



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

ENCLOSURE

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT RULE (10 CFR 50.63)

ENTERGY OPERATIONS, INC

WATERFORD STEAM ELECTRIC STATION UNIT 3

DOCKET NO. 50-382

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, requires licensees to submit information as defined in 10 CFR 50.63, and requires licensees to provide a plan and schedule for conformance to the SBO Rule. The SBO Rule further requires that the baselines 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 Nuclear Management and Resource Council, Inc. (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 responses 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 R. F. Burski on April 14, 1989, March 30, 1990, March 21, and August 30, 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 July 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 a SAIC Technical Evaluation Report (TER) SAIC-91/1254, "Waterford Steam Electric Station, Unit 3, Station Blackout Evaluation," dated December 11, 1991 (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 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 the plant offsite AC power design characteristic Group "P2," an emergency AC (EAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.975. The licensee based the selection of the "P2" group on an independence of offsite power classification of Group "13," a severe weather (SW) classification of Group "1" and an extremely severe weather (ESW) classification of Group "3." The Group "C" EAC configuration is based on two 4400kW EDGs 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 having an average EDG reliability greater than 0.94 over the last 50 demands. Using this data, the target EDG reliability (0.975) selected by the licensee is appropriate. However, the licensee should also include the EDG reliability calculations for the last 20 and 100 demands in the documentation to be retained by the licensee in support of the SBO submittals.

The licensee's ESW classification is not consistent with the information provided in NUMARC 87-00. According to Table 3-2 of NUMARC 87-00, the ESW classification is Group "4" instead of Group "3" as selected by the licensee. However, the offsite AC power design characteristic Group (P2) of the plant is unaffected by this discrepancy.

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 AC power 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 approximately 80,000 gallons of water are required for decay heat removal during a 4-hour SBO event at the Waterford plant and that the depressurization of the primary system is not initiated until electrical power is restored. The plant Technical Specifications (TS) require a minimum permissible condensate inventory of 170,000 gallons to be maintained in the condensate storage tank. This TS required capacity exceeds the amount of water needed to cope with a 4-hour SBO event. Therefore, the licensee concluded that the condensate is sufficient to cope with a 4-hour SBO event.

Based on its review, the staff agrees with the licensee that there is sufficient condensate at the Waterford plant to cope with a 4-hour SBO event.

2.2.2 Class 1E Battery Capacity

The licensee stated that Waterford 3 has three safety related battery systems (3A-S, 3B-S, and 3AB-S) and all three battery systems are used during an SBO event. The licensee assumed that load shedding occurs within 30 minutes of the onset of the SBO event. The licensee used a final cell voltage of 1.75 V to demonstrate adequate battery capacity and concluded that batteries 3A-S and 3B-S have approximately 10% and battery 3AB-S 4% excess capacity for a 4-hour SBO. The voltage at the equipment terminals remains above the minimum required for SBO equipment to operate during the SBO event.

The staff has identified the following concerns regarding the adequacy of the batteries:

- a. The licensee proposes to shed the instrumentation from the batteries during an SBO. This is not in accordance with the guidance provided in "NUMARC Supplemental Questions and Answers," Item Number 7. The normal battery-backed plant monitoring and electrical system controls are an integral part of the control room and are considered essential for successfully coping with and recovering from an SBO. If monitoring systems are not shed, the batteries may not have enough capacity to support the 4-hour SBO coping duration.
- b. Although the licensee identified the breakers to be opened, the licensee did not specifically identify the loads being shed during an SBO event.
- c. For the battery calculation, the licensee assumed an initial electrolyte temperature of 77°F. The licensee should ensure that the temperature of the batteries will not drop below this temperature under all circumstances.

- d. The licensee used a design margin of 1.00 in its battery calculations. This is not consistent with the guidance provided in IEEE-Std. 485, which recommends a design margin of 1.10-1.15. Battery 3AB-S has a design margin of 1.04 which is below the low end specified in IEEE-Std 485. Therefore, the battery calculations are not conservative.

Recommendations: (1) The licensee should justify the shedding of the control room monitoring systems considering the requirements of "NUMARC Supplemental Questions and Answers" Item Number 7.2; (2) the licensee should identify the specific loads shed by the plant and justify shedding of these loads; (3) the licensee should ensure that the temperature does not drop below 77°F under all circumstances; and (4) the batteries should have a design margin of at least 10% as recommended by IEEE Std. 485. Any modifications that will be implemented 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 the Waterford plant has sufficient compressed air supplies to cope with a 4-hour SBO event.

2.2.4 Effects of Loss of Ventilation

The licensee, using the guidance described in NUMARC 87-00, has performed plant specific analysis to determine the effects of loss of ventilation during a 4-hour SBO event and identified the dominant areas of concern (DACs) at the Waterford plant (see SAIC TER for the list of DACs and their associated initial temperatures and calculated peak temperatures). The licensee stated that reasonable assurance of the operability of SBO response equipment in these DACs has been assessed in accordance with the guidance described in NUMARC 87-00, and concluded that no plant modifications will be required.

Based on its review, and upon the completion of the implementation of the following staff recommendations, the staff finds that the effects of loss of ventilation during a 4-hour SBO event at the Waterford plant have been properly evaluated and that reasonable assurance of the operability of the SBO response equipment in the DACs has been provided for a 4-hour SBO event.

Recommendations: The licensee should: (1) establish an administrative procedure to ensure that the room temperatures in the DACs during normal power operation will not exceed the assumed initial temperatures during an SBO event, and (2) establish a procedure in accordance with the guidance described in NUMARC 87-00 to open the control room cabinets and doors within 30 minutes of the onset of an SBO event.

2.2.5 Containment Isolation

The licensee stated that the containment isolation valves have been reviewed to verify that containment isolation valves that must be capable of being closed or operated during an SBO event can be positioned with indication independent of the unit's preferred and Class 1E AC power supply. No modifications and/or associated procedure changes will be required to ensure that appropriate containment integrity can be provided during an SBO event.

Based on its review, the staff concludes that the containment isolation valve design and separation at the Waterford plant meets 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. 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 uncover. Therefore, RCS makeup systems under SBO conditions are not required to maintain core cooling.

Expected maximum losses from the RCS are 25 gpm from each of the RCS pumps, and 12 gpm allowed by the TS for a total of 112 gpm. Over 4 hours this leak rate results in a loss of 4,010 cubic feet. The total RCS inventory available is 11,000 cubic feet which includes 800 cubic feet of water in the pressurizer. At the end of 4 hours, the pressurizer is empty and the system has lost 3,210 cubic feet of water. The remaining inventory is sufficient to keep the core covered and cooled through natural circulation. Therefore, the plant has sufficient reactor coolant inventory for the 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 pressurized water reactors. 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 modified to meet the guidelines in NUMARC 87-00, Section 4, in the following areas:
1) AC power restoration and 2) severe weather.

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 stated that no modifications are required to cope with an SBO for 4 hours. However, there are several concerns which may require modifications for their resolutions. These include battery capacity (Section 2.2.2), procedures to ensure that the room temperature in the DACs during normal power operation will not exceed the assumed initial temperature and to open the control room cabinets and doors within 30 minutes of the onset of an SBO event (Section 2.2.4).

Recommendation: The licensee should include a full description including the nature and objectives of any required modifications 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) 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 remains an open item at this time. 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 has committed that the target reliability of 0.975 will be maintained. However, the licensee did not specifically state that a reliability program in accordance with RG 1.155, Section 1.2, will 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, confirmation that a procedure is established to ensure that the room temperature in the DACs during normal plant operation will not exceed the assumed initial temperature and that control room cabinets and doors are opened within 30 minutes of the onset of 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, and 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-91/1254, Technical Evaluation Report, Waterford Steam Electric Station, Unit 3, Station Blackout, December 11, 1991.

Principle Contributor: N. Trehan

Date: January 15, 1992

Attachment:
TER