



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20585

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT EVALUATION

GEORGIA POWER COMPANY

VOGTLÉ ELECTRIC GENERATING PLANT UNITS 1 AND 2

DOCKET NOS. 50-424/425

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 using an AC independent response format to the SBO rule were provided by letters from W. G. Hairston, III, on April 12, 1989, and March 28, 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 May 23, 1991, and licensee's responses to NRC questions regarding the SBO submittals were received on June 10, 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 an SAIC Technical Evaluation Report (TER) SAIC-91/66B6, "VOGTLE ELECTRIC GENERATING PLANT UNITS 1 AND 2, STATION BLACKOUT EVALUATION," dated August 22, 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 4 hours based on a plant AC power design characteristic Group "P1," an emergency AC (AAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.95. The AAC power configuration Group "C" is based on two EDGs not credited as AAC power sources, with one EDG required to operate safe shutdown equipment following a loss of offsite power.

The target EDG reliability was based on the Vogtle units having an average EDG reliability greater than 0.90 for the last 20 demands. Although this is an acceptable criterion for choosing an EDG target reliability, the guidance of RG 1.155 requires that EDG statistics for the last 50 and 100 demands also be calculated. The "P1" grouping is based on an independence of offsite power classification of Group "1 1/2," a severe weather (SW) classification of Group "1," and an extremely severe weather (ESW) classification of Group "2."

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 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 the SBO for a 4-hour coping duration.

### 2.2.1 Condensate Inventory for Decay Heat Removal

The licensee stated that 203,000 gallons of condensate were required for decay heat removal for the proposed SBO duration of 4 hours. The required volume of condensate (203,000 gallons) was determined utilizing Westinghouse curve SSE-1515 which was originally provided for use in the Vogtle Condensate Storage Tank Verification calculation. The minimum permissible condensate storage tank level per Technical Specifications (TS) provides 340,000 gallons of water which exceeds the required quantity for coping with a 4-hour SBO.

During the review of the licensee's submittals related to SBO events, the staff consultant performed an independent analysis which agrees with the licensee's conclusion that there is sufficient condensate at the Vogtle plant to cope with an SBO event of 4 hours. Based on its review, the staff concludes that the condensate inventory for decay heat removal during an SBO at the Vogtle plant is acceptable.

### 2.2.2 Class 1E Battery Capacity

The licensee stated that the battery capacity calculations have been performed in accordance with NUMARC 87-00, Section 7.2.2, to verify that 125V Class 1E batteries have sufficient capacity to meet SBO loads for 4 hours without the need to resort to load stripping. However, the licensee indicated that the Vogtle Emergency Operating Procedure 19100-C, "Response to Loss of All AC Power," made provisions for load stripping which would take place ½ to 1 hour after the procedure is initiated. The licensee also mentioned that the lighting in the main control rooms will require augmentation to assure sufficient light after the initial 90 minutes of lighting provided by self-contained, gel-cell battery packs. A permanent modification to augment the lighting for the required duration is expected to be complete by the end of 1992.

The review of the battery sizing calculations for SBO loads provided by the licensee reveals the following concerns:

- 1) The licensee needs to verify that the battery room temperature of 70°F as used in the battery capacity calculations is the lowest anticipated electrolyte temperature during normal operation per NUMARC 87-00, Section 7.2.2.
- 2) The licensee did not consider any design margin (10% to 15% per IEEE Std. 485) in its battery capacity calculation.
- 3) The inverter 1DD1I4 full load efficiency of 74.5% as used in the calculation is non-conservative since the load is 80% of the rating.
- 4) The no load loss of 1800W for 25KVA inverters (1DD1I5 and 1DD1I6) is non-conservative.

Based on the above, the staff cannot conclude on the adequacy of the battery capacity.

Recommendation: The licensee needs to reevaluate the battery capacity considering the above concerns. The battery capacity verification and any resulting modification should be included in the documentation that is to be maintained by the licensee in support of the SBO submittals.

#### 2.2.3 Compressed Air

The licensee stated that no air operated valves are relied upon to cope with an SBO for 4 hours. The atmospheric relief valves (ARVs) are manually operated from a ground-level hand-pump station located in the main steam isolation valve (MSIV) area, approximately 8 feet below the main steam piping and ARVs. The manual operation of the steam generator ARVs are covered under Vogtle site procedures and training. The licensee has determined the final temperature of 126°F during an SBO event for the MSIV area and hence remains habitable. The licensee stated that sound powered communication with the control room would be available from these areas.

Based on its review, the staff agrees with the licensee that no air operated valves are relied upon to cope with an SBO event for 4 hours at the Vogtle plant.

#### 2.2.4 Effects of Loss of Ventilation

The licensee stated that all components required to function during an SBO event to achieve and maintain safe shutdown were identified. Based on NUMARC 87-00 criteria and supplemental guidelines, only the turbine-driven auxiliary feedwater pump room was considered to be a dominant area of concern (DAC). However, to assess the reasonable assurance of operability (RAO) of all SBO components, all areas outside the containment (with the exception of the control room and MSIV areas) housing SBO components were evaluated using the guidances described in NUMARC 87-00 to determine their steady-state temperature during an SBO event. The initial temperature used in the calculations and the calculated SBO temperatures for these areas are summarized in Table 1 of the attached SAIC TER. With the exception of the calculated temperature (119°F)

for the control building inverter and switchgear rooms, the calculated temperatures for all areas are within the acceptance limits described in NUMARC 87-00 for the equipment required to cope with an SBO event.

The licensee stated that the control rooms for the two units are open to each other. The two rooms share a common ductwork system served by four 100-percent capacity, independent, safety-related HVAC systems. Any of the four systems is capable of providing the necessary cooling to maintain the normal ambient conditions for both control rooms. Therefore, during an SBO, the control room of the affected unit will receive HVAC cooling powered from the unaffected unit. Based on its review, the staff agrees with the licensee that during an SBO event, the control room of the affected unit will receive HVAC cooling powered from the unaffected unit. Therefore, the control room is not a DAC.

With respect to the MSIV areas, the SBO temperature was enveloped by Vogtle Design Criteria DC-1007, "Environment." The determination of the DC-1007 abnormal temperature of 126°F was based on the loss of all normal ventilation in the MSIV areas for 24 hours with all normal heat sources operating, which envelops SBO conditions. Based on its review, the staff finds this approach acceptable.

The licensee calculated a maximum steady state temperature of 119°F for the control building inverter and switchgear rooms. This was based on an initial ambient temperature of 85°F and opening of the doors to these rooms during an SBO. The licensee stated that the Vogtle plant SBO procedures would be revised to require that during an SBO event, the doors to the rooms which house the vital inverters and dc switchgear will be opened. The licensee evaluated the reasonable assurance for the equipment operability (RAO) at 119°F and concluded that, except for certain circuit breakers, all other equipment would be operational at this temperature. The licensee stated that six circuit breakers in Unit 1 and seven circuit breakers in Unit 2 will be replaced with larger size circuit breakers to avoid the potential of spurious tripping due to a temperature induced shift in tripping characteristics at elevated ambient temperatures.

The licensee used the normal room temperature as the initial temperatures for the control building inverter and switchgear rooms heat-up calculations. The staff finds that the licensee should either use as an initial temperature the maximum allowed by TS or the maximum value allowed under administrative procedures. If the licensee's administrative procedures do not specify an operating temperature limit, the licensee should revise their administrative procedures to maintain the normal operating temperatures in these areas at or below the value used in their SBO heat-up analysis.

The licensee has not addressed the containment temperature during an SBO event and the SBO equipment operability inside the containment.

Recommendations: The licensee should verify that the containment temperature profile during an SBO event is bounded by that of the LOCA/High Energy Line Break temperature profile. This verification should be included with other documentation that is to be maintained by the licensee in support of the SBO submittals. The licensee should use an initial temperature for the SBO control building complex heat-up calculation no lower than that allowed by the TS or the administrative procedures.

#### 2.2.5 Containment Isolation

The licensee 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 blacked out unit's Class 1E power supplies. The licensee further stated that no plant modifications or procedure changes are required to ensure appropriate containment integrity under SBO conditions.

Based on its review of SAIC's TER and the list of CIVs provided by the licensee, the staff concurs with the SAIC TER that with the exception of the excess letdown and sealwater line penetration (X-49), the containment isolation valve design and operation at Vogtle plant have met the intent of the guidances described in RG 1.155.

Recommendation: The licensee needs to list the normally open ac motor-operated globe valves in the excess letdown and seal water leakoff line (X-49) in an appropriate procedure and identify the actions necessary to ensure that these valves can be fully closed during an SBO event. The valve closure needs to be confirmed by position indication (local, mechanical, remote, process information, etc.). This information should 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 adequacy of the reactor coolant system inventory for 4 hours under SBO conditions was assessed to ensure that the core is covered using Westinghouse generic analysis WCAP-10541, Rev. 2, which was determined by Westinghouse to be applicable to Vogtle. The Westinghouse generic analysis determined that the core will be covered for approximately 18 hours using 21 gpm per RCP seal leakage and ability to maintain natural circulation. The licensee concluded that the core will be covered for more than the 4-hour coping duration based on 25 gpm per RCP seal leakage at Vogtle. After reviewing SAIC's TER with its independent coping assessment, the staff agrees with the licensee that Vogtle units have sufficient capability to maintain reactor coolant inventory for a 4-hour SBO event.

The reactor coolant inventory evaluation as discussed above was based on the guidance of NUREG-87-00 of 25 gpm reactor coolant pump seal leak rate for pressurized water reactors. The 25 gpm seal leak rate was agreed to between NUREG and the NRC staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines a higher RCP seal leak rate than assumed for the RCS inventory evaluation, the licensee committed to implement the potential impact of this resolution on its analysis and actions addressing conformance to the SBO Rule.

### 2.3 Procedures and Training

The licensee stated that the procedural requirements for coping with an SBO have been reviewed and the grid restoration procedures have been updated to meet the requirements of the SBO Rule. The licensee added the following documents to the SBO procedures:

Black Start Procedures for Plant Vogtle;  
Restoration of Offsite AC Power for the Shutdown of Plant Vogtle.

The licensee also stated that the plant procedures have been reviewed, and changes, if necessary to meet NUMARC 87-00, will be implemented in the following areas:

Loss of All AC;  
Severe Weather; and  
System Operating Procedures for Diesel Generator Operation.

The licensee indicated that these procedure changes 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 an 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.

### 2.4 Proposed Modifications

The licensee stated that the following modifications would be required to attain the proposed 4-hour SBO coping duration:

- 1) Lighting in the common main control room will be augmented to assure sufficient lighting after the 90 minutes of initial lighting provided by self-contained gel-cell battery packs.
- 2) Six circuit breakers in Unit 1 and seven circuit breakers in Unit 2 will be replaced with larger size circuit breakers to avoid the potential of spurious tripping due to a temperature induced shift in tripping characteristics at elevated ambient temperatures.

The licensee indicated that the above modifications will be completed within one year after the issuance of the SE.

Recommendation: The licensee should include a full description including the nature and objectives of the required modifications in the documentation that is to be maintained by the licensee in support of the SDO submittals.

#### 2.5 Quality Assurance and Technical Specifications

The licensee did not address quality assurance (QA) or TS pertaining to the SBO equipment.

The TS for the SBO equipment are currently being considered generically by the NRC in the context of the TS 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 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, Appendix A. Further, this verification should be documented as part of the package supporting the SBO Rule response.

## 2.6 EDG Reliability Program

The licensee's submittals on SBO did not specifically address the commitment to implement an EDG reliability program to conform to the guidance of RG 1.155, Position 1.2. However, in the submittal of March 28, 1990, the licensee committed to maintain the EDG target reliability of 0.95. Although the licensee has committed to a reliability program pending resolution of GI B-56, "Diesel Generator Reliability," they should implement a program that meets as a minimum the guidance of RG 1.155, Position 1.2.

Recommendation: The licensee should provide confirmation and include in the documentation supporting the SBO submittals that is to be maintained by the licensee that such a program meeting the guidance of RG 1.155, Position 1.2, is in place or will be implemented.

## 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 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 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. The staff agrees with the licensee's calculation of a 4-hour SBO coping duration. The licensee provided a coping analysis using the "AC-Independent" approach. Based on our review, some actions and verifications need to be completed as described in the recommendations itemized herein. These include verification of the Class 1E battery adequacy; confirmation that the initial temperature used for the control building complex heat-up calculations is consistent with the maximum allowed; verification that the containment temperature profile during an SBO is bounded by the LOCA High Energy Line Break profile; verification that containment isolation can be obtained if needed; description of SBO procedure changes and hardware modifications; implementation of an EDG reliability program in accordance with the guidance of RG 1.155, Section 1.2; and ensuring that the SBO equipment is covered by a QA program consistent with the guidance of RG 1.155, Appendix A. 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

SAIC - 91/6686, Technical Evaluation Report, Vogtle Electric Generating Plants, Units 1 & 2, Station Blackout Evaluation, August 22, 1991.

Principal Contributor

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