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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE STATION BLACKOUT RULE (10 CFR 50.63)

COMMONWEALTH EDISON COMPANY

LASALLE COUNTY STATION, UNITS 1 AND 2

DOCKET NOS. 50-373 AND 50-374

1.0 INTRODUCTION

On July 21, 1988, the Code of Federal Regulations, 10 CFR Part 50, was amended to included 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 Section 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 Basis 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 the 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. H. Richter on April 17, 1989, March 30, 1990, and June 22, 1990, to the U.S. Nuclear Regulatory Commission (NRC), Document Control Desk. The licensee provided responses to NRC questions by a letter from Peter L. Piet, dated September 23, 1991. The licensee's responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. The

results of the SAIC review are documented by a Technical Evaluation Report (TER) SAIC-91/1268 "LASALLE COUNTY STATION, UNITS 1 AND 2, STATION BLACKOUT EVALUATION," dated December 20, 1991 (Attachment 1).

2.0 EVALUATION

After reviewing the licensee's submittals and the SAIC TER, the staff concurs with the SAIC analysis 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 "D," and a target Emergency Diesel Generator (EDG) reliability of 0.975. The EAC power configuration Group "D" is based on three EDGs not credited as AAC power sources, with two EDGs required to operate safe shutdown equipment of both units following a loss of offsite power. The target EDG reliability was based on the LaSalle County Station (LaSalle) having an average EDG reliability greater than 0.90, 0.94, and 0.95 for the last 20, 50, and 100 demands respectively. A review of the information in NSAC-108 indicates that the EDGs at the LaSalle Station have an average of 38 valid demands per calendar year and had a site average reliability level of 0.998 per EDG per year during the calendar years of 1983 through 1985. Based on the above, the target EDG reliability (0.975) selected by the licensee is appropriate. The "P1" grouping is based on an independence of offsite power classification of Group "I1/2," a severe weather (SW) classification of Group "2," and an extremely severe weather (ESW) classification of Group "1."

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

2.2 Alternate AC (AAC) Power Source

The licensee stated that the Division-3 diesel generator is available as an AAC power source to operate systems necessary for the required SBO coping duration and recovery therefrom at LaSalle.

2.2.1 General Staff Position on AAC Power Sources

The definition in 10 CFR 50.2, RG 1.155, and NUMARC 87-00 define an AAC power source in terms of four attributes: (1) connections to the offsite or the onsite AC power systems, (2) minimum potential for common cause failure with offsite power or the onsite emergency AC power sources, (3) timely availability, and (4) required capacity and reliability. More specifically, in regard to the fourth attribute, the definition reads as follows:

(4) Has sufficient capacity and reliability for operation of all systems required for coping with station blackout and for the time required to bring and maintain the plant in safe shutdown (non-design basis accident).

In view of the variety of types, capacities, and capabilities of power sources proposed as AAC sources by various licensees, the staff has characterized proposed AAC power sources as being either optimum, fully capable, or partially capable. This characterization, which relates only to the capacity attribute cited above, was necessary in order to facilitate the staff review of licensee responses to the SBO rule. It does not invalidate or revoke any of the requirements or guidance applicable to AAC power sources.

An optimum AAC power source design is one that is capable of powering simultaneously both safety trains or normal safe shutdown systems and equipment. Such a design, following actuation of the AAC source, would provide completely redundant normal safe shutdown capability during an SBO and recovery therefrom from the main control room.

A fully capable AAC power source design is one that is capable of powering at least one complete safety train of normal safe shutdown systems and equipment. This includes decay heat removal, battery charging, HVAC (heating, ventilation, and air conditioning), emergency lighting, and the associated controls and instrumentation. Thus, although redundant capability is not available, a fully capable AAC source would enable attainment of safe shutdown during an SBO and recovery therefrom from the main control room.

A minimally capable AAC power source design is one that is not capable of powering all (or any) normal safety train related safe shutdown equipment; but, it is capable of powering specific equipment that, in conjunction with extensive manual operator actions both inside and outside of the control room, is critical for attaining safe shutdown during an SBO. Appendix R diesels proposed as an AAC source are examples of minimally capable AAC sources. With this design, operability of the main control room could not be assured unless the batteries were sized to operate for the SBO duration, or battery charging capability was provided by the AAC source.

Connectability of AAC Power Sources

The basic criteria governing the connectability of an AAC power source are contained in 10 CFR 50.2 (the AAC source should be connectable to but normally not connected to the offsite or onsite emergency AC power systems) and 10 CFR 50.63 (SBO should not assume a concurrent single failure or design basis accident). Therefore, as a minimum, an AAC source need only be connectable to one set of safe shutdown equipment, regardless of whether that equipment is part of a safety train or not.

2.2.2 Proposed AC (AAC) Power Source

The licensee, in its revised submittal, stated that an AAC power source option exists at LaSalle and is available within 10 minutes of the onset of an SBO event. The AAC power source identified is the Division-3 diesel generator (each unit) which supplies power to the HPCS system and its auxiliaries. The licensee stated that the Division-3 diesel generator (DG) is physically and electrically isolated from the normal safe shutdown equipment and that it is not susceptible to any single point vulnerability. The licensee added that this AAC source has sufficient capacity to operate systems capable of coping with an SBO for the required duration of 4 hours. The licensee further stated that the HPCS system is capable of maintaining the plant in hot shutdown for the expected duration of the SBO event.

The staff conceptually accepts that the Division-3 DG could meet the minimally capable AAC source requirements and the connectability criteria above if a cross-connect capability is provided to one of the other full divisions to power the required SBO loads. However, the licensee proposes to use the Division-3 DG only to power the HPCS pump and its associated systems. The Division-3 DG will not be connectable to other emergency trains, and the licensee did not propose to use the excess capacity to augment the plant's ability to cope with an SBO event. Therefore, the staff would not classify the Division-3 DG as an AAC source. However, it is acceptable to the staff to use the Division-3 DG to assist in coping during an SBO event. The licensee provided a coping analysis using the "AC-Independent" approach, so the issue of whether the Division-3 DG is or is not classified as an AAC source is not relevant.

2.3 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.

2.3.1 Condensate Inventory for Decay Heat Removal

The licensee stated that based on an analysis performed in accordance with the guidance described in NUMARC 87-00, 167,000 gallons of water were required for decay heat removal during a 4-hour SBO event and that RCIC or HPCS would be utilized to remove the decay heat. The HPCS system takes suction from the suppression pool, while the RCIC system initially takes suction from the condensate storage tank (CST), and upon depletion of the CST transfers the suction to the suppression pool which contains over 955,000 gallons of water. Based on its review, the staff concludes that the licensee will have sufficient water to cope with a 4-hour SBO event at LaSalle.

2.3.2 Class 1E Battery Capacity

The licensee stated that the 125V (Divisions 1 and 2) and 250V Class 1E batteries, except the Unit-2, Division-2, 125V battery, have been replaced with larger capacity batteries. The licensee indicated that a battery capacity calculation has been performed in accordance with NUMARC 87-00, Section 7.2.2, to verify that the Class 1E batteries have sufficient capacity to meet SBO loads for 4 hours with load shedding. The licensee provided battery capacity calculations with and without load shedding. The calculation used the minimum Technical Specification allowed electrolyte temperature of 60°F, a design margin of 1.0 and an aging factor of 1.25 for all batteries except for the Division-3 batteries.

The licensee provided a list of loads that it plans to shed from the station batteries. The loads to be shed include lighting, controls and oil pumps for nonessential equipment. The staff agrees with the licensee that the shedding of nonessential controls, oil pumps and unnecessary lighting will not significantly affect the plants ability to cope with an SBO. Battery calculation provided by the licensee indicates a minimum margin of 8.3% for all Class 1E batteries except the Division-3 batteries. The Division-3 battery is not required to copy with an SBO and Division-3 battery charger will be available if the Division-3 diesel generator is used during an SBO event. Based on the above, the staff concludes that the Class 1E batteries have adequate capacity to meet the SBO loads for 4 hours.

2.3.3 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 backup sources independent of the preferred and Class-1E power supplies.

Based on its review, the staff concludes that LaSalle has sufficient compressed air supplies to cope with a 4-hour SBO event.

2.3.4 Effects of Loss of Ventilation

The licensee, using its engineering judgement and the guidance described in NUMARC 87-00, identified the auxiliary electric equipment rooms (AEERs), the control room, the RCIC room and the drywell as the dominant areas of concern (DACs) and performed plant-specific analyses to determine the effects of loss of ventilation in these DACs during an SBO event (see SAIC's TER for the list of the DACs and their associated calculated peak temperatures).

Based on its review, the staff concludes that the effects of loss of ventilation during an SBO event at LaSalle have been properly evaluated and that reasonable assurance of equipment operability in the DACs is provided.

Recommendations: The licensee should: (1) establish an administrative procedure to ensure that the AEER temperature and the control room temperature during normal operation will not exceed the assumed initial temperatures used

in the temperature transient analyses for an SBO event and (2) verify that the SBO drywell temperature profile will not exceed the temperature profile (including duration) used for equipment qualification (EQ).

2.3.5 Containment Isolation

The licensee provided a list of all of the containment isolation valves (CIVs) and a justification for excluding certain valves. Based on its review, the staff concludes that the containment isolation valve design and operation at LaSalle have met the intent of the guidance described in RG 1.155 and are, therefore, acceptable.

2.3.6 Reactor Coolant Inventory

The licensee stated that since decay heat is removed by the discharge of steam through the main steam line safety/relief valves into the suppression pool, this source will not be significantly depleted by RCIC/HPCS operation. The suppression pool contains over 955,000 gallons of water. The licensee also stated that the RCS and condensate inventory calculation is based on an assumed 18 gpm per recirculation pump seal leak and a 25 gpm maximum Technical Specification allowed leakage. The licensee performed a RCS inventory analysis and determined that the suppression pool heat capacity temperature limit is not exceeded during an SBO event with a duration of 4 hours. The analysis using an initial suppression pool temperature of 105°F, and manual depressurization cooldown at 100°F/hr until the reactor pressure decreases to 167 to 172 psi, shows that adequate reactor water level is maintained throughout the 4-hour SBO event.

Based on its review, the staff finds that insufficient information was provided to determine if the lowest reactor vessel water level (-130") results in a brief core uncovery. Also, the staff finds that the final suppression pool temperature of 215°F with RCIC or 232.1°F with HPCS is very high and has similar concerns as identified in SAIC's TER (see TER Section 3.3.6).

The reactor coolant inventory evaluation as discussed above was based on the guidance of NUMARC 87-00 of 18 gpm recirculation pump seal leak rate for boiling water reactors. The 18 gpm 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 a higher recirculation pump seal leak rate than assumed for the RCS inventory evaluation, the licensee should be aware of the potential impact of this resolution on its analysis and actions addressing conformance to the SBO rule.

Recommendations: (1) The licensee needs to provide an analysis that shows that the core remains covered. If the core is briefly uncovered, the analysis needs to specify the duration of core uncovery. (2) The licensee also needs to verify that the suppression pool temperatures are within the acceptable range for the operation of RCIC and HPCS equipment. (3) In addition, the licensee needs to verify that, following restoration of AC power, recovery

from these elevated suppression pool temperatures is possible and does not impact the ability to run the reactor heat removal system in the suppression pool cooling mode without cavitating or damaging the pumps.

2.4 Proposed Procedures and Training

The licensee stated that plant procedures have been reviewed and revisions necessary to meet the intent of the guidelines in NUMARC 87-000, Section 4, are identified. The licensee indicated that these procedure revisions will be completed within one year after the issuance of the SE.

The staff did not review the affected procedures or training. The staff expects the licensee to maintain and implement these procedures including any others that may be required to ensure an appropriate response to a SBO event. Although personnel training requirements for an SBO response were not specifically addressed in the licensee's submittals, the staff expects the licensee to implement the appropriate training to ensure an effective response to an SBO.

2.5 Proposed Modifications

The licensee stated that the 125V Class 1E batteries for Divisions 1 and 2, and the 250V Class 1E batteries for both units have been replaced with the exception of the Unit 2, Division 2, 125V battery which is scheduled for replacement during the 4th refueling outage (1st quarter of 1992). The licensee also indicated that the procedure changes for SBO will be completed within 1 year after the issuance of the SE. The staff finds the licensee's schedule acceptable.

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

2.6 Quality Assurance and Technical Specifications

The licensee reviewed the list of equipment required during an SBO. For equipment not classified as either safety-related or regulatory-related, the licensee stated that a QA program meeting the guidance of RG 1.155, Appendix A will be provided. The staff accepts the licensee's statement.

The TS for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains 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.

2.7 EDG Reliability Program

The licensee stated that an EDG reliability program incorporating the five elements discussed in RG 1.155, Regulatory Position 1.2 will be established to ensure that the target reliability of 0.975 is maintained. In addition, the licensee is monitoring the resolution of Generic Issue B-56 "Diesel Generator Reliability." The licensee indicated that they will review and revise their program, if necessary, when the final guidance on the resolution of this issue is published. The staff accepts the licensee's commitments.

2.8 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 any 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 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 staff 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 commitments need to be made as described in the recommendations itemized herein. These include documentation of the proposed modifications, confirmation of an administrative procedure to ensure that the AEER and control room temperatures will not exceed the assumed initial temperatures used in the heat-up calculation, verification that the SBO drywell temperature profile is bounded by the EQ temperature profile and verification that the

core remains covered except for a brief uncovery. 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 the SE will be implemented. The schedule for implementation should also be provided in accordance with 10 CFR 50.63(c)(4).

Attachment: Technical Evaluation Report

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Dated: March 6, 1992