UNITED STATES
NUCLEAR REGULATORY COMMISSION
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ENCLOSURE

SUPPLEMENTAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT EVALUATION

TENNESSEE VALLEY AUTHORITY

SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-327 AND 328

1.0 INTRODUCTION

The NRC staff's Safety Evaluation (SE) pertaining to the Tennessee Valley Authority's (the licensee's) initial responses to the Station Blackout (SBO) Rule, 10 CFR 50.63, was transmitted to the licensee by letter dated January 14, 1992. In this letter, the staff indicated that we could not conclude that the licensee's proposed method of coping with an SBO for the Sequoyah Nuclear Plant (SQN), Units 1 and 2, conformed with the SBO Rule. Therefore, the licensee was asked to submit a revised response to the SBO Rule which addressed the areas of non-conformance. The licensee responded to the staff's SE, and specifically to the recommendations, by letter from J. L. Wilson, Tennessee Valley Authority, to the Document Control Desk, U.S. Nuclear Regulatory Commission, dated April 16, 1992.

2.0 EVALUATION

The licensee's responses to each of the staff's recommendations are evaluated below:

2.1 Class 1E Battery Capacity (SE Section 2.2.2)

In the SE, the staff stated that the licensee did not provide information on the loads to be stripped nor on the assumptions it used in its determination of having 4-hour battery capacity. The staff stated that without this information, the adequacy of the battery capacity cannot be verified.

SE Recommendation

The licensee should submit the battery capacity calculation and identify the loads that will be shed. The battery capacity verification and any resulting modification or procedure changes should be included in the documentation supporting the SBO submittals that are to be maintained by the licensee.

Licensee Response

In response to the above recommendation, the licensee stated that the 125V vital and 250V station battery calculations are not in final form. The licensee indicated that both calculations consider loads to be shed manually during an SBO event 30 minutes after the start of the event (except for the main turbine emergency bearing oil pump that requires removal at 3.5 hours into the SBO event). The licensee further stated that they have evaluated the safe shutdown path available during an SBO event and developed a list of components and instrumentation that are required to maintain the safe shutdown path utilizing the turbine-driven auxiliary feedwater (AFW) pump. No components were shed that are necessary to support the shutdown path. Reactor vessel level instrumentation and the inter-plant radio system will be available during the SBO event. The licensee stated that the final list, which will be [illegible] December 15, 1992, will reflect the loads that will be maintained such [illegible]e operator will have the capability to monitor core conditions and to [illegible]sidual heat during the 4-hour SBO event.

[illegible]tion

[illegible]e review of the marked-up pages of the calculations SQN-SBO-001 and [illegible]1, the staff finds that the licensee has used an aging factor of 25 percent and temperature correction factor of 11 percent based on the lowest electrolyte temperature of 60°F. The staff determined the available margin for 125V vital batteries as 3.5 percent. However, the staff cannot determine the available margin for 250V station batteries. Therefore, the licensee should complete the battery calculations and verify that sufficient margin will be available to compensate for less than optimum operating conditions of the battery due to improper maintenance, recent discharge, and inaccuracy in reading discharge characteristics. The staff has determined that the licensee's response to this issue is acceptable and that these calculations should be available for a future audit.

2.2 Compressed Air (SE Section 2.2.3)

In the SE, the staff reported that the air-operated valves relied upon to cope with an SBO for 4 hours could be operated manually and the licensee planned to add compressed air back-up supplies and the associated procedure which would provide remote control of these valves for the 4-hour coping duration requirement.

SE Recommendation

If the modification cited above is not made to the compressed air system, the licensee should perform a habitability assessment, including the lighting and communication equipment, for the areas in which operators need to be to operate the atmospheric relief valve (ARVs) and the auxiliary feedwater (AFW) flow control valves.

Licensee Response

In the response, the licensee indicated that the operation of the turbine-driven, AFW pump level control valves was previously evaluated as requiring a supplemental air supply in order to function during the 4-hour SBO event. A new design using fail-open valves with on/off control, which do not use a continuous bleed controller, will be implemented. These valves will open at the initiation of the event and operate a limited number of times during the event. The flow to, and level in, the steam generators (SGs) are monitored from the main control room, and the flow magnitude is manually controlled by varying the turbine speed to control the SG level. No local manual operator action will be required. With this modification to the valves, and the procedure revision to the control strategy for the turbine, supplemental air to the level control valves will be reduced substantially from the original SBO proposal, such that compressed air bottles or additional accumulators will not be required for an SBO.

The licensee further indicated that ARV operation for SBO will not be required because the strategy for the SBO mitigation is based on the use of the safety-relief valves that lift automatically at preset pressures. However, the cooldown option using the ARVs will be available and controlled manually from a non-hostile environment if it is necessary. This capability is proceduralized in Emergency Contingency Instruction (ECA) 0.0. Sound-powered telephones are available in these rooms for communication to the control room. In addition, hand-held flashlights are available to the operators as well as permanently installed emergency and Appendix R lighting for travel to and operation of these valves.

Staff Evaluation

Based on its review, the staff finds the licensee's responses acceptable and, therefore, considers this SE issue related to the adequacy of compressed air during an SBO event at the Sequoyah plant resolved.

2.3 Effects of Loss of Ventilation (SE Section 2.2.4)

2.3.1 Switchgear Room, Cable Spreading Room, and Inverter Room (SE Section 2.2.4)

SE Recommendation

The licensee should: 1) provide a detailed description of the computer code used to perform the heat-up analyses; and 2) ensure that it has considered areas which house SBO response equipment as areas of concern, including the switchgear room, cable spreading room, inverter room, etc.

Licensee Response

In the response, the licensee provided a detailed description of the computer code used to perform the heat-up analysis. Basically, the code is an improved digital computer software system designed to solve the lumped parameter

(e.g., resistor-capacitor thermal analog network representations of the physical thermal systems using finite difference techniques).

The licensee indicated that the plant procurement required the vital inverters to be designed to operate continuously in the range of 32°F to 122°F. The 480V board rooms that contain the vital inverters should not be subjected to temperatures above 110°F during a 4-hour SBO event. This engineering judgement is based on the temperatures measured in the vital battery rooms during the performance of Special Test ST-7, for reactor coolant system natural circulation during initial plant start-up in which ac power was removed. To confirm the engineering judgement, a transient heat balance calculation for the 480-V board rooms will be performed using a computer code with the results documented in Calculation SQN-SBO-001.

The licensee further indicated that the cable spreading room, switchgear room, and turbine building do not contain active equipment required to mitigate the SBO event.

Staff Evaluation

Based on its review, the staff finds the licensee's response acceptable and, therefore, considers that this SE issue related to the effects of loss of ventilation in the switchgear, cable spreading, and inverter rooms during an SBO event resolved.

2.3.2 Control Room Complex (SE Section 2.2.4.2)

SE Recommendation

In addition to the detailed description of the computer code discussed in SE Section 2.2.4, the licensee should provide the input parameters (i.e., initial room temperature, heat loads, etc.) for the staff to review. The licensee should also establish a procedure to ensure that the control room complex temperature during normal power operation will not exceed the assumed initial temperature used in the heat-up calculation.

Licensee Response

The licensee indicated that before the SBO, temperatures (including boundary temperatures) were assumed to be at their normal maximum value. These temperatures are representative of the maximum normal operating conditions that would occur during the summer months.

The licensee further indicated that Periodic Instruction 0-PI-OPS-000-606.0 is an existing plant instruction which verifies that ambient temperatures in critical spaces are within limits, and records these temperatures once per shift. Historical data documented by these reports was used as the basis for establishing the maximum temperatures that are used in the thermal transient

analysis. This procedure contains limits for ambient temperatures and requires actions to notify appropriate organizations to ensure correction of out-of-limit conditions. Since this procedure exists, there is no need to establish a new program.

Staff Evaluation

Based on its review, the staff finds the licensee's response acceptable and, therefore, considers this SE issue related to the effects of loss of ventilation in the control room during an SBO event resolved.

2.3.3 West Valve Vault (SE Section 2.2.4.3)

SE Recommendation

In the SE, the staff recommended that, in addition to the detailed description of the computer code discussed in Section 2.2.4 above, the licensee should provide the information per the staff's consultant, Science Applications International Corporation (SAIC) request:

"Provide information that supports the west valve vault temperature studies bounding an SBO event with the steam relief." (see Appendix A to the SAIC Technical Evaluation Report (TER))

Licensee Response

In the response, the licensee provided the detailed information as requested by the staff's consultant. The following is a summary of the response:

1. Historical data, recorded during an HVAC failure with maximum outdoor air temperatures while the plant was in Mode 1, listed a maximum temperature in the west main steam valve vault (MSVV) of 163°F.

2. TVA has evaluated the SBO heat load in the west MSVV against the Mode 1 normal heat load and concluded that the SBO load is lower. Therefore, the maximum temperature in an SBO event would be less than 163°F.

3. Extensive environmental response analyses considering main steam line and main feedwater line break temperature profiles in the west MSVV are the basis for equipment qualification of 10 CFR 50.49 components necessary for safe shutdown.

4. No operator entry into the west MSVV will be required during an SBO.

The licensee indicated that the west MSVV temperature exceeds 120°F and contains components required to mitigate an SBO event. This area is considered by TVA to be a dominant area of concern and is acceptable based on the evaluation contained in SQN-SBO-001 and the discussion above.

Staff Evaluation

Based on its review, the staff finds the licensee's response acceptable and, therefore, considers this SE issue related to the effects of loss of ventilation in the west valve vault during an SBO event resolved.

2.4 Proposed Modifications (SE Section 2.4)

SE Recommendation

The licensee should include a full description including the nature and objective of any required modifications in the documentation supporting the SBO submittals that is to be maintained by the licensee.

Licensee Response

The licensee stated that the only modifications required are the Auxiliary Feedwater (AFW) valve changes. The licensee provided the following schedules:

Unit 2 - To be completed by restart following the Cycle 6 refueling outage.

Unit 1 - To be completed by restart following the Cycle 7 refueling outage which is scheduled for October 1994. (The Unit 1 Cycle 6 refueling outage is scheduled to begin in less than 10 months of the anticipated acceptance of SBO response by NRC. This would not be sufficient time for procurement and design of the new control system.)

The licensee further stated that the SBO supporting documentation (engineering calculations, design change packages, training rosters, etc.) for these modifications and the SBO strategy are maintained in a similar manner to other commitments, statements, procedures, and descriptions.

Staff Evaluation

Based on its review, the staff finds the licensee's response to the above cited SE issue to be acceptable.

2.5 Quality Assurance and Technical Specifications (SE Section 2.5)

SE Recommendation

The licensee needs to list the equipment that will be used to provide information and/or to support plant coping during an SBO and should verify that SBO equipment is covered by an appropriate quality assurance (QA) program consistent with the guidance of Regulatory Guide (RG) 1.155, Appendix A. Furthermore, this verification should be documented as part of the package supporting the SBO Rule response.

Licensee Response

The licensee stated that the SBO equipment that is safety related is already required to be in a QA operability program. The non-Class 1E distribution required to provide offsite power to the safety related busses is required to be operable in accordance with Technical Specification (TS) 3.8.1.1. The 250V station battery is inspected periodically and is scheduled for capacity testing every 5 years. The condensate storage tank has a TS requirement that the inventory of condensate be maintained above 190,000 gallons. The other SBO mitigation equipment is safety related. For the above reasons, operability of the equipment required for coping with an SBO is reasonably assured should the event occur. The licensee has provided a list of equipment required during an SBO event.

The licensee further indicated that they will establish an augmented QA program to be applied to components required for coping with the SBO event that will be consistent with the guidance of RG 1.155, Appendix A.

Staff Evaluation

Based on its review and the licensee's commitment to establish a augmented QA program which will be consistent with the guidance of RG 1.155, Appendix A, the staff finds the SE issue resolved.

2.6 Emergency Diesel Generator Reliability Program (SE Section 2.6)

SE Recommendation

The licensee should provide confirmation and include the documentation supporting the SBO submittals that a program meeting as a minimum the guidance of RG 1.155, Position 1.2, is in place or will be implemented.

Licensee Response

The licensee stated that the present reliability program for the emergency diesel generator unit (EDGU) does not meet the requirements of RG 1.155; however, these procedures will be revised to incorporate requirements from RG 1.155 as to the EDGU target reliability and maintenance programs necessary to maintain this reliability. The present reliability for the EDGUs, as of March 13, 1992, is 99 percent for the average of all four emergency onsite supplies.

Staff Evaluation

Based on its review and the licensee's commitment to revise the existing reliability program to incorporate requirements from RG 1.155, Position 1.2, the staff finds the SE issue resolved.

2.7 Class 1E Battery Capacity (SAIC TER Section 3.2.7)

SAIC Concern

In the TER, the staff's consultant indicated that the licensee needs to ensure that it has considered field flashing at the end of the 4-hour SBO event when determining the adequacy of the diesel generator (DG) battery capacity.

Licensee Response

In the response, the licensee stated that the EDGU batteries do not have sufficient capacity to supply control power to the diesels for the entire duration of an SBO event. The licensee further stated that at the onset of an SBO, the operators will send a team to the DG building to troubleshoot and attempt to repair the failed EDGUs. The DG starting air system will perform a starting sequence and then lock out. This first start sequence depletes the normal supply of starting air; until the trouble is found and corrected, the second starting air supply is not connected. It would be up to the team that is sent to make the repairs to turn off the battery if deemed necessary. In any event, only one more start sequence remains in the backup starting air supply.

If the engine is capable of being started, the voltage on the generator will build up without field flash. This occurs because of residual magnetism in the field (rotor) iron. Since the delay of a few seconds is not critical at the end of the 4-hour event, flashing the field is not required.

The control power to the 6.9-kilovolt shutdown boards will be available at the time of the event to connect the emergency ac should it become available.

The DG batteries were discussed in the supplemental response to NRC dated April 5, 1990, in which it was stated that the battery did not have the capacity to cope the 4-hour duration of an SBO event.

Staff Evaluation

Based on its review, the staff finds the licensee's response acceptable and, therefore, considers its consultant's concern related to the EDGU field flashing at the end of the 4-hour SBO event resolved.

2.8 Containment Isolation (SAIC TER Section 3.2.5)

SAIC Concern

In the TER, the staff's consultant indicated that they did not receive any information of whether the licensee used any exclusion criteria in addition to those given in RG 1.155, and that one valve that cannot be excluded by the five criteria given in RG 1.155 requires manual action if it needs to be closed during an SBO event. The staff's consultant further indicated that the licensee needs to include the manual closure of this valve in an appropriate procedure and ensure that the valve is accessible.

Licensee Response

In the response, the licensee indicated that the exclusion criteria of NUMARC 87-00, as endorsed by RG 1.155, were used for reviewing containment isolation valves. Six valves were identified that would require manual operation in the event that containment isolation is needed during an SBO event. These six valves are located in "habitable areas," and would, therefore, be accessible for manual closure if containment isolation was required during an SBO event. Plant operating procedures will be revised as committed to in the licensee's letter to NRC dated April 18, 1989, to incorporate necessary operator actions to accomplish closure and/or verification of closure of these valves in the event that containment isolation is required during an SBO event.

Staff Evaluation

Based on its review, the staff finds the licensee's response acceptable and, therefore, considers its consultant's concern related to the containment isolation during an SBO event resolved.

3.0 SUMMARY AND CONCLUSION

The NRC staff's SE pertaining to the licensee's initial responses to the SBO Rule, 10 CFR 50.63, was transmitted to the licensee by letter dated January 14, 1992. The staff could not conclude that the licensee's proposed method of coping with an SBO for SQN conforms with the SBO Rule. As a result, the licensee was asked to submit a revised response to the SBO Rule which addresses the areas of non-conformance. The licensee's responses to each of the staff's recommendations have been evaluated in this Supplemental Safety Evaluation (SSE) and found to be acceptable. However, the licensee should complete the battery calculations and verify that sufficient margin will be available to compensate for less than optimum operating conditions of the battery due to improper maintenance, recent discharge, and inaccuracy in reading discharge characteristics.

This SSE documents the NRC's final regulatory assessment of the licensee's proposed conformance to the SBO Rule. Therefore, no further submittals from the licensee will be required on this item. The staff considers the 2-year clock for implementation of the SBO Rule in accordance with 10 CFR 50.63 (c)(4) to begin upon receipt by the licensee of the enclosed SSE. Therefore, the licensee should take the necessary actions to ensure complete compliance with SBO as indicated in the staff SE and SSE. The documentation for the analyses and actions required to resolve these concerns should be included with the other documentation to be maintained by the licensee in support of the SBO Rule implementation for future NRC audit.

Principal Contributors: A. Pal and D. Shum

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