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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT RULE (10 CFR 50.63)

TEXAS UTILITIES ELECTRIC COMPANY, ET AL.

COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 1

DOCKET NO. 50-445

1.0 INTRODUCTION

On July 21, 1988, the Code of Federal Regulations (CFR), 10 CFR Part 50, was amended to include a new Section 50.63 entitled, "Loss of All Alternating Current Power," (Station Blackout). The Station Blackout (SBO) Rule requires that each light-water-cooled nuclear power plant be able to withstand and recover from an SBO of a specified duration. The SBO Rule also requires licensees to submit information as defined in 10 CFR 50.63 and to provide a plan and schedule for conformance to the SBO Rule. The SBO Rule further requires that the baseline assumptions, analyses, and related information be available for NRC review. Guidance for conformance to the SBO Rule is provided by: (1) Regulatory Guide (RG) 1.155, "Station Blackout," (2) the Nuclear Management and Resources Council, Inc., (NUMARC) 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," and (3) NUMARC 87-00, "Supplemental Questions/Answers and Major Assumptions," dated December 27, 1989, (issued to the industry by NUMARC on January 4, 1990).

To facilitate the NRC staff's (hereafter referred to as staff) review of licensee responses to the SBO Rule, the staff endorsed two generic response formats. One response format is for use by plants proposing to use an alternate AC (AAC) power source and the other format is for use by plants proposing an AC independent response. The generic response formats provide the staff with a summary of the results from the licensee's analysis of the plant's SBO coping capability. The licensees are expected to verify the accuracy of the results and maintain documentation that supports the stated results. Compliance to the SBO Rule is verified by a review of the licensee's submittal, an audit review of the supporting documentation as deemed necessary, and possible followup NRC inspections to ensure that the licensee has implemented the appropriate hardware and/or procedure modifications that will be required to comply with the SBO Rule.

The licensee's responses to the SBO Rule were provided by letters from W. J. Cahill, Jr. on November 5, 1990, and November 22, 1991, to the U.S. Nuclear Regulatory Commission, Document Control Desk. Also, there was a teleconference between representatives of the licensee and the NRC staff on November 1, 1991. The licensee's responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. The results of the review are documented by an SAIC Technical Evaluation Report (TER) SAIC-91/1803, "Comanche Peak Steam Electric Station, Unit 1, Station Blackout Evaluation," (Attachment).

2.0 EVALUATION

After reviewing the licensee's submittals and the SAIC TER the staff concurs with the SAIC analyses and conclusions as identified in the SAIC TER (refer to the Attachment for details). The staff findings and recommendations are summarized as follows:

2.1 Station Blackout Duration

The licensee has calculated a minimum acceptable SBO duration of 4 hours based on a plant offsite AC power design characteristic Group "P1," an emergency AC (EAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.95. The licensee confirmed that the AC power design characteristic Group is "P1." The Group "C" EAC configuration is based on two EDGs per unit. One EAC power supply per unit is required to operate safe shutdown equipment following a loss of offsite power. The target EDG reliability was based on Comanche Peak Steam Electric Station (CPSES), Unit 1, having an average EDG reliability greater than 0.90 and 0.94 over the last 20 and 50 demands. Using this data, the target EDG reliability (0.95) selected by the licensee is appropriate and meets the criteria specified in RG 1.155 and NUMARC 87-00. However, the licensee should also include the EDG reliability calculations for the last 100 demands, provided the EDGs have experienced 100 demands. This documentation should be retained by the licensee in support of the SBO submittals. The "P1" grouping is based on an independence of offsite power classification of Group "I 1/2," a severe weather (SW) classification of Group "1," and an extremely severe weather (ESW) classification of Group "1."

After reviewing the available information in the licensee's submittals, RG 1.155, NUMARC 87-00, and SAIC's TER, the staff agrees with the licensee's evaluation of a 4-hour SBO coping duration.

2.2 Station Blackout Coping Capability

The characteristics of the following plant systems and components were reviewed to assure that the systems have the availability, adequacy, and capability to achieve and maintain a safe shutdown and to recover from an SBO for a 4-hour coping duration.

2.2.1 Condensate Inventory For Decay Heat Removal

The licensee stated that based on a plant-specific analysis, 187,200 gallons of water would be required for cooldown, decay heat removal and restoring the steam generator levels during a 4-hour SBO event. The Comanche Peak Technical Specifications (TS) require a minimum permissible condensate storage tank level of 282,540 gallons of water which exceeds the quantity required for coping with a 4-hour SBO event.

Based on its review, the staff concludes that the licensee will have sufficient condensate inventory to cope with a 4-hour SBO event at the Comanche Peak plant.

2.2.2 Class 1E Battery Capacity

The licensee stated that a battery capacity calculation has been performed pursuant to Section 7.2.2 of NUMARC 87-00 to verify that the Class 1E batteries have sufficient capacity to supply the connected loads continuously during a 4-hour SBO event. The licensee states that this calculation took no credit for load shedding and was performed in accordance with IEEE-485. In its HVAC calculation for the battery room, the licensee calculated a minimum battery room temperature of 67°F. The licensee performed a battery sizing calculation that assumed an electrolyte temperature of 65°F and concluded that, even without load shedding, the heaviest loaded battery would have sufficient capacity to carry its load for a 4-hour period and provide sufficient DC power for EDG field flashing.

During the November 1, 1991, telephone conference, the licensee stated the following:

- A temperature correction factor of 1.08 based on a minimum expected electrolyte temperature of 65°F was used.
- A 25 percent aging factor was used.
- A design margin of 25 percent to 35 percent was used for all batteries.
- No load shedding was considered.
- The DC powered ventilation fans for the inverter rooms (proposed SBO modification) will not be loaded from Class 1E buses. The licensee intends to use either the existing non Class 1E batteries or install a new battery to support this load.
- The Class 1E battery loads in the FSAR bound the SBO loads.

The licensee further states that the SBO battery load was bounded by the FSAR load, and that each Class 1E 125 VDC system has the capacity to continuously supply all essential loads for a period of 4 hours. The staff agrees with the licensee that the Class 1E battery capacity is adequate to supply the required SBO loads for a 4-hour event.

2.2.3 Compressed Air

The licensee stated that air-operated valves relied upon to cope with an SBO for 4 hours can either be operated manually or have sufficient backup sources independent of the preferred Class 1E power supply.

Based on its review, the staff concludes that the licensee has provided adequate assurance that air operated valves relied upon to cope with an SBO of 4-hours duration either have sufficient backup sources or can be operated manually.

2.2.4 Effects of Loss of Ventilation

The licensee has identified the dominant areas of concern (DACs) at the Comanche Peak plant (see SAIC TER for the list of DACs and their associated calculated temperatures) and performed plant-specific analyses in accordance with the guidance described in NUMARC 87-00 to determine the effects of loss of ventilation in these DACs during a 4-hour SBO event. The licensee concluded that, with the exception of the ventilation fans to be installed to the uninterruptable power supply (UPS) inverter rooms, no plant modification or procedure change is required to provide reasonable assurance for equipment operability in these DACs. The staff's evaluation of the effects of loss of ventilation in each of these areas is provided below.

2.2.4.1 Control Room, Electrical Equipment Areas, Containment Ground Floor, Valve-Rooms, Pressurizer Compartment, Main Steam Penetration Area, Main Steam Penetration Platform, and Turbine-Driven AFW Pump Room

The licensee provided the calculated peak temperatures during a 4-hour SBO event in the above areas (see SAIC TER). However, with respect to the temperature transient analyses, the licensee has not provided the detailed information for the staff to review, therefore, the staff has not been able to conclude that the calculated peak temperatures in these areas are acceptable.

Recommendation: The licensee should document all of the input parameters (i.e., equipment heat loads, personnel heat loads, thermal conductivity for structures, room free air volumes, initial temperatures, etc.) and provide the justification for each of these input parameters used in the temperature transient analyses. The licensee should provide input parameters and justifications to the NRC staff for review for the control room analysis. The input parameters and justification for the other rooms should be included with the documentation that is to be maintained by the licensee in support of the SBO submittals.

2.2.4.2 UPS and Distribution Rooms

With an assumption of 104°F for the initial room temperature, the licensee calculated a peak temperature of approximately 154.5°F for the UPS and distribution rooms. The licensee stated that since operability of the

inverters located in these rooms cannot be assured at the maximum temperatures expected during a station blackout, a hardware modification is planned to reduce these temperatures. The modification will install DC-powered ventilation fans that will supply a sufficient capacity of outside air to the UPS rooms to maintain the room temperatures below the temperature at which inverter operability can be assured. If necessary, this modification will also include the installation of additional battery capacity.

Based on its review, the staff finds the above cited modification acceptable. However, the licensee needs to reevaluate the temperature rise calculations for these rooms taking into account the installation of the DC powered ventilation fans.

Recommendation: The licensee should reevaluate the temperature rise calculations for the UPS and distribution rooms taking into account the installation of the DC powered ventilation fans and verify that the maximum temperatures expected during a 4-hour SBO event are lower than the temperature limit for the operability of the inverters.

2.2.4.3 Containment

The Comanche Peak plant containment is a typical large dry containment. Based on its review of similar large dry containments designed for Westinghouse reactors, the staff concludes that the loss-of-coolant accident/main steam line break (LOCA/MSLB) temperature profile at the Comanche Peak plant will bound the temperature profile resulting from a 4-hour SBO event.

2.2.5 Containment Isolation

The licensee states that the plant list of containment isolation valves (CIVs) has been reviewed to verify that valves which must be capable of being closed or that must be operated under station blackout conditions can be positioned with indication independent of the preferred and blacked-out unit's Class 1E power supplies. The licensee further states that no plant modifications and associated procedure changes are required.

Based on its review, the staff concludes that the containment isolation valve design and operation at the Comanche Peak plant have met the intent of the guidance described in RG 1.155 and are, therefore, acceptable.

2.2.6 Reactor Coolant Inventory

The licensee stated that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is cooled has been assessed for 4 hours. A plant-specific analysis was used for this assessment. The licensee stated that the expected rates of reactor coolant inventory loss under SBO conditions do not result in core uncovery. Therefore, RCS makeup systems under SBO conditions are not required to maintain core cooling under natural circulation conditions.

Expected maximum losses from the RCS are 25 gpm from each of the four RCS pumps at 2250 psia and 12 gpm allowed by the TS for a total of 112 gpm for each unit. It was assured that the reactor was not depressurized below the accumulator injection pressure of 785 psi. The licensee concluded that the core would remain covered in excess of 8 hours. Based on the above parameters, the staff's consultant calculated that the volume of water remaining in the core at the end of a 4-hour SBO would be 6313 cubic feet. The staff's consultant concluded, based on experience with similar 4-loop Westinghouse pressurized water reactors (PWRs), that the core would not be uncovered during a 4-hour SBO event. Therefore, the staff considers that there is reasonable assurance that the reactor coolant inventory will be adequate during a 4-hour SBO.

The reactor coolant inventory evaluation as described above was based on the guidance provided in NUMARC 87-00 of 25 gpm per reactor coolant pump (RCP) seal leakage for PWRs. The 25 gpm value was agreed to between NUMARC and the staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines higher RCP leakage rates than assumed for this evaluation, the licensee should be aware of the potential impact of this resolution on their analyses and actions addressing conformance to the SBO Rule.

2.3 Proposed Procedures and Training

The licensee stated that plant procedures have been reviewed and that changes necessary to meet the guidelines in NUMARC 87-00, Section 4, will be implemented in the following areas:

- Station blackout response - Procedure ECA-0.0A, "Loss of All AC Power"
- AC power restoration - Procedure ECA-0.0A, "Loss of All AC Power"
- Severe weather - Procedure ABN-907A, "Acts of Nature"

The licensee also stated that procedure changes associated with its proposed modification in the UPS inverter rooms will be identified, developed, and implemented coincident with the installation of the modification. The staff did not review the procedures or proposed procedure modifications. The staff expects the licensee to implement and maintain these procedures including any others that may be required to ensure an appropriate response to an SBO event. Although personnel training requirements for an SBO response were not specifically addressed by the licensee's submittal, the staff expects the licensee to implement the appropriate training to ensure an effective response to an SBO event.

2.4 Proposed Modification

The licensee states that based on the HVAC analysis, the operability of the UPS inverters (in rooms 119 and 121) could not be assured at the maximum temperatures expected during an SBO. As a result, a hardware modification is planned to reduce these temperatures. DC-powered ventilation fans will be installed to supply a sufficient capacity of outside air to the UPS rooms to maintain the room temperatures below the temperature at which inverter operability can be assured. During the telephone conference on November 1, 1991, with the staff, the licensee stated that this additional capacity would

not come from the existing Class 1E batteries. If necessary, this modification will include the installation of additional battery capacity. The new ventilation fans will draw power from either the existing non-Class 1E batteries or from a new dedicated battery. The licensee stated that the UPS rooms hardware modifications are planned for a refueling outage at least 120 days after receipt of the NRC Safety Evaluation Report. The staff finds the licensee's proposed modifications to be acceptable provided they are properly implemented.

Recommendation: The licensee should include a full description, including the nature and objectives of the proposed modifications identified above, in the documentation that is to be maintained by the licensee in support of the SBO submittals.

2.5 Quality Assurance and Technical Specifications

The licensee stated that all equipment required to cope with an SBO is safety-related and included in the plant's QA program, pursuant to 10 CFR 50, Appendix B, except for the turbine stop valves. The licensee states that in the SBO scenario, the turbine stop valves are relied upon for immediate steam isolation. These valves are non-safety related, but are surveilled and maintained per plant Technical Specification 3/4.3.4, "Turbine Overspeed Protection."

The licensee did not specifically address Quality Assurance (QA) programs or TS for the SBO equipment. The TS for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specifications Improvement Program and remains an open item at this time. However, the staff expects plant procedures to reflect the appropriate testing and surveillance requirements to ensure the operability of the necessary SBO equipment. If the staff later determines that TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

Recommendation: The licensee should verify and confirm that the ventilation fans and the additional batteries, if required, as discussed in Section 2.4, are covered by their QA program consistent with the guidance of Appendix A, RG 1.155. Verification that such a program is in place should be included as part of the documentation supporting the SBO Rule responses.

2.6 EDG Reliability Program

The licensee stated that Comanche Peak Unit 1 is committed to Safety Guide 9 (3/10/71) and the TransAmerica Delaval, Inc., EDG Reliability Program. The licensee further states that they will reevaluate this program upon resolution of Generic Issue B-56, "Emergency Diesel Generator Reliability," and issuance of Regulatory Guide 1.9, Revision 3, "Selection, Design, Qualification, Testing, and Reliability of Diesel Generator Units Used as Onsite Electrical Power Systems at Nuclear Power Plants," consistent with the reporting requirements of Regulatory Guide 1.9.

Recommendation: The licensee should provide confirmation and include in 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.

2.7 Scope of Staff Review

The SBO Rule (10 CFR 50.63) requires licensees to submit a response containing specifically defined information. It also requires utilities "...to have baseline assumptions, analyses, and related information used in their coping evaluations available for NRC review." The staff and its contractor (SAIC) did not perform a detailed review of the proposed hardware and procedural modifications which are scheduled for later implementation. However, based on our review of the licensee's supporting documentation, we have identified the following areas for focus in any followup inspection or assessment that may be undertaken by the NRC to verify conformance with the SBO Rule. Additional items may be added as a result of the staff review of the actions taken by the licensee in response to this SE.

a. Hardware and procedural modifications,

b. SBO procedures in accordance with RG 1.155, Position 3.4, and NUMARC 87-00, Section 4,

c. Operator staffing and training to follow the identified actions in the SBO procedure,

d. EDG reliability program meets, as a minimum, the guidelines of RG 1.155,

e. Equipment and components required to cope with an SBO are incorporated in a QA program that meets the guidance of RG 1.155, Appendix A, and

f. Actions taken pertaining to the specific recommendations noted above in the SE.

3.0 SUMMARY AND CONCLUSION

The staff has reviewed the licensee's responses to the SBO Rule (10 CFR 50.63) and the TER prepared by the staff's consultant, SAIC. Based on our review, several confirmations and commitments need to be made as described in the recommendations itemized herein. These include the provision of detailed information regarding the temperature transient analyses for the Control Room and other equipment areas identified in Section 2.2.4.1 for staff review, reevaluation of temperature rise calculations and equipment operability for the UPS and distribution rooms, description of the proposed modifications, and verification of a QA program for the proposed ventilation fans and battery associated with UPS and Distribution Rooms consistent with RG 1.155, Appendix A, and an EDG reliability program that meets, as a minimum, the guidelines of RG 1.155, Section 1.2. The licensee should include the documentation associated with the above actions and verifications with the other documentation supporting the SBO

submittal, and maintain this documentation for further inspection and assessment as may be undertaken by the NRC to further verify conformance with the SBO Rule.

Based on our review of the submittals, we find the licensee's responses and proposed method of dealing with an SBO to be incomplete and the staff cannot assess conformance with the SBO Rule. The licensee should provide for staff review the input parameters used in the temperature transient analyses (see Section 2.2.4.1 of this SE) and provide justification for each of these input parameters. The licensee should also confirm within 60 days that the recommendations identified within this SE will be implemented. Upon receipt of the information and confirmations, the staff will provide its assessment on Comanche Peak's conformance to the SBO Rule. The schedule for implementation should also be provided in accordance with 10 CFR 50.63(c)(4).

Attachment:
SAIC-91/1803, Technical Evaluation Report,
Comanche Peak Steam Electric Station,
Unit 1, Station Blackout Evaluation

Date: February 27, 1992