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

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT RULE (10 CFR 50.63)

SOUTHERN CALIFORNIA EDISON CO., INC.

SAN ONOFRE, UNITS 2 AND 3

DOCKET NOS. 50-361/362

1.0 INTRODUCTION

On July 21, 1988, the Code of Federal Regulations, 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 Part 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 follow-up 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 M. O. Medford, F. R. Nandy and R. M. Rosenblum on April 17, 1989, May 1, 1990, and

September 12, 1991, respectively, to the U.S. Nuclear Regulatory Commission, Document Control Desk. 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 a SAIC Technical Evaluation Report (TER) SAIC-91/1251, "SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 and 3, STATION BLACKOUT EVALUATION," dated December 13, 1991, (Attachment 1).

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 Attachment 1 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 Group "C" EAC configuration is based on two EDGs per unit credited as emergency AC power supplies with one EDG required to operate safe shutdown equipment following a loss of offsite power. The target EDG reliability was based on a nuclear unit average EDG reliability greater than 0.95 over the last 100 demands. Using this data, the target EDG reliability (0.95) selected by the licensee is appropriate. However, the licensee should also include the EDG reliability calculations for the last 20 and 50 demands in the documentation to be retained by the licensees 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 licensee has proposed coping independent of an alternate AC power source for the required SBO coping duration of 4-hours and recovery therefrom. 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 74,987 gallons of water are required to cope with a 4-hour SBO event. The plant Technical Specifications (TS) require a minimum permissible condensate of 144,000 gallons to be maintained in the condensate storage tank. This TS required capacity exceeds the amount of water necessary for coping with a 4-hour SBO event.

Based on its review, the staff finds that there is sufficient water at San Onofre, Units 2 and 3, to cope with a 4-hour SBO event.

2.2.2 Class 1E Battery Capacity

The licensee stated that without design margin, the existing batteries have sufficient capacity to support the SBO loads for 4-hours. The licensee provided the SBO battery capacity calculations and load profiles which assumed a 25% aging factor and a 11% temperature correction factor corresponding to the minimum TS temperature of 60°F. The licensee has not added the design margin of 10-15% to the cell size but has added a 5 amp load to all load profiles to accommodate future design modifications.

Based on its review, the staff finds that the zero percent design margin is not consistent with IEEE Std. 485 which recommends a design margin of 10-15%. The staff's consultant (SAIC) calculations indicate that batteries "A" and "B" do not have sufficient design margin to conform to the guidance of IEEE Std. 485. Moreover, the licensee used a reduced vital bus inverter current associated with an end of duty cycle voltage. Also, the licensee did not state the effects of the loss of instrumentation which will be shed during the 4 hour coping period.

Recommendations: The licensee should confirm that the calculations used to determine the battery capacity adequacy conforms to IEEE Std. 485, including a 10% to 15% design margin to compensate for less than optimum operating conditions. Batteries "A" and "B" should have sufficient design margin as required by IEEE Std. 485. Moreover, the licensee should consider the full inverter current associated with the end of duty cycle voltage. Also, the licensee should justify that the instrumentation lost during load shedding will not affect the operator's ability to monitor the status of the plant during the 4 hour coping period. If adequate capacity cannot be demonstrated, other measures should be taken to ensure that the batteries have sufficient capacity to cope with and recover from a 4-hour SBO event. The analysis confirming that the battery has adequate capacity should be included in the documentation supporting the SBO submittals that is to be maintained by the licensee.

2.2.3 Compressed Air

The licensee stated that the air-operated valves relied upon to cope with an SBO for 4-hours can either be operated manually or have sufficient back-up sources independent of the preferred and Class-1E power supply. The licensee also stated that the valves requiring manual operation or valves that require back-up sources for operation are identified in plant procedures.

Based on its review, the staff agrees with the licensee and the TER that San Onofre, Units 2 and 3 have sufficient compressed air supplies to cope with a 4-hour SBO event.

2.2.4 Effects of Loss of Ventilation

The licensee performed plant-specific analyses to determine the effects of loss of ventilation and identified the AFW pump rooms, inverter rooms (distribution rooms), switchgear rooms, control room cabinet area and the control room as dominant areas of concern (DAC). The licensee stated that reasonable assurance of the operability of SBO response equipment in the above DAC has been assessed using the guidance described in NUMARC 87-00 and concluded that no modifications or associated procedures are necessary to provide reasonable assurance of equipment operability during an SBO event. With regard to the containment, heat-up analysis for an SBO event has not been performed. The licensee stated that the containment heat loads resulting from a reactor coolant system leakage of 11 gpm are well below the heat loads assumed in the LOCA HELB analysis, and thus, no additional analyses were performed. The staff evaluation of the effects of loss of ventilation in each of these areas is provided below:

2.2.4.1 AFW Pump Room

The licensee indicated that the calculated peak temperature for the AFW pump room is 107.4°F. Based on its review, the staff finds this calculated peak temperature acceptable and agrees with the licensee that there is reasonable assurance of SBO response equipment operability in the AFW pump room during an SBO event at San Onofre, Units 2 and 3.

2.2.4.2 Inverter Room (Distribution Room), Switchgear Room, Computer Room, Control Room, and Control Room Cabinet Area

The licensee's calculated peak temperature during an SBO event for each of the above DAC is presented in the SAIC TER.

During the course of its review, the staff's consultant reviewed the input parameters used by the licensee for the temperature transient analyses during a SBO event and found that some nonconservative values were assumed for initial room temperatures, outside temperatures, personnel heat loads, equipment heat loads, etc. (See SAIC TER Section 3.2.4). Based on its review,

the staff agrees with its consultant's conclusion that the effect of these nonconservative input parameters on these DAC final calculated peak temperatures would be significant, and that if the licensee were to use more conservative values for the input parameters, the final calculated peak temperatures in these DAC may well exceed those currently calculated by the licensee. Therefore, the staff has not been able to conclude that the current calculated peak temperatures as presented in SAIC TER for these DAC are acceptable.

In addition, the licensee has not addressed the procedure which will require the operators to open instrument cabinet doors within 30 minutes following an SBO event in accordance with the guidance in NUMARC 87-00.

Recommendations: (1) The licensee should repeat the temperature transient analysis for each of the above DAC taking into account the nonconservatism as identified in the SAIC TER. With respect to the initial room temperature used for the analysis in each DAC, the licensee should use a conservative value corresponding to the Technical Specification temperature limit or the maximum value allowed under an administrative procedure. If the licensee's administrative procedure does not specify an operating temperature limit, the licensee should establish an administrative procedure or revise the existing procedure to maintain the temperature in each of the DAC at or below the initial room temperature used in the temperature transient analysis. (2) The licensee should provide a procedure which will require the operators to open instrument cabinet doors within 30 minutes following an SBO event in accordance with the guidance described in NUMARC 87-00.

2.2.4.3 Containment

Based on the expected heat loads resulting from an assumed RCS leakage of 11 gpm, the licensee concluded that the containment temperature profile during the SBO event was enveloped by the temperature profiles resulting from the LOCA/HELB.

Based on its review, the staff finds that the licensee's assumption of 11 gpm RCS leakage is nonconservative and inconsistent with the guidance described in NUMARC 87-00 for RCS leakage during an SBO event. Therefore, the staff has not been able to conclude that the containment temperature profile during an SBO event will be enveloped by the temperature profiles resulting from the LOCA/HELB.

Recommendation: The licensee should recalculate the expected containment heat loads resulting from an assumed RCS leak rate which is consistent with the guidance described in NUMARC 87-00 and verify that these (25 gpm per reactor coolant pump seal plus the TS limit for RCS) expected heat loads are enveloped by the LOCA/HELB temperature profiles.

2.2.5 Containment Isolation

The licensee stated 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 blacked-out unit's preferred and Class 1E power supplies. For those valves which could not be excluded using the five exclusion criteria of RG 1.155, the licensee provided justifications of how these valves would be assured of being closed during an SBO event. Consequently, the licensee stated that no plant modifications and associated procedure changes were determined to be required.

Based on its review, the staff concludes that the containment isolation valve design and operation at San Onofre, Units 2 and 3, have met the intent of the guidance described in RG 1.155, and are 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. The generic analysis listed in Section 2.5.2 of NUMARC 87-00 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.

The staff's consultant SAIC performed an independent evaluation of RCS inventory. The licensee assumed a RCS leakage of 11 gpm in its RCS inventory calculation which is inconsistent with the guidance provided in Generic Issue 23. The licensee should have considered 25 gpm per RCP in addition to the 11 gpm TS leakage.

Using the information provided by the licensee above and assuming a total leak rate of 111 gpm, the volume of water remaining in the core at the end of a 4-hour SBO was calculated to be 5717 ft^3. This exceeds the required volume of 2674 ft^3 to cover the core as reported by the licensee. Thus, despite the lack of agreement with the licensee's approach, we agree that the core will not be uncovered during a 4-hour SBO event.

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 pressurized water reactors. The 25 gpm value was agreed to by 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, where necessary, will be modified by July 31, 1989, to meet the guidelines in NUMARC 87-00, Section 4, in the following areas:

1. SBO response,
2. AC power restoration, and
3. Severe weather.

The licensee stated that procedure changes associated with any modifications required after assessing the coping capability will be completed within 2 years after notification by the NRC in accordance with 10 CFR 50.63 (c)(3). 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.

2.4 Proposed Modifications

The licensee did not identify any modifications to assure a 4-hour coping capability as being necessary. The staff's consultant SAIC identified several concerns which may require modifications for their resolution.

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 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 Specification Improvement Program and remain an open item at this time. However, the staff would expect that the plant procedures will 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 SBO equipment is or will be covered by an appropriate 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 response.

2.6 EDG Reliability Program

The licensee stated that the target reliability of 0.95 will be maintained. The licensee stated that a TS change in accordance with NSAC-108, as well as NUMARC 87-00, Appendix D will be pursued. However, the licensee did not specifically state that a reliability program in accordance with RG 1.155, Section 1.2 would be implemented.

Recommendation: The licensee should implement an EDG reliability program which as a minimum meets the guidance of RG 1.155, Section 1.2. Confirmation that such a program is in place or will be implemented should be included in the documentation supporting the SBO submittals that is to be maintained by the licensee.

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 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 follow-up 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 procedures,

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 verification and confirmation to assure the Class 1E battery is adequate, reassessment of the effects of loss of ventilation for all control building rooms containing SBO equipment and the containment during an SBO, opening the instrument cabinet doors within 30 minutes following an SBO event, description of any proposed modifications, confirmation that the SBO equipment is covered by an appropriate QA program consistent with RG 1.155, a commitment to implement 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 in conformance with the SBO Rule contingent upon receipt of confirmation from the licensee within 30 days that the recommendations identified within this SE will be implemented. The schedule for implementation should also be provided in accordance with 10 CFR 50.63(c)(4).

4.0 ATTACHMENT

SAIC-91/1251, Technical Evaluation Report, San Onofre Nuclear Generating Station, Units 2 and 3, Station Blackout Evaluation, December 13, 1991.

Principle Contributor: N. Trehan

Date: