ENCLOSURE 1

E. I. HATCH UNITS 1&2
STATION BLACKOUT SAFETY EVALUATION

1.0 INTRODUCTION:

On July 21, 1988, the Code of Federal Regulations 10CFR 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 specified duration, requires licensees to submit information as defined in 10 CFR Part 50.63 and requires licensees 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 rule is provided by (1) Regulatory Guide (RG) 1.155, Station Blackout, (2) 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* 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 2 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 followup 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 Hatch 1&2 Station has proposed using an existing swing emergency diesel generator (EDG) as an AAC power source. The licensee's original response was

*Nuclear Management and Resources Council, Inc.

provided by a letter from Georgia Power Company to U.S. Nuclear Regulatory Commission (NRC) dated April 12, 1989, and supporting documentation provided on August 29, 30 and September, 1989. In addition, the licensee provided a response to the NUMARC 87-00 Supplemental Questions/Answers by a letter from W. G. Hairston III, to NRC dated March 27, 1990. The licensee 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-89/1152, "Hatch Units 1 and 2, Station Blackout Evaluation," dated November 9, 1990 (Attachment No. 1).

2.0 EVALUATION:

After reviewing the licensee's SBO submittal and the SAIC TER, the staff concurs with the conclusions as identified in the SAIC TER (refer to Attachment No. 1 for details of the review). Based on this review, the staff findings and recommendations are summarized as follows:

2.1 Station Blackout Duration

The licensee has calculated a minimum acceptable station blackout duration of 4 hours based on an offsite power design characteristic Group "P1," an Emergency AC (EAC) power configuration Group "C," and an EDG reliability target of 0.95. The target EDG reliability was based on Hatch Units 1&2 EDGs having an average reliability greater than 0.95 over the last 100 demands. The P1 grouping is based on an independence of offsite power classification of Group "I 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 evaluation of a 4 hour SBO coping duration.

2.2 Alternate AC (AAC) Power Source

The licensee has proposed using the existing swing EDG as an AAC power source to operate systems necessary for the required SBO coping duration and recovery therefrom.

2.2.1 General staff position on AAC power sources

The definition in 10CFR §50.2, RG 1.155 and NUMARC 87-00 define 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 SBO rule 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 of 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.

2.2.1.1 EDGs used as AAC power sources

The guidance on the use of existing EDGs as AAC power sources is documented in the station blackout rule 10 CFR §50.63, RG 1.155 Position C.3.3.5 and NUMARC 87-00 (Section 2.3.1(3)). This guidance is further explained in NUMARC 87-00 Supplemental Questions and Answers dated December 27, 1989, under questions 3.4 and B.3. The station blackout rule states:

> "At multi-unit sites, where the combination of emergency ac power sources exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining emergency ac power sources may be used as alternate ac power sources provided they meet the applicable requirements."

The rule requires minimum redundancy. This means that the plants that have more than the required redundancy of emergency ac (EAC) sources for a loss of offsite power event, on a per nuclear unit basis, may use one of the existing emergency sources as an AAC source.

2.2.1.2 Connectability of AAC power sources

The basic criteria governing the connectability of an AAC power source are contained in 10CFR 50.2 (The AAC source should be connectable to but normally not connected to the offsite or onsite emergency AC power systems), 10CFR 50.63 (SBO should not assume a concurrent single failure or design basis accident.), and in Appendix A of 10CFR 50 (The single failure criterion and the independence requirements apply to the non-blackout (NBO) unit.). Therefore, in a one unit site 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, or whether the AAC source is an excess redundancy EDG or an independent power source.

However, at a two (or more) unit site where the EDGs meet the AAC source excess redundancy or excess capacity criterion, one intertie circuit between units is acceptable provided it is separately connectable to each safety (EDG) bus in both units. This follows from the application of the above criteria and the assumptions that must be taken that an SBO can occur in either unit, and that the single failure in the NBO unit can be on either one of its EDGs or on its respective safety bus.

2.2.2 Proposed AAC power source

The Hatch station is a two unit site with two dedicated EDGs per unit and an EDG "1B" which swings over to the unit having a loss of coolant accident (LOCA). The licensee has proposed using the swing EDG "1B" as an AAC source for either unit. The AAC source is connectable to the "F" bus on either unit and will be available within 1 hour from the onset of an SBO event. The licensee also stated that the AAC power source meets the criteria in Appendix B of NUMARC 87-00. The ability of EDG "1B" to provide power to the 4kV buses is periodically tested.

The staff's review indicates that on the failure of any two EDGs in the blacked out unit (assuming two dedicated EDGs and swing EDG "1B" as a normal contingent of EDGs in SBO unit), the remaining EDG can be selected as an AAC power source. However, the staff evaluation is based on EDG "1B" as an AAC power source since it is bounding because it requires more manual actions and time (within one hour) to make it available to power the safe shutdown loads than either of the other two EDGs. Based on the above, the staff agrees with the licensee that EDG "1B" (or any one of the other two EDGs) can be designated as an AAC power source.

EDG "1B" has a continuous rating of 2850kW and a 168 hour rating of 3250kW. The expected SBO load on EDG "1B" after load shedding is 3245kW. EDG "1B" does not have a 2000 hour rating; however, it is identical to the other EDGs which have a 2000 hour rating of 3100kW. Based on this, we assume that the 2000 hour rating of EDG "1B" is also 3100kW. Therefore the 2000 hour rating of EDG "1B" (or any of the other EDG) is less than the expected SBO loads as identified above. However, according to the licensee's back-up documentation certain loads are not needed to cope with an SBO, such as the loads on MCC-1A, and could be shed. The licensee needs to reevaluate the load reduction scheme such that the EDG "1B" loading is below or within its 2000 hour rating. Also, paragraph B.12 of NUMARC 87-00, Appendix B states that the AAC system should be demonstrated by initial test to be capable of powering the necessary equipment within one hour and should be capable of maintaining the voltage and frequency within the limits of established industry standards.

The licensee has identified a concern that if the NBO unit receives a high drywell temperature (which gives a high drywell pressure trip) signal, the control logic will assume a LOCA and, per design, EDG "1B" will shift to the NBO unit during an SBO event. For this event, the licensee states that design modification options are under review and the plant emergency procedures modified to include operator actions to ensure that a safety injection signal on the NBO unit can be isolated to prevent EDG "1B" shifting from the SBO unit to the NBO unit.

Recommendations: The licensee should 1.) reevaluate the loads and provide a load reduction scheme such that the EDG "1B" loading will be below 3100kW while

coping with an SBO, 2) implement design modification and procedure changes to prevent the EDG "1B" shifting from the SBO unit to the NBO unit during a high drywell temperature signal, and 3.) demonstrate by initial test the capability of EDG "1B" to power the necessary SBO equipment within one hour, while maintaining voltage and frequency within limits consistent with the established industry standards in accordance with NUMARC 87-00, Appendix B, Paragraphs B.9 and B.12. The results of the analyses and tests for the above items should be included with the documentation maintained by the licensee in support of the SBO submittals.

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 recover from an SBO for a 4-hour coping duration.

2.3.1 Condensate inventory for decay heat removal

The licensee states that RCIC is normally lined up to take suction from the condensate storage tank (CST) to the reactor pressure vessel (RPV) until such time as either the CST reaches its low level set point or the suppression pool reaches its high level set point. The difference between the minimum suppression pool level and the level that causes RCIC pump to shift suction is approximately 29,000 gallons. Upon reaching either of the limits, the RCIC suction will automatically shift to the suppression pool. The CST on both units is a 500,000 gallon tank with 100,000 gallons dedicated to HPCI and RCIC systems. The instrumentation and control power required to shift the suction from the CST to the suppression pool will be available during an SBO. The licensee did not perform condensate inventory calculations in accordance with NUMARC 87-00 Section 7.2.1. There is no Technical Specification requirement to maintain a specified CST level during reactor operation. However, the suppression pool on each unit is required by Technical Specifications to contain minimum inventory of 653,000 gallons of water. The staff, therefore, concludes that the 653,000 gallons in the suppression pool provides adequate water to cope with an SBO of 4 hours.

2.3.2 Class 1E battery capacity

The licensee has determined that station service and diesel generator batteries each has sufficient capacity for one hour. After one hour the AAC source will be available to power the Division 1 ("A") train battery chargers.

The staff agrees with the licensee's assessment except for the following concerns:

1) The licensee has taken credit for the ability to operate the dc powered RCIC suction valves but has not included the power requirement for these valves in the battery 2A calculations.

2) The battery calculation has listed four operations of the RCIC steam isolation valves but has not addressed as to why four operations are needed.

3) The licensee has stated the operability of station service battery chargers may be affected by high temperatures in the control building. The licensee needs to define the extent of the potential problem and determine the appropriate corrective actions. This could affect the battery chargers for both the SBO and the NBO unit.

Recommendations:

a. The licensee needs to reverify their assessment that the battery has sufficient capacity to power all normal battery backed monitoring and electrical systems and controls for the required SBO duration and recovery therefrom, taking into account the RCIC suction valves. The calculations should also address the utilization of the 4 operations of the RCIC systems isolation valves.

b. The licensee should evaluate and take the appropriate corrective actions, as necessary, to preserve the operability of the station

service battery chargers which may be affected by the high temperatures in the control building

The results of the analyses and assumptions used, should be submitted to the NRC staff for review and also included with the documentation maintained by the licensee in support of the SBO submittals.

2.3.3 Compressed air

The licensee stated that no credit is taken for the use of the compressed air system during an SBO event. The safety relief valves (SRVs) are equipped with accumulators capable of 5 operations of each valve and are backed up by a safety-related nitrogen system.

The staff agrees that the plant instrument and service air compressors are not required during an SBO. All air operated, safety related equipment will fail to the required position upon the loss of compressed air. The SRV pilot solenoid valves have sufficient motive force from the accumulators and nitrogen system. The compressed air portion of the licensee's coping analysis is in accordance with the guidance of NUMARC 87-00 and is, therefore, acceptable.

2.3.4 Effects of loss of ventilation

The licensee analyzed the effects of SBO steady state air temperatures for plant areas containing SBO equipment. With compensatory procedural actions, the licensee stated that steady state room air temperatures can be maintained within limits to provide reasonable assurance of SBO equipment operability (refer to Attachment 1 for details).

The staff agrees with the licensee's stated results except in the following areas: 1) control room, 2) Containment/Drywell, and 3) battery charger area. 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 effects of loss of ventilation for the areas identified in this section and correct the deficiencies. If

the licensee's reevaluation shows that additional procedure changes or hardware modifications are necessary to ensure equipment operability in the above mentioned areas, then the licensee should implement the appropriate procedure changes or modifications accordingly. The licensee should submit the results of the analyses, and assumptions used, for NRC staff review, and also maintain these analyses in the documentation supporting the SBO submittal. In addition, procedural controls should be established to open the control room cabinet doors within 30 minutes from the onset of SBO to provide adequate air mixing to maintain cabinet temperatures in equilibrium with the control room temperature.

2.3.5 Containment isolation

The licensee has reviewed the plant list of containment isolation valves to verify which valves must be capable of being closed during an SBO event. The licensee has determined that at least one valve on each penetration can be closed using a handwheel, AAC or dc power.

The licensee has correctly identified the containment isolation valves. However, since the AAC power is not available for the first hour after the onset of an SBO, the licensee should determine which valves and position indication require AAC power and include them in the appropriate procedure.

Recommendation: The licensee should determine which valves and position indicators will require power from the AAC source and ensure that each is identified in the appropriate plant procedures.

2.3.6 Reactor coolant inventory

The RCIC system is normally lined up to take suction from the CST. The suction then shifts to the suppression pool when either the CST reaches its low level setpoint or the suppression pool reaches its high level setpoint. During the SBO event the plant operators will utilize one of the Safety Relief Valves (SRVs) to maintain plant conditions below the suppression pool heat capacity temperature limit (HCTL) curve. The licensee also stated that suppression pool cooling, although not expected to be required for four hours, would be available within

one hour with the operation of the AAC source. Suppression pool cooling could be used to preclude a pool temperature increase above the HCTL.

The licensee provided an alternative justification to show that the expected rates of reactor coolant inventory loss under SBO conditions would not result in core uncovery during the 4 hour SBO duration. A previous analysis, which had evaluated the effectiveness of RCIC at reduced flow rate of 360 gpm versus a design flow rate of 400 gpm, demonstrated that reactor pressure vessel (RPV) water level would remain above Level 1. This analysis had assumed a loss of station power and an initial RPV water level at the scram setpoint. The results of this analysis were used to show that the RCIC system was capable of providing sufficient makeup inventory and that water level would be adequate.

After reviewing the licensee's submittal, the staff agrees with the assessment in the SAIC TER that, during an SBO, it is possible to exceed the HCTL and enter a condition that would require depressurization to remain below the HCTL curve. In one submittal the licensee stated that the operators would operate an SRV to maintain conditions below the HCTL curve and in a second submittal, that a controlled depressurization would be performed at about 2.5 hours into the SBO event. In either case, suppression pool cooling was not necessary for the four hours. The licensee should clarify whether depressurization is necessary, especially, if suppression pool cooling is available at the time of AAC source availability (1 hour). After establishing the coping approach, the licensee should determine the peak suppression pool temperatures during any period without pool cooling, taking into consideration the localized pool temperatures and using the correct HCTL curve. The staff found inconsistencies between the various backup analyses.

Recommendation: The licensee should provide a clear description of the procedural guidance to the plant operators and the approach that will be used to cope with the SBO event. After establishing this approach, the licensee should determine the peak suppression pool temperatures, taking into account the localized suppression pool temperatures, and using the correct HCTL curve. The licensee should submit the results of the analysis, and the assumptions used, for NRC staff review. The procedural guidance, assumptions, and

supporting calculations should also be included in the SBO supporting documentation to be maintained by the licensee.

The reactor coolant inventory evaluation as discussed above was based on the guidance provided in NUMARC 87-00 for seal leakage of 18 gpm per recirculation pump (RCP) for boiling water reactors. The 18 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.

2.4 Procedures and Training

The licensee has stated that the appropriate procedures have been reviewed and modified. Furthermore, the licensee has stated that the changes will meet the guidelines of NUMARC 87-00 and will be implemented.

The proposed procedure modifications indicated above were not reviewed, but the staff expects the licensee to maintain and implement these procedures including any others that may be required to ensure an effective 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 the SBO.

2.5 Proposed Modifications:

The licensee has identified a concern that if the NBO unit receives a high drywell temperature (which gives high drywell pressure trip) signal, the control logic will assume a LOCA, and per design, EDG "1B" will shift to the NBO unit during an SBO event. To ensure that EDG "1B" does not shift away from the blacked out unit, the licensee stated that design modification options are under review, and the plant emergency operating procedures will include operator actions to ensure that a safety injection signal on the NBO unit can be isolated.

The licensee has proposed to replace some of the acoustical ceiling tiles in the control room and control building with an egg crate type tile to permit free airflow to the space above. The loss of ventilation in the control building could also affect the operability of the battery chargers of both units. The licensee will propose modifications for the operability of the battery chargers at high temperatures.

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

2.6 Quality Assurance (QA) and Technical Specifications (TS)

The licensee has stated that all SBO equipment are currently covered by QA programs with the exception of reactor protection system (RPS) distribution system. The system is designed to be fail safe and its failure will not adversely affect the plant's ability to achieve and maintain hot shutdown during an SBO. The importance of RPS distribution system in coping with an SBO could not be determined. Therefore, the licensee needs to provide additional information regarding the importance of RPS distribution system in coping with an SBO before the compliance with the guidance of RG 1.155 can be evaluated.

The technical specifications (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 a TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

Recommendations: 1. The licensee should provide additional information regarding the importance of the RPS distribution system in coping with an SBO,

and, 2. the licensee should identify the equipment powered from the RPS MG sets which is necessary during an SBO and include it in the QA program.

2.. EDG Reliability Program

The licensee's submittal on SBO did not specifically address a commitment to implement a reliability program for the emergency ac power sources in accordance with RG 1.155. However, during the meeting, the licensee stated that a reliability program for Hatch emergency ac power sources is consistent with the guidance of RG 1.155, Section 1.2 and that if needed, the program will be adjusted in accordance with regulatory guidance.

Recommendation: The licensee should implement an EDG reliability program which meets 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 supporting the SBO submittals that is to be maintained by the licensee.

2.8 Scope of staff review

The station blackout rule (10CFR 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 evaluation available to NRC." The staff and its contractor (SAIC) did not perform a detailed review of the proposed procedure modifications which are scheduled for later implementation, and hardware modification were not proposed by the licensee. Therefore, based on our review of the licensee supporting documentation and SBO audit, we have identified the following areas for focus in any followup inspection or assessment that may be undertaken by the NRC to further verify conformance with the SBO rule.

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 this SE.

3.0 SUMMARY AND CONCLUSIONS

The staff has reviewed the licensee's response to the SBO rule (10 CFR 50.63) and the Technical Evaluation Report prepared by the staff's consultant, SAIC. Based on the staff's review of the licensee's submittals and SAIC TER, the staff finds that the Hatch station does not conform with the SBO rule and the guidance of R.G. 1.155, and therefore recommends that the licensee reevaluate the areas of concern that have been identified in this SE. Guidance for the licensee to review and implement the staff's recommendations is provided in RG 1.155, NUMARC 87-00 and the supplementary guidance (NUMARC 87-00 Supplementary Questions/Answers; NUMARC 87-00 Major Assumptions) dated December 27, 1989, which was issued to the industry by NUMARC on January 4, 1990. The staff's concerns that are identified in this SE should be addressed by the licensee, and a revised response submitted to the NRC within 60 days. The licensee is expected to ensure that the baseline assumptions of NUMARC 87-00 are applicable to the Hatch plant. Also, the licensee should maintain all analyses and related information in the documentation supporting the SBO submittal for further inspection and assessment as may be undertaken by the NRC to audit conformance with the SBO rule.

TECHNICAL EVALUATION REPORT

E. I. HATCH UNITS 1 AND 2

STATION BLACKOUT EVALUATION

Science Applications International Corporation

An Employee-Owned Company

ATTACHMENT 1

SAIC-89/1152

TECHNICAL EVALUATION REPORT

E. I. HATCH UNITS 1 AND 2

STATION BLACKOUT EVALUATION

TAC Nos. 68553 and 68554

Science Applications International Corporation
An Employee-Owned Company

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TECHNICAL EVALUATION REPORT

E. I. HATCH UNITS 1 AND 2
STATION BLACKOUT EVALUATION

1.0 BACKGROUND

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR Part 50 by adding a new section, 50.63, "Loss of All Alternating Current Power" (1). The objective of this requirement is to assure that all nuclea power plants are capable of withstanding a statio blackout (SBO) and maintaining adequate reactor core cooling and appropriate containment integrity for a required duration. This requirement is based on information developed under the commission study of Unresolved Safety Issue A-44, "Station Blackout," (2-6).

The staff issued Regulatory Guide (RG) 1.155, "Station Blackout," to provide guidance for meeting the requirements of 10 CFR 50.63 (7). Concurrent with the development of this regulatory guide, the Nuclear Utility Management and Resource Council (NUMARC) developed a document entitled, "Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00 (8). This document provides detailed guidelines and procedures on how to assess each plant's capabilities to comply with the SBO rule. The NRC staff reviewed the guidelines and analysis methodology in NUMARC 87-00 and concluded that the NUMARC document provides an acceptable guidance for addressing the 10 CFR 50.63 requirements. The application of this method results in selecting a minimum acceptable SBO duration capability from two to sixteen hours depending on the plant's characteristics and vulnerabilities to the risk from station blackout. The plant's characteristics affecting the required coping capability are: the redundancy of the onsite emergency AC power sources, the reliability of onsite emergency power sources, the frequency of loss of offsite power (LOOP), and the probable time to restore offsite power.

In order to achieve a consistent systematic response from licensees to the SBO rule and to expedite the staff review process, NUMARC developed two

generic response documents. These documents were reviewed and endorsed by the NRC staff (9) for the purposes of plant specific submittals. The documents are titled:

1. "Generic Response to Station Blackout Rule for Plants Using Alternate AC Power," and

2. "Generic Response to Station Blackout Rule for Plants Using AC Independent Station Blackout Response Power."

A plant-specific submittal, using one of the above generic formats, provides only a summary of results of the analysis of the plant's station blackout coping capability. Licensees are expected to ensure that the baseline assumptions used in NUMARC 87-00 are applicable to their plants and to verify the accuracy of the stated results. Compliance with the SBO rule requirements is verified by review and evaluation of the licensee's submittal and audit review of the supporting documents as necessary. Follow up NRC inspections assure that the licensee has implemented the necessary changes as required to meet the SBO rule.

In 1989, a joint NRC/SAIC team headed by an NRC staff member performed audit reviews of the methodology and documentation that support the licensees' submittals for several plants. These audits revealed several deficiencies which were not apparent from the review of the licensee submittals using the agreed upon generic response format. These deficiencies raised a generic question regarding the degree of the licensees' conformance to the requirements of the SBO rule. To resolve this question, on January 4, 1990, NUMARC issued additional guidance as NUMARC 87-00 Supplemental Questions/Answers (10) addressing the NRC's concerns regarding the deficiencies. NUMARC requested that the licensees send their supplemental responses to the NRC addressing these concerns by March 30, 1990.

2.0 REVIEW PROCESS

The review of the licensee's submittal is focused on the following areas consistent with the positions of RG 1.155:

A. Minimum acceptable SBO duration (Section 3.1),

B. SBO coping capability (Section 3.2),

C. Procedures and training for SBO (Section 3.4),

D. Proposed modifications (Section 3.3), and

E. Quality assurance and technical specifications for SBO equipment (Section 3.5).

For the determination of the proposed minimum acceptable SBO duration, the following factors in the licensee's submittal are reviewed: a) offsite power design characteristics, b) emergency ac power system configuration, c) determination of the emergency diesel generator (EDG) reliability consistent with NSAC-108 criteria (11), and d) determination of the accepted EDG target reliability. Once these factors are known, Table 3-8 of NUMARC 87-00 or Table 2 of Regulatory Guide 1.155 provides a matrix for determining the required coping duration.

For the SBO coping capability, the licensee's submittal is reviewed to assess the availability, adequacy and capability of the plant systems and components needed to achieve and maintain a safe shutdown condition and recover from an SBO of acceptable duration which is determined above. The review process follows the guidelines given in RG 1.155, Section 3.2, to assure:

a. availability of sufficient condensate inventory for decay heat removal,

b. adequacy of the class 1E battery capacity to support safe shutdown,

c. availability of adequate compressed air for air-operated valves necessary for safe shutdown,

d. adequacy of the ventilation systems in the vital and/or dominant areas that include equipment necessary for safe shutdown of the plant,

e. ability to provide appropriate containment integrity, and

f. ability of the plant to maintain adequate reactor coolant system inventory to ensure core cooling for the required coping duration.

The licensee's submittal is reviewed to verify that required procedures (i.e., revised existing and new) for coping with SBO are identified and that appropriate operator training will be provided.

The licensee's submittal for any proposed modifications to emergency AC sources, battery capacity, condensate capacity, compressed air capacity, appropriate containment integrity and primary coolant make-up capability is reviewed. Technical Specifications and quality assurance set forth by the licensee to ensure high reliability of the equipment, specifically added or assigned to meet the requirements of the SBO rule, are assessed for their adequacy.

The licensee's proposed use of an alternate AC power source is reviewed to determine whether it meets the criteria and guidelines of Section 3.3.5 of RG 1.155 and Appendix B of NUMARC 87-00.

The Georgia Power Company presented its submittal and provided significant supporting documentation to the NRC/ SAIC staff review team at NRC headquarters on August 29-30, 1989. This presentation intended to provide the reviewers with essentially the same amount of information as would be obtained

in a site audit review. The following evaluation was written in coordination with the NRC staff and encompasses the review of the licensee's submittals dated April 12, 1989 (12) and March 27, 1990 (33), supporting documentation provided for the meeting of August 29-30, 1989, and additional information provided (32) in response to issues raised during the above meeting.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Georgia Power Company (GPC), calculated (12 and 33) a minimum acceptable station blackout duration of four hours for the E. I. Hatch Units 1 or 2. The licensee stated that no modifications are necessary to attain this proposed coping duration.

The plant factors used to estimate the proposed SBO duration are:

1. **Offsite Power Design Characteristics**

   The plant AC power design characteristic group is "P1" based on:

   a. Independence of the plant off-site power system characteristics of "I1/2,"

   b. Expected frequency of grid-related LOOPs of less than one per 20 years,

   c. Estimated frequency of LOOPs due to extremely severe weather of 9.0E-4 (12) per year which places the plant in ESW group "2," and

   d. Estimated frequency of LOOPs due to severe weather of 6.3E-4 (12) per year which places the plant in SW group "1."

2. **Emergency AC (EAC) Power Configuration Group**

   The EAC power configuration of the plant is "C." Each of the two units at Hatch are equipped with two emergency diesel generators which are normally available to the unit safe shutdown equipment.

One EAC power supply is necessary to operate safe shutdown equipment following a LOOP.

3. Target Emergency Diesel Generator Reliability

The licensee has selected a target EDG reliability of 0.95 based on having a nuclear unit average EDG reliability of greater than 0.95 for the last 100 demands consistent with NUMARC 87-00.

Review of Licensee's Submittal

The factors which affect the estimation of the required SBO coping duration are: the independence of offsite power system grouping, the estimated frequency of LOOPs due to severe and extremely severe weather conditions, the classification of EAC, and the selection of EDG target reliability. The licensee's estimations of the frequency of LOOPs due to severe and extremely severe weather conditions were based on the data given in NUMARC 87-00.

The independence of the offsite power system is correctly classified as "I1/2." All the offsite power sources are connected to the plant through one switchyard, and the normal source of AC power to the safe-shutdown buses is from the offsite power sources through the units start-up auxiliary transformers. Each unit is equipped with two start-up auxiliary transformers one of which is normally connected to the safe-shutdown buses. Upon loss of power from the unit's start-up auxiliary transformer, the safe-shutdown buses are automatically fast-transferred to a second start-up auxiliary transformer. Using Table 5 of the RG 1.155, the independence of the offsite power can be classified as "I2."

Based on an independence of offsite power system "I1/2," an ESW group "2," and a SW group "1," we agree that the plant is in the "P1" off-site power design characteristic group.

The assignment of the EDG target reliability is supported by the demonstrated EDG start and load-run reliability of greater than 0.95 over the last 100 demands. The licensee provided a summary of the EDG reliability statistics during the meeting in August 1989. This data was not reviewed in detail. A cursory review of the data which covers the period from January 1986 to July 1989, indicated that the EDGs were consistently having a reliability level greater than 0.975. In its submittal dated March 27, 1990 (33), the licensee stated that the targeted EDG reliability will be maintained, and that an EDG reliability program will be addressed following the resolution of Generic Issue B-56, Diesel Generator Reliability.

Based on the offsite power design characteristic group "P1," EAC group "C" and an EDG reliability target reliability of 0.95, we agree with the licensee's selection of a four hour coping duration.

3.2 Alternate AC (AAC) power source

Licensee's Submittal

The licensee stated that the AAC power source is the previously installed class 1E emergency diesel generator, EDG 1B, that is essentially identical to the four EDGs used as EAC power sources. The licensee stated that the AAC power source meets the criteria specified in NUMARC 87-00, Appendix B, and that it will be available to the blacked unit within one hour from the onset of an SBO event. EDG 1B is shared between the two units and can be connected to either Unit 1 emergency bus 1F or Unit 2 emergency bus 2F. The F bus on each unit supplies 4.16 kV ECCS pumps in both division I and II. The F bus is normally connected to Unit's division I 600 V distribution system via a normally installed disconnect link. The licensee stated that EDG 1B reliability exceeds 95% in accordance with the NSAC-108 methodology for the last 100 demands.

The licensee evaluated (12) EDG 1B for compliance to each of the criteria in Appendix B of NUMARC 87-00, and concluded that EDG 1B qualifies for use as an AAC power source. The licensee is committed to:

1. Develop and implement plant procedures to perform 1-hour manual action walk-through verification assessment (NUMARC 87-00 Sections B.10 and B.12), and

2. Develop and implement plant procedures to perform various manual actions associated with operating the AAC source (NUMARC 87-00 Section B.10 and B.12).

The licensee stated (32) that the ability of EDG 1B to provide power to 4.16 kV buses is regularly tested. However, the capability to power the division I 600 V bus on either unit and the manual actions required to load each bus are not tested periodically. The licensee stated that this capability is part of the current plant design and requires no special provisions regarding the AAC power source in order to comply with SBO guidance. The licensee proposes not to perform this test because it involves completely deenergizing one division of 600 V loads. The licensee added that this capability will be demonstrated via a simulated test and that applicable EOPs will be verified.

Review of Licensee's Submittal

The Hatch site is equipped with five redundant EDGs. These EDGs are configured into two-dedicated EDGs per unit and one shared (or swing) EDG between the units. The two dedicated EDGs, (EDG A and EDG B), power two redundant divisions of emergency buses. The shared EDG, (EDG 1B), powers its own 4.16 kV bus in each unit and is manually connectible to both divisions of 600 V emergency buses. After the assumption of two failed EDGs at one unit, any one of the remaining three EDGs could be selected as an AAC power source. The designation of EDG 1B as an AAC power source is bounding since it requires more manual actions and time (within one hour) to make it available to power the safe shutdown loads.

Based on the above, and except for the following concerns, we agree with the licensee that the AAC power source (EDG 1B) meets the guidance provided in NUMARC 87-00, Appendix B.

The licensee is committed to powering the F bus in the blacked out unit within one hour of the onset of an SBO. The operator actions to power the SBO loads from this bus are simple, but need to be verified in accordance with the guidance provided in Appendix B of NUMARC 87-00.

According to the licensee's back-up documentation, after some load stripping and connection of the 600 V bus, the expected SBO load is on EDG 1B is 3,245 kW. Three major loads; an RHR service water pump, a plant service water pump, and an RHR pump, constitute about 2400 kW of this load. The rest of the load comes from two battery chargers, and assorted 600 V loads. The AAC power source (EDG 1B) has a continuous rating of 2,850 kW and a 168 hour rating of 3,250 kW. According to the plant Final Safety Analysis Report Update (FSAR), when the EDG 1B was purchased the diesel generator manufacturer did not have a 2,000 hour rating procedure, therefore no 2,000 hour rating was available; however, EDG 1B is identical to other four EDGs at the site. The licensee stated (32) that EDG 1B was pre-operationally tested to 3,250 kW. Therefore, based on this statement, we can assume that the 2,000 hour rating of the EDG 1B to be identical to the other EDGs at the site which is 3,100 kW. The plant Technical Specifications, Section 3/4.8.1.1.2.d.9, only requires that the EDG 1B be tested at a maximum load of 2,547 kW for two hours every refueling. Our concern is that the EDG 1B may not have the ability to handle the load transients during SBO operation. Neither the testing of EDG 1B to 3,100 kW, nor the ability of EDG 1B to handle expected load transient during an SBO has been verified by the licensee. The licensee needs to provide verification based on manufacturer's test loading data that EDG 1B can carry the required SBO loads.

The licensee's EDG 1B loading calculation (17) identifies the loads that could be shed; these are the loads associated with the equipment that are not necessary to cope with an SBO. Our review of these loads

indicates that there are number of small loads, especially those on MCC-1A, that could also be shed. Investigation into this load reduction is appropriate since EDG 1B is expected to be operating very close to its load limit. The licensee stated that caution statement will be added to the appropriate procedures for the operators to use additional care when operating EDG 1B near its load limit.

During the meeting in August 1989, the review team questioned the use of a 40% load factor for the Unit 2 diesel generator battery chargers in Reference 20 (Sheet 5B). The licensee acknowledged the error (32), and corrected the calculation.

Our review identifies a need for a modification to ensure that EDG 1B does not shift to the non-blacked out unit during an SBO event. If the NBO unit receives a high drywell pressure signal, which is expected to occur since no drywell cooling will be used in the NBO unit, the control logic will assume a LOCA, and, per design, EDG 1B will shift away from the blacked out unit. The licensee stated (32) that the plant emergency operating procedures (EOPs) will include operator actions which are required to ensure that a safety injection signal on the NBO unit can be isolated. The licensee added that design modifications options to prevent this concern is under review. The licensee needs to provide information regarding this design modification to the staff for review.

3.3 Station Blackout Coping Capability

The plant coping capability with a station blackout for the required duration of four hours is assessed based on the following results:

1. Condensate Inventory for Decay Heat Removal

Licensee's Submittal

The licensee stated that adequate condensate inventory is available during the required 4-hour SBO coping duration for decay

heat removal, based on an Appendix R calculation (22). The licensee stated (33) that RCIC will start and inject water to the reactor pressure vessel (RPV) from condensate storage tank (CST) until such time as either the CST reaches its low level set point or the suppression pool (torus) reaches its high level set point. Upon reaching either of these limits, the RCIC suction will automatically shift to take water from the suppression pool. The CST on both Units is a 500,000 gallon tank with 100,000 gallons dedicated, by virtue of the pump suction locations, for use by the HPCI and RCIC systems; the suppression pool on each unit is required by technical specifications to have a minimum of 653,000 gallons of condensate. The licensee stated that the power supply and the instrumentation required to shift the RCIC suction from the CST to the suppression pool upon the receipt of either a high suppression pool level or a low CST level signal will be available during an SBO.

Review of Licensee's Submittal

The licensee did not perform condensate inventory calculations using the guidance of NUMARC 87-00 Section 7.2.1. The licensee stated that since the suppression pool water is being used to remove decay heat, the NUMARC calculations would not be appropriate. However, the licensee committed to provide condensate inventory calculations in the NUMARC 87-00 format during the meeting of August 29 and 30, 1989.

In response to the above commitment, the licensee stated that between 0 and 24,000 gallons of CST water, plus the quantity of water required to raise the RPV from Level 1 to Level 8, could be used prior to the RCIC pump suction automatically shifting to the suppression pool. Since there is no technical specification requirement to maintain CST level during reactor operation and the water level in the suppression pool can be expected to vary, it is not clear when the shift will occur.

We agree that the 653,000 gallons in the suppression pool provides adequate water volume to cope with a four hour SBO event. However, the licensee needs to ensure that the suppression pool temperature rise during an SBO event would not cause RCIC operability problems.

2. Class 1E Battery Capacity

Licensee's Submittal

The licensee stated that the class 1E batteries at Hatch are adequate to meet station blackout loads for two hours. This is based on the assumption that the loading of the batteries during an SBO event is encompassed by the LOCA scenario (18). The licensee stated that this is acceptable because the AAC power source will be available to power train "A" (Essential Division I) battery chargers within one hour after the onset of an SBO. However, the "B" train battery chargers will not be available, thus no credit is taken for HPCI (which is controlled by DC power from train "B"), during an SBO. The battery chargers for EDG batteries 1C and 2C are not available, but the licensee's analysis (16) stated that four hours of battery operation can be assured.

Review of Licensee's Submittal

The licensees provided recent station and EDG battery capacity calculations (16 and 18) that used the method of IEEE 485-1978 and were performed prior to the "Station Blackout Rule" (1). Except for the following two concerns, we agree with the licensee's assessment of the battery capacity for train "A":

1. The licensee takes credit for the ability to operate the DC powered suction valves in the RCIC system (e.g., MOV F010 for Unit 2), but apparently does not include the power

required to operate these valves in the battery 2A capacity calculations.

2. The battery calculations take into account four operations of the RCIC steam isolation valve. No basis for this assumption is provided. The licensee needs to address these concerns by verifying that the battery calculation is consistent with expected RCIC operations.

To conform with the guidance provided in "NUMARC 87-00 Supplemental Questions/Answers" (10), the licensee needs to ensure that the normal battery-backed plant monitoring and electrical system controls in the control room remain operational for the entire SBO duration. This is essential for successfully coping with and recovering from an SBO. The licensee stated (12) that only two hours of battery operation can currently be assured for station batteries 1B and 2B. The battery chargers for these batteries will not be available. However, the availability of the "A" batteries ensures that at least one division of instrumentation and controls will be available during an SBO event.

During the one hour that the plant would cope with an SBO without AC power, neither the vital instrumentation which can be powered by a static inverter, nor the essential instrumentation which is powered from the 1E electrical system, will be available. The licensee stated that the reactor parameters (pressure, temperature, and level) and containment parameters (suppression pool temperature and level, drywell pressure, temperature and level, etc.) will be monitored by control room instrumentation powered from the DC buses. This could not be verified from the plant FSAR, therefore, the correctness of the licensee's statement is subject to future verification.

3. Compressed Air

Licensee's Submittal

The licensee stated that no credit is taken for the use of the compressed air system during an SBO event. The safety-relief valves (SRVs) are equipped with accumulators capable of five operations of each valve and backed up by a safety-related nitrogen system.

Review of Licensee's Submittal

The plant instrument and service air compressors are not energized or required during an SBO. All air operated, safety related equipment will fail to the desired position upon loss of compressed air. The SRV pilot solenoid valves are powered during the SBO event and adequate motive force is available from the accumulators and nitrogen system. Hence, we agree with the licensee that air operated valves needed to cope with an SBO have adequate back-up sources.

4. Effects of Loss of Ventilation

Licensee's Submittal

The calculated post-SBO steady state ambient air temperature for the plant areas containing SBO equipment are as follows (12):

Area	Temperature (°F)	
	Final	Initial
Room 2C135A	115	104
Room 2C142	128	104
HNP-1 Xfmr CD Room	122	104

The post-SBO ambient air temperature for the following plant areas was taken from existing high energy line break (HELB) calculations (25 and 26):

HNP-1 Reactor Bldg El 130'	115	104
HNP-1 Torus Room	120	104
HNP-2 Reactor Bldg El 130'	107	104
HNP-2 Reactor Bldg El 158'	117	104
HNP-2 Torus Room	120	104

The post-SBO ambient air temperatures for the following areas was also taken from existing calculations (28 and 30):

RCIC Corner Rooms (1 & 2)	120	110
Cable Spreading Room	121	104

Reference 31 describes the above results in more detail. The licensee stated each EDG room will be ventilated when that EDG is running.

The licensee stated that any rooms that do not exceed 120°F are not considered as dominant areas of concern (DAC) and do not require any assessment of equipment operability. The licensee initially qualitatively used (12) the NUMARC 87-00 assumptions that the control room is a condition 1 room and that its temperature would not exceed 120°F. In its supplemental submittal (33), the licensee stated that it has completed a detailed control room heat-up calculations and concluded that the final room temperature would not exceed 120°F and, therefore, it is not considered as a DAC. The licensee stated that sufficient portions of the control room drop ceiling tiles will be replaced with the egg-crate type tiles to enhance natural convection (i.e. increase heat sink by using the control room ceiling surface area).

In its supplemental submittal (33), the licensee identified that the station service battery chargers for both blacked out and the non-blacked out units could be affected by the elevated control building temperatures. In its calculation of the control building temperature rise, the licensee credited the area above the ceiling tiles by assuming that sufficient drop ceiling tiles have been replaced with egg-crate type tiles. The licensee calculated a final room temperature of 133°F for this area. The licensee stated that several options to resolve the battery chargers operability at this temperature are being studied.

The licensee evaluated all equipment for operability in the areas of concern and identified an area (Room 2C135A) in which doors should be opened to assure equipment operability. The licensee stated that equipment qualified to operate in a harsh environment (per 10 CFR 50.49) will operate in any environment existing during a 4-hour SBO. The licensee stated that vendor qualification temperatures were reviewed when provided and appendix F of NUMARC 87-00 was used for the included equipment. Equipment not covered by the above were addressed individually by the licensee.

Molded case circuit breakers are rated, per NEMA standard AB-1, from -5°C (-41°F) to 40°C (104°F). Since SBO temperatures approach 50°C (122°F), the trip de-rating was addressed and the licensee reviewed SBO loads to assure the operability of these breakers.

Per ANSI C57.92-1981, station service transformers should not be loaded to more than 80% at 50°C (122°F) if transformer life is not to be sacrificed. Temperatures greater than 50°C (122°F) were not addressed. During an SBO the transformers will be loaded to approximately 70% at 54°C (129.2°F). The licensee stated that, based on engineering judgment, the loss of life will be minimal and operation during an SBO can be assured.

Per ANSI C57.96-1959, dry-type transformers should not be loaded to more than 88% at 50°C (122°F) if transformer life is not to be sacrificed. Temperatures greater than 50°C (122°F) were not addressed. During an SBO the transformers will be loaded to less than 88%. The licensee stated that, based on engineering judgment, the operation of these transformers is acceptable.

Main Control Room (MCR) circuit cards were analyzed for set point drift to 130°F ambient temperature, which is above the 50°C (122°F) expected in the MCR. The licensee stated that set point stability will not be affected.

The licensee stated (32 and 33) that the drywell temperature would not exceed its design limit for the SBO condition based on analyses of HELB events. The licensee stated that, as a part of the Hatch Equipment Qualification Program, General Electric completed a parametric study to determine the most limiting condition to maximize the drywell temperature. This analysis is included in NSEO-52-0583 dated June 1983. The peak drywell temperature is calculated to be 329°F and the licensee stated that all equipment in the drywell which are used as part of the SBO scenario is qualified for this temperature. The licensee added that no drywell cooler operation was considered in analysis. The licensee concluded that this analysis bounds the conditions that could be expected during an SBO event.

The licensee stated (33) that although the heat-up calculations did not take credit for opening cabinet doors, the cabinet doors in the main control room, control building or reactor building will be opened as required.

Review of Licensee's Submittal

The licensee used the methodology of NUMARC 87-00 (specifically equations E-26 and E-27) to calculate the final temperature of room 2C135A (switchgear hallway room), room 2C142 and the HNP-1 transformer CD room. We agree with the analysis of room 2C142 and the transformer CD room. NUMARC 87-00 states, on page E-12, that this method is valid for rooms with heat loads between 24 kW and 100 kW. Room 2C135A has a heat load of 1.7 kW. Therefore, the calculations performed for this very small room are apparently not valid. However, based on discussions with the NRC staff, the licensee performed a transient heat-up calculation (33) using a computer program, PCFLUD, and stated that the results obtained using NUMARC approach to be conservative. The licensee stated that it has evaluated the transformers and panel boards in this area, and concluded that all equipment will be operable at temperatures greater than the expected temperature of 115°F. We are unable to confirm the licensee's statement, since no analysis was provided to review.

The licensee used HELB analyses of the reactor buildings and torus rooms. The licensee stated that it has verified that the HELB analyses assumptions were consistent with those required for an SBO analysis. The licensee did not provide these analyses to the staff to review.

The licensee initially assumed that the main control room would not exceed 120°F in the one hour without ventilation. Subsequently, the licensee stated (33) that a detailed heat-up calculations for the main control room, (which is shared between two units), has shown that the final temperature to be less than 120°F. The licensee stated that a non-NUMARC method was used for the control room heat-up calculations. This analysis was not provided to be reviewed.

The licensee stated (33) that station service battery chargers could be affected by high control building temperatures. The licensee needs to provide an analysis of equipment operability in this area, and state what actions are required to ensure that the battery chargers remain operational. The licensee's submittal does not clearly state what "options" are under consideration.

In response to an NRC concern during the meeting in August 1989, the licensee verified (32) that power will be available to the station service battery fans once the AAC power source is connected to the 600 V buses. This resolves the concern about hydrogen build-up in the battery rooms.

The licensee stated that the drywell temperatures are bounded by those experienced in HELB scenarios. The HELB entails a rapid energy release to containment, while the SBO scenario releases a significant amount of energy at a slower rate through heat transfer from hot reactor components, SRV/ADS actuations and reactor coolant leakage. The licensee stated drywell/containment cooling will not be available during the entire four hour coping period. The duration of the loss of ventilation/cooling during HELB needs to be verified. Additionally, even though SBO peak ambient temperatures may be lower than HELB peak ambient temperatures, the equipment may be exposed to these elevated temperatures longer in an SBO than in a HELB situation. The licensee needs to explicitly compare the assumptions that went into the referenced HELB analysis in analyzing drywell and containment temperatures to the conditions expected in an SBO scenario.

The licensee's analysis of the RCIC room heat-up was performed using the HEATING6 computer code. We reviewed input and assumptions for mathematical and material property errors. The licensee used a radiative heat transfer term for heat transfer from steam in the room to the walls. It is not clear where the

steam is coming from, or how much this term (radiation) will effect the final results. We performed an independent verification of the RCIC room steady-state final ambient temperature using the licensee's generated heat loads and the NUMARC method, and determined the final steady-state ambient temperature to be 133°F. We do not expect that the RCIC room will reach this steady-state temperature during the one hour without room cooling during an SBO. Since the licensee stated that RCIC room cooling will be provided when the AAC source is available, one hour after the onset of an SBO, we agree with the licensee's conclusion that room temperature will not adversely affect the performance of the RCIC system.

The licensee has committed (33) to open cabinet doors as required to ensure equipment operability. The licensee needs to establish procedural controls to ensure that the appropriate cabinet doors are opened within 30 minutes of the onset of an SBO in accordance NUMARC 87-00 Supplemental Questions/Answers.

Finally, since the licensee did not provide information regarding the revised heat-up calculations for the main control room, control building, switchgear hallway room, drywell and suppression pool to be reviewed, it would be best if these are investigated by an onsite inspection.

5. **Containment Isolation**

Licensee's Submittal

The licensee has reviewed the plant list of containment isolation valves to verify that valves which should be capable of being closed or be operated (cycled) under station blackout conditions can be positioned (with indication) with handwheel, AAC or DC power. The licensee has stated that all valves that are normally open can be closed manually, all valves that are normally closed

can be verified closed and that valve position indication is available.

Review of Licensee's Submittal

The licensee has provided this analysis (32 and 33) to the staff for review. The licensee identified all penetrations of concern, and determined that at least one valve on each penetration could be closed using a handwheel, AAC power or DC power. The licensee also stated that position indication (local, mechanical, AAC-powered or DC-powered) was available for these valve. Our review of the FSAR indicates that the licensee has correctly identified the containment isolation valves. However, since AAC power is not available for the first hour after the onset of an SBO, the licensee needs to determine which valves and position indicators require AAC power and include these valves in the appropriate procedures to ensure that they are closed during an SBO event.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated that if the condensate storage tank level should empty to the low level set point or the suppression pool level should rise to the high level set point, water from the suppression pool will be injected into the reactor to prevent core uncovery. Any inventory lost from the reactor will be available in the suppression pool.

The licensee stated (22) that RCIC can be used up to four hours before the RPV needs to be depressurized to accommodate the low pressure injection systems. The licensee stated that suppression pool cooling is not required until four hours after the initiation of the SBO event. The need for suppression pool cooling is based on the licensee-stated requirement to maintain suppression pool

bulk temperature below 200°F. The licensee also stated that within one hour after an SBO event suppression pool cooling will be available, if needed, to preclude a temperature increase above the suppression pool heat capacity temperature limit (HCTL).

The licensee explained the SBO coping approach in its submittals (12, 32 and 33). Additionally, the licensee supplied excerpts from References 21 through 24.

Review of Licensee's Submittal

The licensee stated that it expects SRVs to lift at first and then be cycled by operators to control pressure in the vessel. RCIC will be operating throughout the event. Reference 21 calculates that, during the one hour of SBO without AC power, the suppression pool will heat up to 153°F. This calculation assumes an initial suppression pool temperature of 95°F, which is based on an old Technical Specification. The current maximum allowed suppression pool temperature is 100°F. Using the correct initial suppression pool temperature (100°F), we agree that the suppression pool will not approach the HCTL given in Reference 22 during the first hour following the onset of SBO. However, the suppression pool temperature will exceed the HCTL given in Reference 24 during the first hour. The licensee needs to identify, and follow the correct HCTL curve. It is necessary for the licensee to determine which HCTL is correct, since the reactor must be depressurized prior to exceeding the HCTL.

Reference 22 analyzes suppression pool conditions (without cooling) beyond the one hour time frame. The analysis shows that the operator should begin the depressurization of the reactor about 2.5 hours into the SBO to remain below the HCTL. This analysis assumes an initial suppression pool temperature of 95°F and calculates a final temperature of 211°F. Additionally, Reference 22 apparently assumes that RCIC uses CST water, which is

much cooler than suppression pool water. One of the acceptance criteria listed in Reference 22 is to maintain the suppression pool below 200°F to ensure adequate NPSH for the low pressure pumps. Since the revised plant Technical Specifications allows the suppression pool to reach 100°F during normal plant operation and Reference 22 does not assume the injection of suppression pool water, contrary to the licensee's coping approach, this analysis cannot be considered to be conservative. Therefore, it appears that the licensee's statement that the suppression pool cooling is not required for four hours following an SBO may be incorrect.

The licensee takes credit for meeting the requirement to consider 18 gpm of recirculation pump seal leakage based on Reference 23, which is a RCIC performance analysis evaluated as part of the Appendix R requirements. This reference shows that the RCIC system is capable of providing sufficient make-up inventory to prevent reactor water level from dropping below Level 1 with the RCIC pump performance degraded by 40 gpm. The licensee stated that it realizes that the 40 gpm is less than the 61 gpm of leakage (two pumps @ 18 gpm and 25 gpm leakage per Technical Specification 3.4.3.2), but it believes that reactor water level will be adequate. The licensee stated that during the first two hours following the onset of SBO, HPCI is available and could be used for a brief period to prevent uncovering the core. The licensee did not address the potential for the failure of the HPCI system due to the unavailability of HPCI room cooling during the SBO event. Although HPCI may work for a brief period, it can not be credited because no evaluation of the HPCI room temperature and equipment operability were performed. The RCIC flow will initially be less than reactor inventory losses (leakage and loss through the SRVs), but will exceed these losses during the first hour after the onset on an SBO event, therefore, the RPV inventory will be maintained for the rest of the SBO duration. With proper procedural guidance, we agree that the licensees's approach to

maintaining adequate water inventory in the reactor would meet the SBO guidance.

The licensee stated that the only guidance necessary for the operator is the existing guidance which requires the operators to maintain the suppression pool temperature below the HCTL. In one place (32), the licensee stated that the operators will perform a controlled depressurization about 2.5 hours into the SBO event, as described in Reference 22. Reference 22 describes an event with no suppression pool cooling. In other places (12 and 32), the licensee stated that suppression pool cooling is available within one hour. The licensee needs to determine whether or not depressurization is required when suppression pool cooling is provided one hour after the onset of an SBO. Plant operators are operating with the AAC power source at near full capacity and plant parameters very near the HCTL. The operator needs specific procedural guidance on either managing reactor heat load and electrical power to avoid depressurization, or preparing for depressurization. The licensee needs to provide a clear description of procedural guidance that is consistent with the assumptions in the supporting analysis and the approach (e.g., depressurize or not) used in the calculations for the reactor depressurization scenario(s).

Additionally, using a single or several selected SRVs could result in extremely high local pool temperatures. The licensee did not consider this phenomena. High local pool temperatures reduce the steam condensing capability of the torus and can affect the operation of RCIC during SBO, or RHR during recovery from the SBO.

NOTE:

The 18 gpm reactor recirculation pump 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 higher RCP seal leak rates than

assumed for the RCS inventory evaluation, the licensee needs to be aware of the potential impact of this resolution on its analyses and actions addressing conformance to the SBO rule.

3.4 Proposed Procedure and Training

Licensee's Submittal

The licensee has stated that the following plant procedures are being reviewed and, if necessary, revised to conform to the guidelines in NUMARC 87-00:

a. Restoration of Offsite AC Power for the Shutdown of Plant Hatch

b. Preparation for Severe Weather Conditions at Plant Hatch

The following procedures will be developed/revised to meet the SBO requirements:

a. Station Blackout Coping Procedure

b. EDG 1B One Hour Manual Action Load Walkthrough Verification Assessment Test

During the meeting in August 1989, the licensee has committed to write a new SBO Emergency Plant Guideline (EPG) or revise the existing procedures to add SBO. The licensee has existing plant policies and guidelines for training upon issuance of new and revised procedures. The licensee stated that these policies will ensure that operators are adequately prepared to cope with an SBO.

Review of Licensee's Submittal

We neither received nor reviewed the above procedures. The licensee stated that procedures will be issued and operators trained in accordance with existing plant policies. We believe that it is the licensee's responsibility to review and implement these procedures, as needed, to mitigate an SBO event and to assure that these procedures are complete and correct in their contents, and that the associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee stated that the 600 V electrical system has been modified to permanently install a disconnect link needed to provide power to division I of the affected plant. This modification significantly reduces the time required for the plant to achieve a stable AAC configuration.

The licensee has committed to replace sufficient portions of the acoustical ceiling tiles in the control room and portions of the control building with the egg-crate type tiles to allow free air flow between the areas above and below the ceiling tiles and to increase heat sink surface area by considering transfer to the ceiling.

Review of Licensee's Submittal

Our review of the licensee's submittals indicates that modifications may also be necessary to ensure that EDG 1B does not shift to the non-blacked out unit during an SBO event. If the non-blacked out unit receives a high drywell pressure signal, which is expected to occur since no drywell cooling will be used in the NBO unit, the control logic will assume a LOCA, and, per design, EDG 1B will shift away from the blacked out unit. The licensee stated that design modification options to prevent this occurrence are under review. The licensee needs to

provide the list of options that are being considered for the staff's review.

With regard to the acoustical ceiling tiles replacement, the licensee needs to provide an analysis to show the adequacy of the number of tile replacements for enhancing air circulation between the areas above and below the acoustical ceiling tiles.

3.6 Quality Assurance and Technical Specifications

Quality Assurance

The licensee generated a comprehensive list of equipment that will be relied upon during an SBO. The licensee stated that all this equipment is safety grade and covered in existing Technical Specifications and/or Quality Assurance (QA) programs with the following exceptions:

C71-P001
2C71-P001
C71-S001A & B
2C71-S001A & B

This equipment is associated with the RPS distribution system. The licensee stated that this equipment is highly reliable and does not intend them in a QA program.

We have determined that the S001 components (from the above list) are the two RPS MG sets per unit, and the P001 components are the associated RPS power distribution panels. The importance of these panels in coping with an SBO cannot be determined from available information. If instrumentation required for coping during the one hour prior to the availability of AAC is powered from these panels, this exemption from QA requirements may not be appropriate. The licensee needs to provide additional information before the compliance with the guidance of R.G. 1.155 can be evaluated. The licensee needs to review the list of loads

powered from these circuits to determine the importance of these circuits for coping with an SBO. From this information, and any other information demonstrating high reliability and/or quality of the above components, a decision can be made concerning the QA requirements.

Technical Specifications

The licensee did not address technical specifications in its submittals. The plant Technical Specifications currently allows the plant to operate for 14 days with the RCIC system inoperable as long as the HPCI system is operable. Since the HPCI system will not be available to provide injection throughout the SBO event, the allowed outage time for the RCIC system needs to be analyzed. The basis of the rather long allowed outage time for RCIC is that RCIC is of secondary importance in design basis accidents such as LOCAs. However, since RCIC is of predominant importance in an SBO event, we believe that this allowed outage time needs to be evaluated and shortened in accordance with RG 1.155, Appendix B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittal and the related supporting documents and discussions with the licensee we find that the submittal conforms with the requirements of the SBO rule and the guidance of RG 1.155 with the following exceptions:

1. **Alternate AC Power Source**

a. Capacity

Appendix B of NUMARC 87-00 states that the AAC power source (EDG 1B) should have adequate capacity to operate the systems necessary for coping with an SBO. The licensee stated that EDG 1B would be loaded to 3,245 kW during an SBO event, which exceeds the assumed 2,000 hour rating for EDG 1B of 3,100 kW. The plant Technical Specifications, Section 3/4.8.1.1.2.d.9, only requires that the EDG 1B be tested at a maximum load of 2,547 kW for two hours every refueling. Our concern is that the EDG 1B may not have the ability to handle the load transients during SBO operation. Neither the testing of EDG 1B to 3,100 kW, nor the ability of EDG 1B to handle expected load transient during an SBO has been verified by the licensee. The licensee needs to provide verification based on manufacturer's test loading data that EDG 1B can carry the required SBO loads.

b. Procedures

The licensee needs to write and verify the procedures necessary to power the blacked out unit within one hour of the onset of an SBO from the AAC power source.

2. Class 1E Battery Capacity

The licensee's analysis stated that the train "A" batteries have adequate capacity to meet the SBO loads for two hours without being charged. These batteries will be charged upon the availability of AAC power, one hour after the onset of SBO. However, the licensee apparently did not correctly consider RCIC operations in the battery capacity calculation (18). It is necessary to verify that the train "A" batteries have adequate capacity to last greater than one hour with RCIC operating. Train "B" batteries are not charged, and may not be able to last the entire coping duration.

3. Effects of Loss of Ventilation

a. Control Room Ambient Air Temperature

The licensee initially qualitatively stated that the control room temperature would not exceed 120°F. Subsequently, it performed a detailed heat-up calculations and stated that the final temperature remains below 120°F. The licensee did not provide information regarding the major assumptions and the results of the final temperature, and whether this calculation is based on one hour or four hour duration. The analysis inherently assumes that sufficient portions of the control room ceiling tiles have been replaced with egg-crate type tiles. The licensee needs to provide analyses of heat-up calculations and the adequacy of number of tile replacements. Additionally, it is necessary to proceduralize the opening of doors and cabinets containing energized equipment within 30 minutes of the onset of SBO in accordance with the guidance of NUMARC 87-00, Section F.5.2.

b. Containment/Drywell Temperature

The licensee stated that the containment/drywell ambient temperature, and therefore the equipment operability in these spaces, is bounded by existing high energy line break (HELB) analyses. It is not clear from available documentation that the assumptions related to:

- o time without cooling and fans,
- o time of equipment exposure to high temperatures and
- o the actual ambient temperatures

are actually bounded by HELB scenarios. The licensee needs to verify that these and all other relevant assumptions and approaches used in the HELB scenarios can be applied to evaluate the SBO scenarios.

c. Battery Charger Area Temperature

The licensee stated that the station service battery chargers for both blacked out and the non-blacked out units could be affected by the elevated control building temperatures. In its calculation of the control building temperature rise, the licensee credited the area above the ceiling tiles by assuming that sufficient drop ceiling tiles have been replaced with egg-crate type tiles, and calculated a final room temperature of 133°F for this area. The licensee stated that several options to resolve the battery chargers operability at this temperature are being studied. The licensee needs to provide an assessment of the equipment operability for this area and identify the required actions to prevent equipment failure during an SBO.

4. Containment Isolation

Some containment isolation valves cannot be shut or verified shut until the AAC power source is available one hour after the onset of SBO. The licensee needs to provide procedural guidance identifying these valves.

5. Suppression Pool Conditions

During an SBO, it appears that it is possible to exceed the heat capacity temperature limit (HCTL) of the suppression pool or to enter into a condition that would require plant depressurization. Analysis and procedures should take this into account. We found inconsistencies between the various backup analyses that could result in giving incorrect guidance to the operators. Referenced analyses have operators following different paths under different circumstances than those of an SBO event. The licensee needs to provided specific guidance to the operator and analyze the expected plant conditions in sufficient detail to ensure that no operating limits (e.g., reactor water level, suppression pool temperature) are exceeded.

In order to describe the coping approach, it is necessary to either:

a. Clearly show that the plant can be operated such that depressurization is not needed and provide the operator guidance to this end, or

b. Describe how the operator will control and recover the plant during and after the depressurization in SBO conditions.

Additionally, once the coping approach is defined, it is necessary to:

a. Analytically determine peak suppression pool temperatures during any periods without suppression pool cooling,

b. Analytically and/or procedurally take localized suppression pool temperatures into account,

c. Identify the proper HCTL curve.

6. Proposed Modifications

Our review of the licensee's submittals indicates that modifications may also be necessary to ensure that EDG 1B does not shift to the non-blacked out unit during an SBO event. The licensee stated that design modification options to prevent this occurrence are under review. The licensee needs to provide the list of options that are being considered for the staff's review.

7. Quality Assurance

The licensee has requested that RPS MG sets and panels not be included in a QA program even though they are used in coping with an SBO. We do not have adequate information to make a decision on this issue. Neither the licensee's submittal nor the plant FSARs are clear on exactly what equipment is powered from these circuits. It is necessary to determine what equipment is powered from these circuits, and identify alternative equipment, powered from sources included in QA programs, that provide the necessary functions during an SBO.

8. Technical Specifications

Since the HPCI system will not be available to provide injection throughout the SBO event, the 14 day allowed outage time for the RCIC system significantly degrades the ability of the plant to cope with an SBO. Since RCIC is of predominant importance in an

SΠO event, this allowed outage time needs to be evaluated and shortened in accordance with RG 1.155, Appendix B.

5.0 REFERENCES

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3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Offsite Power at Nuclear Power Plants," NUREG/CR-3992, February 1985.

4. U.S. Nuclear Regulatory Commission, "Reliability of Emergency AC Power System at Nuclear Power Plants," NUREG/CR-2989, July 1983.

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28. HNP-2 Mech Calc # 524, Rev. 0, Vol 3, Bind 42, "RCIC Room Heatup with Loss of Active Room Cooling."

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