 11: Table notation 10 of TS Table 3.3-5 would be clarified to reflect the starting point of the response time measurement for the loss-of-voltage conditions.

The present wording can be misleading because it does not clearly indicate that the time delay for the loss-of-voltage EDG start relays is not applicable to this measurement. The relay time delay is accounted for in the safety analysis that is separate from the EDG start response requirement of 10 seconds or less. This relay time delay is not intended to be included in the EDG response and is verified by the setpoint requirements for the timer. This application of the relay time delay for the loss of voltage is the same consideration given to the degraded-voltage relay time delay in the same note. Therefore, the proposed changes in the note clarifies the intent of the EDG response time test measurement and are acceptable.

Change 12: Item 6.e of TS Table 4.3-2 would be revised to reflect the design changes and functional unit description change described in Change 1 for TS Table 3.3-3. In addition, proposed changes to the applicable surveillance requirements (SRs) have be included.

Change 13: Item 7.a of TS Table 4.3-2 would be revised to reflect the design changes described in Change 2 for Item 7.a of TS Table 3.3-3. The applicable modes for loss-of-voltage instrumentation SRs would be expanded to include Modes 5 and 6 when the associated EDG is required to be operable and the channel check requirements removed.

Change 14: Items 7.b.2 and 7.b.3 of TS Table 4.3-2 would be revised to reflect consistent instrumentation descriptions and Items 7.b.1 and 7.b.2 would be revised to expand the applicable modes as described in Change 3 for Item 7.a of this table. The channel check requirement would be removed for Item 7.b.1.

Change 15: Table notation footnotes for TS Table 4.3-2 would be updated to reflect the conditions under which the loss-of-power instrumentation SRs must be complied with in Modes 5 and 6.

These changes are consistent with the previous changes discussed in Change 1, Change 2, Change 3, and Change 4 and, therefore, are acceptable. The SR changes are acceptable.

Change 16: Bases Section 3/4.7.1.2, " Auxiliary Feedwater System," would be revised to add a statement indicating that the turbine-driven AFW pump continues to be considered operable when only one train of AFW loss-of-power start function is inoperable because both 6.9 kv shutdown board logic trains supply this function.

The revision to the AFW system bases would implement information regarding the impact of one channel of loss-of-power instrumentation on the turbine-driven AFW pump. The turbine-driven AFW pump receives two independent start signals for a loss-of-power condition through the load-shed relaying. Each train of

instrumentation for the associated shutdown boards sends one of these signals. If either instrumentation train is lost, the turbine-driven AFW pump continues to have an independent and redundant train of instrumentation available for start initiation. Therefore, the turbine-driven AFW pump should not be considered inoperable as long as one complete train of loss-of-power instrumentation is available. On this basis, the staff finds the proposed change acceptable.

In a conference call with the NRC staff the licensee clarified the following points:

(1) The proposed undervoltage relay scheme will relocate the degraded voltage protection from the supply side of the normal feeder to the 6.9 kv shutdown board bus, so that degraded voltage protection will be available regardless of the supply source (normal and alternate). It will support the licensee's use of alternate feeder, which has not been allowed with the present voltage protection design.

(2) The licensee's calculations for the degraded voltage value has been analyzed down to the 120 volt bus level. The safety-related 120 volt distribution system is powered from the vital inverters, and calculations ensure that the input voltage to the inverters is within the required range when the safety-related boards are at the minimum allowable steady-state operating voltage (i.e., 6400 volts at the 6.9 kv shutdown boards). The voltage to the 120 volt components, powered from motor control center control power transformers (CPTs), has been calculated to ensure that the CPT fuses could carry the starter in-rush current during degraded voltage conditions for the accident time delay limit (11.5 seconds).

(3) The electrical load management system for alternating current software, used to perform the voltage analysis, had been previously validated by test in accordance with NRC Branch Technical Position PSB-1.

(4) To control future modification to the bus load, the licensee adheres to Site Standard Practice 9.3, "Plant Modification and Design Change Control," which requires that any loading modification to the plant will be evaluated and the degraded voltage relaying setpoints will be revised, if necessary, to ensure sufficient voltage to all engineered safety features.

## 4.0 SUMMARY

The proposed changes provide appropriate loss-of-power instrumentation requirements for setpoints, actions, applicable modes, response-time measurements, and surveillance requirements. In addition, proposed changes to the instrumentation logic reflect the new relay design configuration that supports the methodology. The addition of Mode 5 and 6 requirements and deletion of the TS 3.0.4 exclusion for Modes 1 through 4 will enhance the understanding of when loss-of-power instrumentation is required to be operable and when mode changes can be made. The revision to the footnote and bases for the AFW loss-of-power instrumentation implements reasonable criteria for the operability of this instrumentation and AFW pumps based on the system design.

The staff has determined that the proposed changes are consistent with a conservative methodology and are acceptable from the standpoint of nuclear safety. Additionally, the staff has found that the licensee has adequately addressed the concerns raised by the staff and demonstrated that the proposed changes will not involve a significant increase in the probability or consequences of an accident previously evaluated. Therefore, the staff finds the revised setpoints and time delays for the loss-of-power and degraded voltage protection instrumentation acceptable.

## 5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Tennessee State official was notified of the proposed issuance of the amendments. The State official had no comments.

## 6.0 ENVIRONMENTAL CONSIDERATION

The amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20 and to the surveillance requirements. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendments involve no significant hazards consideration, and there has been no public comment on such finding (59 FR 4947). Accordingly, the amendments meet the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

## 7.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

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