



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT EVALUATION

CONSUMERS POWER COMPANY

PALISADES NUCLEAR PLANT

DOCKET NO. 50-255

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, analysis, 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 Kenneth W. Berry on April 17, and December 11, 1989; from Thomas C. Bordine on March 27, 1990; and from Richard W. Smedley on July 3, 1990, to U.S. Nuclear Regulatory Commission, Document Control Desk. Also, there was a teleconference between representatives of the licensee and the NRC Staff on October 31, 1990, and a submittal of additional information dated November 7, 1990, in response

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to the teleconference. 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-91/6650, "PALISADES NUCLEAR PLANT, STATION BLACKOUT EVALUATION" dated March 8, 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 station blackout (SBO) duration of four hours based on a plant 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 not credited as AAC power supplies, with one EDG required to operate safe shutdown equipment following a loss of off-site power. The target EDG reliability was based on the Palisades Plant having an average EDG reliability greater than 0.90 over the last 20 demands, greater than 0.94 for the last 50 demands, and greater than 0.95 for last 100 demands. The "P1" grouping is based on an independence of off-site power classification of Group "I 1/2," 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 submittals, RG 1.155, NUMARC 87-00, and SAIC's TER, the staff agrees with the licensee's evaluation of a four hour SBO coping duration.

### 2.2 Station Blackout Coping Capability

The licensee has proposed coping as the means of maintaining the plant in a safe shutdown condition (hot standby) independent of AC power for the required SBO duration of four 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 four hour coping duration.

#### 2.2.1 Condensate Inventory for Decay Heat Removal

The licensee's Technical Specifications require that a minimum of 100,000 gallons of water be available in the condensate storage and primary coolant system makeup tanks combined. Using NUMARC 87-00, the licensee calculated that 56,000 gallons of water are required to cope with an SBO for four hours. The available inventory exceeds the required inventory of 57,100 gallons, based on 102% of a maximum licensed core thermal rating of 2530 Mwt, by a significant margin. The staff, therefore, concludes that there is sufficient condensate water to cope with and recover from an SBO of four hours.

### 2.2.2 Class 1E Battery Capacity

The licensee initially stated that the Palisades Plant Class 1E batteries have sufficient capacity to meet station blackout for four hours assuming loads not needed to cope with a station blackout are stripped. In a subsequent correspondence of November 7, 1990, the licensee submitted the battery analysis and excerpts from the Emergency Operating Procedure (EOP) related to the stripping of the loads from the batteries. After reviewing the available information, the staff agrees with the SAIC assessment in the TER that there are two areas of concern. First, the battery load profile figure indicates a larger load shedding than the loads identified in the procedure (see TER). Second, the licensee assumes that load shedding will begin 10 minutes into the SBO event which is contrary to the guidance provided in NUMARC 87-00, Section 7.2.2, which states that loads can be stripped commencing 30 minutes after the initiation of the station blackout event.

Recommendation: The licensee should not consider load stripping to occur until 30 minutes into the event, verify that the battery load profile envelopes the resulting load requirements, and confirm the battery adequacy for the four hour coping duration and recovery thereafter. Also, the licensee needs to verify that the correct aging and temperature factors recommended in IEEE Std-485 have been applied. The revised results should be reflected in the appropriate plant procedures and included in the SBO submittal supporting documents.

### 2.2.3 Compressed Air

The licensee stated that the air-operated valves relied upon to cope with a station blackout for four hours can either be operated manually or will have sufficient back-up sources independent of the preferred and Class 1E AC power supplies. The licensee also stated that during a station blackout the preferred method of controlling steam-generator pressure is via atmospheric dump valves (ADVs) which are air operated, but do not have a backup air supply. The licensee stated that the needed back-up supplies of compressed air, for a minimum of four hours, will be installed within two years after receipt of NRC's SBO evaluation. The decay-heat release will be manually controlled, using the air ejector to release steam to the atmosphere, until the back-up supplies of compressed air for the operation of the ADVs are installed. The auxiliary feed water (AFW) flow control valves have back-up bottled nitrogen supplies designed to support the AFW operation for 12 hours.

Based on the above, the staff concludes that there is adequate assurance that back-up sources would be available after the implementation of the modifications to operate the air-operated valves during a four hour SBO coping duration and recovery therefrom.

### 2.2.4 Effects of Loss of Ventilation

The licensee stated that heating, ventilation, and air conditioning (HVAC) would not be available during an SBO event. The licensee calculated the maximum bulk ambient temperature of the main control room and the containment, and conducted tests to determine the temperature in the auxiliary feed water (AFW), the cable spreading, and the switchgear rooms. The results of these tests and the calculations were provided in the licensee submittals.

After reviewing the supporting documentation and SAIC's TER, the staff agrees with the licensee's stated results except in the following areas: (1) the control room, (2) battery room, and (3) cable spreading room. The staff concurs with SAIC's assessment of the deficiencies as identified in Attachment 1 for the above mentioned areas.

Recommendation: The licensee should reevaluate the effect of loss of ventilation for the areas identified in this section, specifically in the control room where the licensee used a non-conservative initial temperature and used two different values for the thermal conductivity of concrete in the heat-up calculations. The licensee also should ensure that, in the cable spreading and battery rooms, at least one DC-powered fan will be available to each area after the load shedding process is complete or perform heat-up calculations of these rooms representative of expected room conditions and associated operating equipment during an SBO event. Also, the licensee needs to verify that the loss of heat tracing during an SBO event would not degrade the operation of safe shutdown systems.

The licensee should include the results of the evaluations and confirmations in the supporting documentation that is to be maintained by the licensee.

#### 2.2.5 Containment Isolation

The licensee's initial submittal stated that the plant list of containment isolation valves (CIVs) had been reviewed to verify that valves which must be capable of being closed or that must be operated (cycled) under SBO conditions can be positioned (with indication) independent of the preferred and blackout Unit's Class 1E AC power supplies. The licensee also stated that no motor-operated valves are necessary for containment isolation and no plant modifications or procedure changes are required to ensure appropriate containment integrity under SBO condition.

After reviewing the SAIC TER and list of isolation valves (UFSAR, Table 6-6), the staff concurs with the SAIC TER that there are several valves which do not meet the exclusion criteria outlined in RG 1.155.

Recommendation: The licensee should list in an appropriate procedure all CIV's that cannot be excluded by the exclusion criteria outlined in RG 1.155 (valves that are either normally closed or open and fail as is upon loss of AC power). The procedure should identify the actions necessary to ensure that these valves are fully closed, if needed. The staff's position is that the valve closure needs to be confirmed by position indication (local, mechanical, remote, process information, etc.). This information should also be included with the other documentation that is to be maintained by the licensee in support of the SBO submittals.

#### 2.2.6 Reactor Coolant Inventory

The licensee stated that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure adequate core cooling has been assessed for an assumed leak of 100 gpm (25 gpm per pump) primary coolant pump seal leakage. The licensee concluded that resultant leaks from RCS and control rod drive mechanisms (CRDMs) would not result in core uncover during an SBO of four hours. After

reviewing the supporting documentation and SAIC's TER, the staff agrees with the licensee's assessment that there will be sufficient coolant to provide for core coverage during an SBO event of four hours.

The reactor coolant inventory evaluation as discussed above was based on the guidance of NUMARC 87-00 of 25 gpm per reactor coolant pump (RCP) seal leakage for pressurized water reactors. The 25 gpm RCP seal leakage 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 leakage rates 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.

### 2.3 Procedures and Training

During the teleconference of October 31, 1990, the licensee stated that the AC power restoration, severe weather, and station blackout response procedures have been reviewed and modified as required to meet the guidelines of NUMARC 87-00, Section 4. Also, changes will be implemented to the coping procedures to ensure that all the provisions of NUMARC 87-00, Section 7 are included.

The staff did not review the procedures or proposed procedure modifications. The staff expects the licensee to maintain and implement 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 stated that the coping duration of four hours was determined after accounting for modifications to provide an additional source of off-site power to the plant. These modifications have been completed and were declared operational in the fall of 1989. The licensee also will add back-up compressed-air supplies to support the operation of the atmospheric dump valves (ADVs) during an SBO. These additions will be completed within two years from the completion of the NRC review of the Palisades SBO evaluation in accordance with 10 CFR 50.63 (c)(3).

Recommendation: The licensee should include a full description, including the nature and objectives of the required 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 Technical Specifications (TS) for the SBO equipment. The technical specifications 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 expects 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 are warranted, the licensee will be notified of the implementation requirements.

Recommendation The licensee should verify that the SBO equipment is covered by an appropriate QA program consistent with the guidance of RG 1.155. This evaluation should be documented as part of the documentation supporting the SBO rule response.

## 2.6 EDG Reliability Program

The licensee stated that an EDG reliability program similar to that required by NUMARC 87-00 has been in place for some time at the Palisades Plant, and that the target reliability of 0.95 was selected based on an average reliability greater than 0.90 for the last 20 demands, greater than 0.94 for the last 50 demands, and greater than 0.95 for the last 100 demands. The submittal did not specifically address the commitment to implement an EDG reliability program to conform to the guidance of RG 1.155, Position 1.2.

Recommendation: It is the staff's position that an EDG reliability program should be developed in accordance with the guidance of RG 1.155, Section 1.2. If an EDG reliability program currently exists, the program should be evaluated and adjusted in accordance with RG 1.155. Confirmation that such a program is in place or will be implemented should be included in the documentation that is to be maintained by the licensee in support of the SBO submittals.

## 2.7 Scope of Staff Review

The station blackout 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 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 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 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 station blackout (SBO) rule (10 CFR 50.63) and the Technical Evaluation Report (TER) prepared by the staff's consultant, Science Applications International Corporation (SAIC). Based on our review, some actions and verifications need to be completed as described in the recommendations itemized herein. These include verification of Class-1E battery adequacy, a control room heat-up calculation, verification of the availability of DC-powered fans following load-shedding in the cable-spreading and battery rooms, verification that containment isolation can be obtained if needed, ensuring that the SBO equipment is covered by a QA program consistent with RG 1.155, Appendix A, and implementation of an EDG reliability program in accordance with the guidance 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 documented in 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

- 1.0 SAIC-91/6650, Technical Evaluation Report, Palisades Nuclear Plant, Station Blackout Evaluation, March 8, 1991.

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