ENCLOSURE 1

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)
NEW HAMPSHIRE YANKEE
SEABROOK STATION, UNIT 1
DOCKET NO. 50-443

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 with 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 using an AC independent response format to the SBO Rule were provided by letters from G. S. Thomas on April 17, 1989, and from T. C. Feigenbaum on March 30, 1990, to the U.S. Nuclear Regulatory Commission (NRC), Document Control Desk. The licensee's response to a request for additional information was provided by a letter to the NRC from T. C. Feigenbaum on September 6, 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 an SAIC Technical Evaluation Report (TER) SAIC-91/1801, "SEABROOK STATION, UNIT 1, STATION BLACKOUT EVALUATION," dated December 17, 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 "P2," an emergency AC (EAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.975.

The Group "C" EAC configuration is based on two 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 the Seabrook Station, Unit 1 (Seabrook), having an average EDG reliability greater than 0.90, 0.94 and 0.95 for the last 20, 50 and 100 demands, respectively. Using this data, the target EDG reliability (0.975) selected by the licensee is appropriate.

The offsite AC power design characteristic Group "P2" is based on an independence of offsite power classification of Group "I 1/2," a severe weather (SW) classification of Group "3," and an extremely severe weather (ESW) classification of Group "3." The staff agrees that the plant independence of offsite power system group is "I 1/2." However, the staff does not agree with the licensee in the selection of extremely severe weather (ESW) classification of Group "3." The licensee has provided an analysis of its ESW frequency calculation in response to a request for additional information. However, as discussed in the attached TER, the licensee's calculation is not consistent with the ESW frequency results obtained when using information contained in the plant UFSAR. The UFSAR data, if extrapolated to a height of 30 meters, indicates that the site is in ESW Group "4," which is consistent with the data given in Table 3-2 of NUMARC 87-00. Since both the UFSAR and NUMARC data are consistent, the staff considers the Seabrook site to be in ESW Group "4."

The licensee assumed a single right-of-way for its SW grouping calculation. With a single right-of-way, the site is in SW Group "3."

With an ESW Group of "4," an SW Group of "3," and an independence of offsite power system grouping of "I 1/2," the offsite AC power design characteristics is either "P3" (NUMARC Table 3.5a), requiring an 8-hour coping duration, or "P3*" (NUMARC Table 3.5b) requiring a coping duration of 4 hours, provided that pre-hurricane shutdown procedures are implemented.

Recommendation: The licensee needs to implement pre-hurricane shutdown procedures to retain a 4-hour coping duration. Alternatively, the licensee needs to change the coping duration to 8 hours and reevaluate the plant for an 8-hour 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. This assumes that the licensee agrees to implement the pre-hurricane shutdown procedures.

Recommendation: The licensee needs to implement pre-hurricane shutdown procedures in order to retain a 4-hour coping duration for Seabrook. Otherwise, the licensee needs to reevaluate the plant for an 8-hour coping duration and submit the supporting analyses for NRC review, or provide an alternate ac source.

2.2.1 Condensate Inventory For Decay Heat Removal

The licensee stated that 131,137 gallons of water are required for decay-heat removal during a 4-hour SBO event and that the minimum permissible condensate storage tank (CST) level per Technical Specifications corresponds to 212,000 gallons of water. Therefore, the licensee concluded that adequate supplies of condensate are available to cope 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 Seabrook plant.

2.2.2 Class 1E Battery Capacity

The licensee stated that the Class 1E batteries have sufficient capacity to meet station blackout loads for 4 hours with load shedding. The licensee indicated that the loads which are not required to cope with an SBO will be shed and are identified in plant procedure ECA 0.0 (Loss of all AC Power). The licensee stated that the battery capacity calculation was performed in accordance with IEEE Standard 485. The licensee stated that it did not include a specific design margin and used actual equipment loads instead of the rated loads for some equipment.

The licensee also stated that Seabrook has four safety-related batteries and four DC buses with two batteries/buses per train. The normal configuration is to have each battery feed its respective bus (one battery/bus). However, per Technical Specifications, it is permissible to operate the plant for up to 30 days with the crosstie between the two buses within a train (one battery/two buses). The battery sizing calculation covers each configuration.

The staff did not receive the licensee's battery capacity calculation. However, the licensee provided the load profiles used in the calculation. Based on the

information available in the plant UFSAR and that provided by the licensee, we have the following concerns:

1. The licensee did not consider any design margin (10% to 15% per IEEE Std. 485) to provide for less than optimum operating conditions of the battery due to improper maintenance, recent discharge or ambient temperature lower than anticipated.

2. The staff was unable to verify that the temperature factor used is based on the lowest electrolyte temperature that could occur during normal operation per NUMARC 87-00, Section 7.2.2.

3. The staff was unable to verify that load shedding will occur within the first 40 minutes of the SBO event and that the loads which will be shed will not adversely affect the ability to safely shut the plant down or maintain the plant in a safe shutdown condition.

4. The load profiles submitted by the licensee have discrepancies between the combined loads and individual bus loads in the 40-240 minute period.

5. The staff was unable to determine that the actual equipment loads instead of the rated load is the worst case scenario (e.g., constant KW loads are voltage dependent).

Based on the above, the staff cannot conclude the adequacy of the battery capacity for the required SBO duration.

Recommendation: The licensee should reevaluate the battery capacity considering the above concerns, perform an analysis to show that there is adequate battery capacity for the required duration, and submit the results of the reanalysis to the NRC staff. The battery capacity analysis and verification and any resulting modification, 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 air-operated valves relied upon to cope with a station blackout for 4 hours can either be operated manually or have sufficient back-up sources independent of the preferred and Class 1E AC power supplies. The licensee also stated that valves requiring manual operation or valves that require back-up sources for operation are identified in plant procedure ECA 0.0 (Loss of all AC Power).

Based on its review, the staff agrees with the licensee that the Seabrook plant has sufficient compressed air supply and backup sources to cope with a 4-hour SBO event.

2.2.4 Effects of Loss of Ventilation

The licensee has performed plant-specific analyses to determine the effects of loss of ventilation in the areas where the SBO response equipment are located

during a 4-hour SBO event (see SAIC TER for the list of these areas and their associated calculated temperatures). The licensee indicated that reasonable assurance of the operability of SBO response equipment in these areas has been assessed in accordance with the guidance described in NUMARC 87-00 and concluded that no modification or procedure change is required to provide reasonable assurance for equipment operability.

Based on its review, with the exception of the MS/FW pipe chase electrical room, the control room, and the switchgear room; the staff finds that the effects of the loss of ventilation during a 4-hour SBO event at the Seabrook plant have been properly evaluated and are, therefore, acceptable. The staff's evaluations of the above cited rooms are provided below:

2.2.4.1 MS/FW Pipe Chase Electrical Room

The staff finds the licensee's calculated final temperature (132°F) exceeds the EQ temperature for this area (130°F). Therefore, the staff has not been able to conclude that reasonable assurance of equipment operability has been provided for these areas.

Recommendation: The licensee should ensure that the MSIVs will be closed before the temperature inside the MSIV cabinets exceeds the operability temperature. If the operability temperature for the MSIVs is exceeded prior to the closure of the valves, the licensee should assess the consequences of the failure of the MSIVs to perform their function.

2.2.4.2 Control Room and Switchgear Room

The staff finds that the heat loads assumed in the analyses for the control room and switchgear rooms, and the initial temperatures assumed for the control room, appear to be low. Therefore, the staff has not been able to conclude that the effects of loss of ventilation in these areas during a 4-hour SBO event have been properly evaluated.

Recommendations: (1) The licensee should verify that its heat loads accurately reflect the loads expected in the control room and the switchgear room during an SBO event. (2) For the control room heat-up analysis, the licensee assumed an initial temperature of 75°F, which is non-conservative. If the licensee wishes to use 75°F as the initial temperature, then it must provide an administrative control which ensures that the control room temperature will not exceed the assumed temperature under any circumstance. (3) The licensee should establish a procedure in accordance with the guidance described in NUMARC 87-00 to open the control room cabinet doors within 30 minutes of an SBO event.

2.2.5 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 the Seabrook 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 states that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is adequately cooled for 4 hours has been assessed. The generic analyses listed in Section 2.5.2 of NUMARC 87-00 were 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 (including reflux boiling).

An independent evaluation of the RCS inventory was performed by SAIC using the available information in the plant UFSAR. Based on the postulated leak rate of 110 gpm (25 gpm per pump per NUMARC 87-00 guidelines and an estimated Technical Specification maximum allowable leakage of 10 gpm), the total leakage from the RCS during the 4-hour SBO event is 26,400 gallons or 3500 ft^3. The total RCS volume was determined to be 11,524 ft^3 based on the review of the UFSAR (Table 5.1-1). The RCS volume after leakage is 8000 ft^3 without cooldown. If the primary system is cooled down following ECA 0.0, the RCS volume will be 5000 ft^3 at the end of the SBO event, which is sufficient to keep the core covered. Therefore, the staff concurs with the licensee that sufficient RCS inventory exists to keep the core covered, and natural circulation, through reflux boiling, will keep the core cooled.

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

The licensee identified the procedures that have been reviewed as well as those that have been modified to cope with an SBO event. 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 to existing equipment were required for meeting the SBO Rule. The licensee further stated that all procedure modifications required to cope with an SBO of 4 hours have been completed. However, some modifications may be required to resolve open items as identified in this SE.

2.5 Quality Assurance and Technical Specifications

The licensee's submittals do not provide any information on how the plant complies with the requirement of RG 1.155, Appendices A and B.

The Technical Specifications (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 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 a TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation.

Recommendation: The licensee should verify and confirm 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 the target reliability of 0.975 will be maintained by implementation of a Diesel Generator Reliability Program meeting the Guidance of Regulatory Guide 1.155. The staff accepts the licensee's statement that its EDG reliability program will meet the guidance of RG 1.155, Section 1.2.

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, if required, 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 a commitment to implement pre-hurricane shutdown procedures or reevaluate the plant for an 8-hour coping duration, verification and confirmation to assure that Class 1E battery capacity is adequate, verification of the heat loads in the control and switchgear rooms, confirmation of an administrative control which ensures that the control room temperature will not exceed 75°F, a procedure to open the control room cabinet doors within 30 minutes of an SBO, verification of MSIVS operability, and confirmation that the SBO equipment is covered by an appropriate QA program consistent with RG 1.155. 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-91/1801, Technical Evaluation Report, Seabrook Station Unit 1, Station Blackout Evaluation, December 17, 1991.

Principal Contributors
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