50-445
50-446

April 1, 1992

Recipients of February 27, 1992 Letter to TU Electric
Subject: SAFETY EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION CONCERNING STATION BLACKOUT ANALYSIS FOR COMANCHE PEAK ELECTRIC STATION, UNIT 1 (TAC NO. M68530)

In the distribution of the subject letter, the attachment to the Safety Evaluation was inadvertently not distributed. Attached is a copy of the letter with the appropriate enclosures. We are sorry for any inconvenience this may have caused.

Thomas A. Bergman, Project Manager
Project Directorate IV-2
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

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

February 27, 1992

Docket Nos. 50-445
and 50-446

Mr. William J. Cahill, Jr.
Group Vice President, Nuclear
TU Electric Company
400 North Olive Street, L.B. 81
Dallas, Texas 75201

Dear Mr. Cahill:

SUBJECT: SAFETY EVALUATION AND REQUEST FOR ADDITIONAL INFORMATION CONCERNING STATION BLACKOUT ANALYSIS FOR COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 1 (TAC NO. M68530)

The TU Electric Company responses to the requirements of the Station Blackout (SBO) rule, 10 CFR 50.63, were provided by letters dated November 5, 1990 and November 22, 1991. The information provided by these responses has been reviewed by the NRC staff and Science Applications International Corporation (SAIC), under contract to the NRC. The enclosure provides the staff's preliminary safety evaluation (SE) and the SAIC Technical Evaluation Report (TER) SAIC-91/1803, "Comanche Peak Steam Electric Station, Unit 1, Station Blackout Evaluation," (Attachment to Enclosure). The SE contains recommendations which include a request for additional information (revised response) to be submitted for NRC review. This response, which is limited to the values and justification of input parameters used in the control room temperature transient analysis, should be submitted no later than March 31, 1992.

In addition, the following areas may require followup inspection by the NRC to verify that the requirements of the SBO rule have been satisfied. The staff is developing guidance for this followup inspection to verify the following:

a. Hardware and procedural modifications;

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

c. Operator staffing and training to follow the identified actions in the procedures;

d. Emergency Diesel Generator (EDG) reliability program meets, as a minimum, the guidelines of R.G. 1.155;

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

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

The guidance provided on Technical Specifications (TS) related to SBO states that the TS should be consistent with the Interim Commission Policy Statement on Technical Specifications. The staff has taken the position that TS are required for SBO response equipment. However, the question of how specifications for the SBO equipment will be applied is currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains an open item at this time. In the interim, 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, licensees will be notified of the implementation requirements.

The reporting requirements contained in this letter affect fewer than ten respondents: therefore, OMB clearance is not required under Public Law 96-511.

Sincerely,

Original Signed By

Thomas A. Bergman, Project Manager
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Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

Enclosure:
Safety Evaluation

cc w/enclosure:
See next page

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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-91/1603, "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, 137,200 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 55°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 assumed 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

TECHNICAL EVALUATION REPORT

COMANCHE PEAK STEAM ELECTRIC STATION UNIT 1

STATION BLACKOUT EVALUATION

TAC No. 68530

SAIC
Science Applications International Corporation
An Employee-Owned Company

Final
December 13, 1991

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Contract NR -03-87-029
Task Order No. 116

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TECHNICAL EVALUATION REPORT

COMANCHE PEAK STEAM ELECTRIC STATION UNIT 1
STATION BLACKOUT EVALUATION

1.0 BACKGROUND

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR Part 50 by adding a new section, 50.63, "Loss of All Alternating Current Power" (1). The objective of this requirement is to assure that all nuclear power plants are capable of withstanding a station blackout (SBO) and maintaining adequate reactor core cooling and appropriate containment integrity for a required duration. This requirement is based on information developed under the commission study of Unresolved Safety Issue A-44, "Station Blackout" (2-6).

The staff issued Regulatory Guide (RG) 1.155, "Station Blackout," to provide guidance for meeting the requirements of 10 CFR 50.63 (7). Concurrent with the development of this regulatory guide, the Nuclear Utility Management and Resource Council (NUMARC) developed a document entitled, "Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00 (8). This document provides detailed guidelines and procedures on how to assess each plant's capabilities to comply with the SBO rule. The NRC staff reviewed the guidelines and analysis methodology in NUMARC 87-00 and concluded that the NUMARC document provides an acceptable guidance for addressing the 10 CFR 50.63 requirements. The application of this method results in selecting a minimum acceptable SBO duration capability from two to sixteen hours depending on the plant's characteristics and vulnerabilities to the risk from station blackout. The plant's characteristics affecting the required coping capability are: the redundancy of the onsite emergency AC power sources, the reliability of onsite emergency power sources, the frequency of loss of offsite power (LOOP), and the probable time to restore offsite power.

In order to achieve a consistent systematic response from licensees to the SBO rule and to expedite the staff review process, NUMARC developed two generic

response documents. These documents were reviewed and endorsed (10) by the NRC staff for the purposes of plant specific submittals. The documents are titled:

1. "Generic Response to Station Blackout Rule for Plants Using Alternate AC Power," and

2. "Generic Response to Station Blackout Rule for Plants Using AC Independent Station Blackout Response Power."

A plant-specific submittal, using one of the above generic formats, provides only a summary of results of the analysis of the plant's station blackout coping capability. Licensees are expected to ensure that the baseline assumptions used in NUMARC 87-00 are applicable to their plants and to verify the accuracy of the stated results. Compliance with the SBO rule requirements is verified by review and evaluation of the licensee's submittal and audit review of the supporting documents as necessary. Follow up NRC inspections assure that the licensee has implemented the necessary changes as required to meet the SBO rule.

In 1989, a joint NRC/SAIC team headed by an NRC staff member performed audit reviews of the methodology and documentation that support the licensees' submittals for several plants. These audits revealed several deficiencies which were not apparent from the review of the licensees' submittals using the agreed upon generic response format. These deficiencies raised a generic question regarding the degree of licensees' conformance to the requirements of the SBO rule. To resolve this question, on January 4, 1990, NUMARC issued additional guidance as NUMARC 87-00 Supplemental Questions/Answers (11) addressing the NRC's concerns regarding the deficiencies. NUMARC requested that the licensees send their supplemental responses to the NRC addressing these concerns by March 30, 1990.

2.0 REVIEW PROCESS

The review of the licensee's submittal is focused on the following areas consistent with the positions of RG 1.155:

A. Minimum acceptable SBO duration (Section 3.1),

B. SBO coping capability (Section 3.2),

C. Procedures and training for SBO (Section 3.4),

D. Proposed modifications (Section 3.3), and

E. Quality assurance and technical specifications for SBO equipment (Section 3.5).

For the determination of the proposed minimum acceptable SBO duration, the following factors in the licensee's submittal are reviewed: a) offsite power design characteristics, b) emergency AC power system configuration, c) determination of the emergency diesel generator (EDG) reliability consistent with NSAC-108 criteria (9), and d) determination of the accepted EDG target reliability. Once these factors are known, Table 3-8 of NUMARC 87-00 or Table 2 of RG 1.155 provides a matrix for determining the required coping duration.

For the SBO coping capability, the licensee's submittal is reviewed to assess the availability, adequacy and capability of the plant systems and components needed to achieve and maintain a safe shutdown condition and recover from an SBO of acceptable duration which is determined above. The review process follows the guidelines given in RG 1.155, Section 3.2, to assure:

a. availability of sufficient condensate inventory for decay heat removal,

b. adequacy of the Class-1E battery capacity to support safe shutdown,

c. availability of adequate compressed air for air-operated valves necessary for safe shutdown,

d. adequacy of the ventilation systems in the vital and/or dominant areas that include equipment necessary for safe shutdown of the plant,

e. ability to provide appropriate containment integrity, and

f. ability of the plant to maintain adequate reactor coolant system inventory to ensure core cooling for the required coping duration.

The licensee's submittal is reviewed to verify that required procedures (i.e., revised existing and new) for coping with SBO are identified and that appropriate operator training will be provided.

The licensee's submittal for any proposed modifications to emergency AC sources, battery capacity, condensate capacity, compressed-air capacity, ventilation system for equipment operability, containment isolation valves for providing appropriate containment integrity and primary coolant make-up capability is reviewed. Technical specifications and quality assurance set forth by the licensee to ensure high reliability of the equipment, specifically added or assigned to meet the requirements of the SBO rule, are assessed for their adequacy.

This preliminary SBO evaluation is based upon the review of the licensee's submittal dated November 5, 1990 (13), the licensee's written response (14) to questions discussed during the November 1, 1991 telephone conference, and the information available in the plant Final Safety Analysis Report (FSAR) (12); it does not include a concurrent site audit review of the supporting documentation. Such an audit may be warranted as an additional confirmatory action. This determination would be made and the audit would be scheduled and performed by the NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Texas Utilities (TU) Electric Company, calculated (13) a minimum acceptable station blackout duration of four hours for the Comanche Peak Steam Electric Station (CPSES) Unit 1 site. The licensee stated that no modifications are required to attain this coping duration.

The plant factors used to estimate the proposed SBO duration are:

1. **Offsite Power Design Characteristics**

   The plant AC power design characteristic group is "P1" based on:

   a. Independence of the plant offsite power system characteristics of "I1/2,"

   b. Expected frequency of grid-related LOOPs of less than one per 20 years,

   c. Estimated frequency of LOOPs due to extremely severe weather (ESW) which places the plant in ESW Group "1," and

   d. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW Group "1."

2. **Emergency AC (EAC) Power Configuration Group**

   The EAC power configuration of the plant is "C." CPSES is equipped with two emergency diesel generators per unit. One EAC power supply per unit is necessary to operate safe-shutdown equipment following a loss of offsite power.

3. Target Emergency Diesel Generator (EDG) Reliability

The licensee has selected target EDG reliability of 0.95 for the CPSES EDCs. This target reliability was selected based on having a unit average EDG reliability for the last 20 demands greater than 0.90, and for the last 50 demands greater than 0.94.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the estimated frequency of LOOPs due to ESW and SW conditions, the independence of the offsite power system grouping, the expected frequency of grid-related LOOPs, the classification of EAC, and the selection of EDG target reliability.

Using Table 3-2 of NUMARC 87-00, the expected frequency of LOOPs due to ESW conditions places the CPSES site in ESW Group "1," which is in agreement with what was stated in the licensee's submittal (13).

Using data from Table 3-3 of NUMARC 87-00, the expected frequency of LOOPs due to SW conditions place the CPSES site in SW Group "1," which is in agreement with what was stated in the licensee's submittal (13). This calculation was performed with the condition that there are multiple rights of way among the incoming transmission lines, consistent with information provided in the FSAR (12).

The licensee stated that the independence of the plant offsite power system grouping is "1I/2." A review of the CPSES FSAR (12) shows that:

1. The site has 345 kV and 138 kV switchyards that are physically and electrically independent;

2. During normal operation, 345-kV power is provided to the CPSES Unit 1 emergency buses from the 345 kV switchyard and the Startup transformer (SUT), XST2;

3. In the event that the Unit 1 SUT becomes unavailable to its normally fed Class 1E buses, power is made available from the Unit 2 SUT (XST1) by an automatic transfer. According to the FSAR (12), each SUT has the capacity to carry the required Class 1E loads for both units during all modes of operation.

Based on the above and the criteria stated in Table 5 of RG 1.155, the plant independence of offsite power system group is classified as "I2."

Establishment of the proper Emergency AC (EAC) Configuration Group is based on the number of available EAC sources and the number of EAC sources required to operate safe shutdown equipment following a LOOP. Each unit has two dedicated EAC sources, one of which is required after a LOOP. We agree with the licensee's assessment which places the plant in EAC Group "C."

The licensee selected (13) the EDG target reliability of 0.95 based upon having an average reliability for the last 20 demands greater than 0.90 and for the last 50 demands greater than 0.94. Although this is an acceptable criterion for choosing an EDG target reliability, the guidance of RG 1.155 requires that the EDG statistics for the last 100 demands also be calculated. Without this information, we are unable to adequately judge how well the EDGs have performed in the past and if there should be any concern. We are unable to verify the demonstrated start and load-run reliability of the plant EDGs. This information is only available onsite as part of the submittal's supporting documents. Reliability data from NSAC-108 was not available in this case, as CPSES Unit 1 was not licensed until August, 1990 and NSAC-108 covers the years 1983-1985. Nevertheless, the licensee needs to have an analysis showing the EDG reliability statistics for the last 20, 50 and 100 demands in its SBO submittal supporting documents.

The licensee stated (13) that TU Electric is committed to Safety Guide 9 (3/10/71) and the TransAmerica DeLaval, Inc., EDG Reliability Program. The licensee stated that it will reevaluate this program upon resolution of Generic Issue B-56, "Emergency Diesel Generator Reliability," and the 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.

With regard to the expected frequency of grid-related LOOPs at the site, we can not confirm the stated results. The historical data with regard to LOOP events in the U.S. contained in NUREG/CR-3992 (3) is not applicable to CPSES, as it only covers the years 1973-1980. In the absence of any adverse information, we agree with the licensee's statement.

Based on the above, we agree with the licensee's claim that the offsite power design characteristic of the CPSES Unit 1 site is "P1" with a minimum required SBO coping duration of four hours.

3.2 Station Blackout Coping Capability

The plant coping capability with an SBO event for a required duration of four hours is assessed with the following results:

1. Condensate Inventory for Decay Heat Removal

Licensee's Submittal

The licensee stated (13) that a site-specific calculation determined that 187,200 gallons of water would be required to cooldown the reactor coolant system, remove decay heat, and restore steam generator levels during a four-hour SBO event. The licensee stated (13) that the minimum permissible condensate storage tank (CST) level per technical specifications provides 282,540 gallons of water, which exceeds the quantity required for coping with a four hour SBO event.

Review of Licensee's Submittal

Using the expression provided in NUMARC 87-00, we estimated that 75,451 gallons of water would be required to remove decay heat during a four-hour SBO event, assuming that no primary system cooldown is

attempted. This estimate is based on the maximum licensed core thermal rating of 3411 MWt listed in the CPSES FSAR (12). The licensee stated that it has considered the effect of RCS cooldown and steam generator blowdown in its calculation. We didn't repeat the licensee's calculations. However, based on our experience with similar PWRs we concur with the licensee that, based on a minimum condensate level of 282,540 gallons, the site has sufficient condensate to cope with a four hour SBO event.

2. **Class-1E Battery Capacity**

Licensee's Submittal

The licensee stated (13) 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 for hour SBO event. This calculation took no credit for load shedding and was performed in accordance with IEEE Std-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 (13) that, even without load shedding, the heaviest loaded battery has sufficient capacity to carry its load for a four hour period and provide sufficient DC power for Diesel Generator field flashing.

In response to questions raised at the November 1, 1991 telephone conference, the licensee stated (14) the following assumptions used in the battery capacity calculation:

- A temperature correction factor of 1.08 based on a minimum expected electrolyte temperature of 65°F was used;

- A 25% aging factor was used;

- A design margin of 25% to 35% 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 the Class 1E buses. The licensee intends to use either the existing non Class 1E batteries or it will install a new battery to support this load.

- The Class 1E battery loads in the FSAR bound the SBO loads.

Review of Licensee's Submittal

The licensee's battery calculations were neither received nor reviewed. Using an aging factor of 1.25 and temperature correction factor of 1.08, the licensee stated that a design margin of 25% to 35% exists for each Class 1E battery during a four hour SBO event. The licensee further stated that the SBO battery load was bounded by the FSAR load. The CPSES FSAR states (12) that each Class-1E 125 VDC system has the capacity to continuously supply all essential loads for a period of four hours. Since the SBO battery load will be smaller than the design basis load considered in the FSAR, we agree with the licensee assertion that the existing Class 1E battery capacity is adequate to supply the required SBO loads for four hours.

3. Compressed Air

Licensee's Submittal

The licensee stated (13) that air-operated valves relied upon to cope with an SBO for four hours can either be operated manually or have sufficient backup sources independent of the preferred and Class-1E power supply.

With regard to AFW flow control, the licensee stated (13) that the AFW throttling valves have accumulators which are sized for 30 minutes of operation. ECA-0.0A specifically cautions the operators about this

limitation, and identifies the valves which operators must locally operate to throttle AFW flow after the air accumulators are depleted. These valves are located in the AFW pump room which is calculated to reach a maximum temperature of 131.1°F during an SBO. During the telephone conference on November 1, 1991, the licensee stated that although the capability exists to control AFW flow from the control room, it intends to follow the guidelines of ECA-0.0A. The licensee stated that it considers 30 minutes to be sufficient for starting the AFW pump and providing flow to a steam generator, and that after 30 minutes only intermittent operator manual actions are required. Further, the licensee stated (14) the following: accessibility and habitability of the AFW pump room were evaluated based on the expected ambient temperature conditions, adequate communications equipment exists in the form of portable radio communications (walkie-talkies), and adequate lighting in the area is provided by Fire Safe Shutdown battery powered lights with capacity in excess of the four-hour coping analysis requirement.

With regard to steam relief to the atmosphere, the licensee stated (13) that the atmospheric relief valves (ARVs) have accumulators which are of sufficient size to enable a controlled cooldown of the RCS from hot standby to hot shutdown over the four hour SBO period. In addition, during the telephone conference the licensee stated that the ARVs will be throttled from the control room during an SBO event and that contingencies exist to operate the ARVs locally, if required.

Review of Licensee's Submittal

Based on the information provided in the licensee's submittal and the licensee's response to questions raised during the November 1, 1991 telephone conference, we conclude that the licensee has provided adequate assurance that all air operated valves relied upon to cope with an SBO of four hours duration have sufficient backup sources and can be operated in a manner that is consistent with the guidance.

4. Effects of Loss of Ventilation

Licensee's Submittal

The licensee stated (13) that as part of its HVAC analysis, all of the areas containing SBO equipment required to cope with an SBO are considered to be dominant areas of concern (DACs), and that all of the equipment has been evaluated for operability in accordance with NUMARC 87-00 guidelines.

CPSES-specific calculations identified the following areas as DACs:

Area/Room Number	Description	Max. SBO Temp (°F)
119	UPS & Distribution Room Train B	154.6
121	UPS & Distribution Room Train A	154.5
154	Containment Ground Floor	150.4
155	Valve Room	150.4
161A	Pressurizer Compartment	150.4
23	Valve Room	150.4
108	Main Steam Penetration Area	141.6
109	Main Steam Penetration Platform	141.6
74	Turbine-Driven AFW Pump Room	131.1
83	Electric Equipment Area	120.7
135	Control Room	120.5

The licensee stated (14) that the Systems Improved Numerical Differencing Analyzer (SINDA) computer code was used for all of its room analyses, except for containment where CONTEMPT-LT26 was used. Both codes determine temperatures as a function of room volumes and how they interact with other rooms, concrete, metal and natural convection airflow. Analyses are organized by building/room and also take into account the affect of the temperature outdoors as it varies diurnally. Heat addition from electrical equipment, mechanical

equipment, piping and lighting where applicable, was considered and quantified for each room.

The licensee provided (14) a list of the major assumptions made in its heatup calculations. [In many cases there was no clear reference to which room(s) the assumption applied or how the calculation was carried out.] The licensee's assumptions are listed below:

- AC powered electrical cables associated with the EDGs were considered to be energized. This is conservative since, during an SBO, these cables would not be energized.

- Piping heat loads were based on the most conservative modes of operation such as LOCA in one unit with the other unit in cooldown. This is conservative since most of these heat sources (i.e. residual heat removal, containment spray, component cooling water) would not be in operation during an SBO.

- The maximum room design temperatures (104, 120 and 122°F as stated in Table 9.4.2 of the FSAR) for CPSES were used as initial temperatures for all rooms except the control room. These initial temperatures are based on 110°F outside air and equipment operating prior to an SBO with an ultimate heat sink temperature of 102°F. Analyses showed that the peak temperatures occurred beyond the four hours assumed for the SBO event, except in the case of the UPS rooms.

- With regard to the control room, the licensee assumed an initial temperature of 80°F (maximum normal temperature per FSAR Table 9.4.2), an outside temperatures of 193°F on the control room roof, 125°F on the south wall, and 120°F on the north wall.

- The licensee assumed the surrounding concrete in the control room (including the ceiling) to be used as heat sinks. The licensee justified the use of the concrete ceiling as a heat sink by stating that there is a five inch "snake space" around the perimeter of the

ceiling and "egg crate" material over the horseshoe area. No credit was taken for the heat sink capacity of the massive metal seismic ceiling supports in the control room. No credit was taken for mechanical equipment or piping heat in the control room.

- Credit is taken for opening rs and/or cabinets in the control room, battery charger and inverter rooms to mitigate the effects of internal heating of electrical equipment. Procedure ABN-601 , "Response to a 138/346 kV System Malfunction," governs these actions.

- Inverter efficiencies of 77% for the 7.5 KVA units and 85% for the 10 KVA units were assumed.

- For the containment the licensee assumed an initial temperature of 120°F, a heat addition rate of 666 Btu/hr from piping and equipment and thermal conductivities of 26 BTU/hr-ft-°F for steel and 0.854 BTU/hr-ft-°F for concrete. Decay heat rate and seal leakage were determined to be unnecessary based on a LOCA/MSLB temperature profile provided in the licensee's submittal.

In addition, the licensee provided (14) a tabular list of the material properties used as SINDA input.

The licensee has determined that the final calculated temperature of 120.5°F for the control room does not prevent the operators from performing necessary actions, nor does it affect the operability of control room equipment and instrumentation.

The licensee calculated (13) a minimum temperature for the battery room of 67°F. In its battery sizing calculation, the licensee conservatively assumed an electrolyte temperature of 65°F.

The licensee stated (13) that a Westinghouse calculation of the temperature response of a large dry containment like Comanche Peak's indicates that temperatures inside containment, resulting from the loss

of ventilation during an SBO, are enveloped by the loss-of-coolant accident (LOCA) and high-energy line break (HELB) temperature profiles.

The licensee concluded (13) that no modification or associated procedure changes were required to provide reasonable assurance of equipment operability for any of the equipment except the uninterruptable-power-supply (UPS) inverters located in rooms 119 and 121. Since operation of the inverters cannot be assured at the maximum temperatures expected during an SBO, a hardware modification is planned to reduce these temperatures (see Section 3.4).

Review of Licensee's Submittal

The licensee's calculations were neither received nor reviewed. The information provided by the licensee is inadequate to make a judgement on the accuracy of the calculated final temperatures. The licensee stated that it has assessed equipment operability at the reported final temperatures and has concluded that equipment operability would not be degraded in any of the rooms examined, with the exception of the UPS inverter rooms.

We have reviewed the information provided by the licensee and categorized our response according to the level of information available with regard to the heatup calculation for each room. Our review will be divided into three parts. The first part provides a general comment with regard to one of the quantifying assumptions used by the licensee in all of its heatup calculations. The second part will address those areas where there is insufficient information for comment. The third part will individually address each area where the licensee has provided specific information with regard to its heatup calculations.

General Comment:

Throughout the calculations, the licensee assumes a concrete thermal conductivity of 0.854 and 0.92 (Btu/hr ft °F). These values have previously been considered too high and therefore non-conservative for SBO analysis. A more appropriate and acceptable value of 0.7 needs to be used.

Areas with insufficient information to comment:

Assuming that the calculated temperatures provided by the licensee conservatively represent the room conditions during an SBO and taking into account the licensee's assessment of equipment operability at the calculated temperatures, we consider the licensee's analysis to conform with the SBO rule pending future review of the licensee's heatup calculations (including the quantifying assumptions, initial temperatures, heat loads, room areas, any other supporting information used as input to the SINDA computer code and the SINDA program qualification package) for the following rooms:

- Containment Ground Floor (154)
- Valve Rooms (23 and 155)
- Pressurizer Compartment (164A)
- Main Steam Penetration Area (108)
- Main Steam Penetration Platform (109)
- Turbine-driven AFW Pump Room (74)

Comments related to specific rooms:

- Control Room and Electrical Equipment Area

  The licensee's calculated temperature for the Control Room of 120.5°F and for the Electrical Equipment area of 120.7 are of concern. Without knowledge of the total heat loads, room areas and quantifying assumptions used in the SINDA computer code used by the licensee, we do not have any confidence that these are

conservative results. The licensee needs to provide additional information (including the quantifying assumptions, initial temperatures, heat loads, room areas and any other supporting information used as input to the SINDA computer code) to verify that the Control Room and Electrical Equipment Area heatup calculations were based on a conservative analysis.

The licensee used the maximum operating temperature of 80°F as an initial Control Room temperature in its temperature rise calculation. This value is non-conservative unless there exists administrative controls to verify that this temperature will not be exceeded during normal operation of the plant. Otherwise, the licensee needs to use as an initial temperature the maximum temperature allowed by technical specifications.

- UPS and Distribution Rooms

The licensee assumed inverter efficiencies of 77% for the 7.5 KVA units and 85% for the 10 KVA units. We believe these efficiencies are non-conservative. Based on our experience, a more realistic efficiency assumptions for 7.5 KVA and 10 KVA inverters are 75% and 80% respectively. The licensee needs to use the inverter efficiencies recommended above, or provide technical justification for the use of higher inverter efficiencies in its analysis. In addition, the licensee must verify that the heat loss associated with the inverters is based on the rated load for each inverter and as the inverters are considered constant heat loss equipment (i.e. independent of actual load).

The licensee concluded that the operation of the inverters in the UPS and Distribution rooms cannot be assured at the maximum temperatures expected during an SBO. The licensee is planning to install DC powered ventilation fans in these rooms that will supply a sufficient capacity of outside air to these rooms to maintain the room temperature below the temperature at which inverter operability can be assured. We accept the licensee's resolution to

this problem. However, the licensee needs to re-evaluate the temperature rise calculations for these rooms taking into account the above considerations regarding inverter efficiencies and heat loads.

- Battery Rooms

  We agree with the licensee's approach to calculating the minimum expected temperature in the battery room and selecting a temperature lower than the minimum expected temperature as the electrolyte temperature in the battery sizing calculation.

- Containment

  Essentially, for a large dry containment, the LOCA/MSLB temperature profile bounds an SBO event. However, the licensee's response does not soundly support this conclusion. Although the containment heat load assumed by the licensee (5E+6 Btu/hr) appears to be reasonable, the licensee did not consider the heat loads associated with decay heat rate and the assumed seal leakage of 111 gpm, consistent with the reactor coolant inventory analysis.

  Because of the variability among plants, the licensee cannot use a generic analysis without justifying its applicability to the plant in question. The licensee needs to provide additional information to verify that the LOCA/MSLB temperature profile bounds an SBO event.

Thus, the licensee needs to address each of the comments described above that were specific to individual rooms in its heatup calculations, assume a more conservative value for concrete thermal conductivity of (0.7 Btu/hr ft °F) in its calculations, and provide additional information for future review (as described above) for those rooms that were identified as having insufficient information.

5. Containment Isolation

Licensee's Submittal

The licensee stated (13) 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 (cycled) under station blackout conditions can be positioned with indication independent of the preferred and blacked-out unit's Class-1E power supplies. The licensee stated that no plant modifications and associated procedure changes were determined to be required.

Review of Licensee's Submittal

Using information contained in FSAR Tables 6.2.4-1, 6.2.4-2 and 6.2.4-3 (12) we reviewed the list of plant CIVs to determine those which could not be excluded from consideration using the five criteria of R.G. 1.155. Our review did not identify any valves which could not be excluded using the five exclusion criteria of R.G. 1.155. Thus, we conclude that all valves which must be capable of being closed or that must be operated (cycled) under station blackout conditions can be positioned with indication independent of the preferred and blacked-out unit's Class-1E power supplies.

6. Reactor Coolant Inventory

Licensee's Submittal

The licensee stated (13) that a plant-specific analysis of RCS inventory assumed that reactor coolant pump leakage is initially 25 gpm/pump and decreases with decreasing RCS pressure. This analysis shows that the expected rates of RCS inventory loss under SBO conditions do not result in core uncovery in four hours. Therefore, makeup systems, in addition to those currently available under SBO conditions, are not required to maintain core cooling under natural recirculation.

The licensee stated (14) that an additional 12 gpm technical specification leakage was assumed in its calculation. The licensee assumed RCP leakage to be a function of RCS pressure with an initial RCP seal leakage of 25 gpm/pump at 2250 psia RCS pressure. It was assumed that the reactor was not de-pressurized below the accumulator injection pressure of 785 psi. Further, the licensee stated that the calculation was performed in two segments. During the first 2900 seconds of the SBO event, the licensee evaluated the RCS inventory losses using the RETRAN-02 transient analysis code and a two-loop model of the RCS. The code was used to accurately account for the numerous perturbations which occur in the system (i.e. reactor trip, RCS coastdown, AFW initiation, RCS depressurization). After 2900 seconds, the licensee performed a hand calculation to determine the approximate time until core uncovery. The licensee stated that this was possible because after 2900 seconds the system is relatively stable with no major perturbations occurring. The licensee concluded that the core would remained covered in excess of eight hours.

Review of Licensee's Submittal

Using the information provided in the CPSES FSAR (12), assuming a total leak rate of 112 gpm and reactor depressurization to the accumulator injection pressure of 785 psi, we calculated the volume of water remaining in the core at the end of a four hour SBO to be 6313 ft^3. Based on our experience with similar 4-loop Westinghouse PWRs, this exceeds the required volume of to cover the core. s, we conclude that the core will not be uncovered during a four hour SBO event.

NOTE:

The 25-gpm RCP seal leak rate was agreed to between NUMARC and the NRC staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines higher RCP seal leak rates than assumed for the RCS inventory evaluation, the licensee needs to be aware of the potential impact of this resolution on its analyses and actions addressing conformance to the SBO rule.

3.3 Proposed Procedure and Training

Licensee's Submittal

The licensee stated (13) 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 added 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.

Review of Licensee's Submittal

We neither received nor reviewed the affected procedures, although several procedure changes have been identified as being required to maintain containment integrity under SBO conditions. We consider these procedures to be plant-specific actions concerning the required activities to cope with an SBO. It is the licensee's responsibility to revise and implement these procedures, as needed, to mitigate an SBO event and to assure that these procedures are complete and correct, and that the associated training needs are carried out accordingly.

3.4 Proposed Modification

Licensee's Submittal

In its HVAC analysis, the licensee determined (13) that the operability of the UPS inverters (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. 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. In the telephone conference on November 1, 1991, the licensee stated that this additional capacity would not come from the existing Class 1E batteries. The new ventilation fans will draw power from either the existing non-Class 1E batteries or from a new dedicated battery. The licensee stated (13) that the UPS rooms hardware modifications are planned for a refueling outage at least 120 days after receipt of the NRC Safety Evaluation Report.

Review of Licensee's Submittal

We accept the licensee's proposed modification to reduce the temperature in the UPS inverter rooms. The licensee needs to provide assurance that this modification will not impact the capability of the Class 1E batteries to supply SBO loads during a four hour SBO event.

In addition, our evaluation found several areas where the licensee may need to perform re-evaluations, some of these may result in modifications/ changes to the existing equipment.

3.5 Quality Assurance and Technical Specifications

The licensee stated (14) that all equipment required to cope with an SBO is safety-related and included in the CPSES QA program, pursuant to 10CFR50, Appendix B, except for the turbine stop valves. 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 CPSES Technical Specification 3/4.3.4, "Turbine Overspeed Protection."

4.0 CONCLUSIONS

Based on our review of the licensee's submittals and the information available in the FSAR for CPSES Unit 1, we find that the submittal conforms with the requirements of the SBO rule and the guidance of RG 1.155 with the following exceptions:

1. Effects of Loss of Ventilation

We consider the licensee's analysis to conform with the SBO rule pending future review of the licensee's heatup calculations (including the quantifying assumptions, initial temperatures, heat loads, room areas, any other supporting information used as input to the SINDA computer code and the SINDA program qualification package) for the following rooms:

- Containment Ground Floor (154)
- Valve Rooms (23 and 155)
- Pressurizer Compartment (164A)
- Main Steam Penetration Area (108)
- Main Steam Penetration Platform (109)
- Turbine-driven AFW Pump Room (74)

Based upon a review of the information provided by the licensee, we have concerns in the following areas:

General

Throughout the calculations, the licensee assumes a concrete thermal conductivity of 0.854 and 0.92 (Btu/hr ft °F). These values have previously been considered too high and therefore non-conservative for SBO analysis. A more appropriate and acceptable value of 0.7 needs to be used.

Control Room and Electrical Equipment Area

The licensee needs to provide additional information (as described in Section 3.2) to verify that the Control Room and Electrical Equipment Area heatup calculations were based on a conservative analysis. The licensee used the maximum operating temperature of 80°F as an initial Control Room temperature in its temperature rise calculation. This value is non-conservative unless there exists administrative controls to verify that this temperature will not be exceeded during normal operation of the plant. Otherwise, the licensee needs to use as an initial temperature the maximum temperature allowed by technical specifications.

UPS and Distribution Rooms

The inverter efficiencies assumed by the license in its calculation are non-conservative. The licensee needs to use more conservative inverter efficiencies (as recommended in Section 3.2), or provide technical justification for the use of higher inverter efficiencies in its analysis. The licensee needs to verify that the inverter heat loads are based on design loads rather than SBO loads which are expected to be much less. The licensee is planning to install DC powered ventilation fans in these rooms reduce the temperature during an SBO and insure inverter operability. We accept the licensee's resolution to this problem. However, the licensee needs to re-evaluate the temperature rise calculations for these rooms taking into account the above considerations regarding inverter efficiencies and heat loads.

Containment

Because of the variability among plants, the licensee cannot use a generic analysis without justifying its applicability to the plant in question. The licensee needs to provide additional information to verify that the LOCA/MSLB temperature profile bounds an SBO event.

2 Proposed Modification

The licensee needs to provide assurance that its proposed modification to reduce the temperature in the UPS inverter rooms will not impact the capability of the Class 1E batteries to supply SBO loads during a four hour SBO event.

In addition, our evaluation found several areas where the licensee may need to perform re-evaluations, some of these may result in modifications/changes to the existing equipment.

5.0 REFERENCES

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3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Offsite Power at Nuclear Power Plants," NUREG/CR-3992, February 1985.

4. U.S. Nuclear Regulatory Commission, "Reliability of Emergency AC Power System at Nuclear Power Plants," NUREG/CR-2989, July 1983.

5. U.S. Nuclear Regulatory Commission, "Emergency Diesel Generator Operating Experience, 1981-1983," NUREG/CR-4347, December 1985.

6. U.S. Nuclear Regulatory Commission, "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, May 1983.

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8. Nuclear Management and Resources Council, Inc., "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00, November 1987.

9. Nuclear Safety Analysis Center, "The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," NSAC-108, Wyckoff, H., September 1986.

10. Thadani, A. C., Letter to W. H. Rasin of NUMARC, "Approval of NUMARC Documents on Station Blackout (TAC-40577)," dated October 7, 1988.

11. Thadani, A. C., letter to A. Marion of NUMARC, "Publicly-Noticed Meeting December 27, 1989," dated January 3, 1990, (Confirming "NUMARC 87-00 Supplemental Questions/Answers," December 27, 1989).

12. Comanche Peak Steam Electric Station, Final Safety Analysis Report (FSAR).

13. Cahill, William J., letter to NRC Document Control Desk, "Response to Station Blackout Rule," Docket No. 50-445, dated November 5, 1990.

14. Cahill, William J., letter to NRC Document Control Desk, "Response to NRC Request for Additional Information Regarding CPSES Station Blackout Submittal," Docket No. 50-445, dated November 22, 1991.