ENCLOSURE 1

ARKANSAS NUCLEAR ONE, UNIT 1 (ANO-1)
STATION BLACKOUT SAFETY EVALUATION REPORT

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.

*Nuclear Management and Resources Council, Inc.

For ANO-1, the licensee has proposed using existing emergency diesel generators (EDGs) as an AAC power source and has submitted its response in the applicable generic response format. The licensee's original response was provided by letters from T. G. Campbell (Arkansas Power & Light Co.) to U. S. Nuclear Regulatory Commission (NRC) dated April 13, 1989. In addition, the licensee provided responses to the NUMARC 87-00 Supplemental Questions/Answers by letters from N. S. Cains and J. J. Fisicaro to NRC dated April 3, and July 17, 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-90/1074, Arkansas Nuclear One, Unit 1 Station Blackout Evaluation," dated September 17, 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 of "P1", an Emergency AC configuration group "C", and an EDG reliability target of .95. The target EDG reliability was based on ANO Unit 1 EDGs having an average reliability greater than 0.95, 0.94 and 0.90 over the last 100, 50 and 20 demands respectively. The P1 grouping is based on an independence of offsite power classification of Group "I 1/2", a severe weather (SW) classification of Group "2" and an extremely severe weather (ESW) classification of Group "1".

After reviewing the available information in the licensee's 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 existing EDGs 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 emergency diesel generators (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 statement requires minimum redundancy. This means that in order to qualify as an AAC source, there must be an EDG available in the non-blackout (NBO) unit that is in addition to the number of EDGs required to meet the minimum EDG redundancy requirement for powering a normal safe shutdown for a loss of offsite power (LOOP) event. Thus, the EDG's in a two unit site with two dedicated EDG's per unit would not qualify as AAC sources because the two EDGs per unit just meet the minimum redundancy requirement, i.e., there is no excess EDG.

However, there are some plants at two unit sites which just meet minimum redundancy but where each EDG is of sufficient capacity to fully power all the normal LOOP loads of the NBO unit, and also has sufficient excess capacity for powering the required safe shutdown loads of the SBO unit. In recognition of the existence of this type of situation, the staff has interpreted the excess EDG redundancy requirement of the SBO rule to allow EDGs just meeting the minimum EDG redundancy requirements, to qualify as AAC sources on the basis of excess capacity, provided the other applicable requirements for AAC sources are also met.

The NRC's basic position on the use of EDGs as AAC power sources on the basis of excess capacity is that such excess capacity should not be attained by load shedding in the NBO unit which results in a degradation of its normally available safe shutdown capability for the loss-of-offsite-power (LOOP) condition. Any actions that would add to the burden of operators that are already in a high stress environment, such as load switching or disablement of information read-outs or alarms in the control room, are considered to be a degradation of normal safe shutdown capability for LOOP in the NBO unit. The staff position is therefore that the normal equipment compliment should remain available with adequate EDG capacity for use should it become necessary. The NBO unit should have the capability for hot shutdown/hot standby forced cooling, cooldown and depressurization as required. While additional events are not explicitly being postulated, it is not prudent to diminish the capability of the NBO unit to mitigate problems should they arise. It is not in the interest of safety to

reduce the capability to handle various eventualities in one unit for the purpose of meeting the SBO rule in another unit. Each unit must meet the SBO rule on its own merits without reducing another unit's capability to respond to its own potential problems.

Therefore, a multi-unit site with the dedicated EDGs just meeting the minimum redundancy requirement but not having the excess capacity defined above for qualifying as an AAC source does not meet the SBO rule AAC source option requirements. Further measures are required such as a separate AAC source or a coping analysis which shows the plant can cope with and recover from an SBO for the required duration independent of AC power.

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 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 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 ANO Station is a two unit site with two dedicated EDGs per unit. The proposed AAC power source for the blacked out unit is a cross-tied EDG from the NBO unit.

The licensee's submittal states that the EDG/AAC source is available within 1 hour of the onset of the SBO event, and has sufficient capability to provide power for safe shutdown of both units for a 4-hour SBO duration. The licensee's submittal stated that load shedding is required in the NBO unit in order to achieve this EDG capability and has, therefore, proposed a load management scheme to power the needed equipment for safe shutdown operation of the blacked-out unit and NBO unit. No details of the load shedding scheme were provided. The staff has reviewed the licensee's response (see Attachment 1 for details) and has concluded that the load shedding scheme will result in the degradation of safe shutdown capability of the NBO unit and the excess capacity made available by load shedding cannot be credited as an AAC source for the blacked out unit. Therefore, the licensee's proposed actions do not conform to the guidance on the use of existing EDGs on the basis of excess capacity as an AAC power sources as documented in the 10 CFR §50.63, RG 1.155 Position C.3.3.5, NUMARC 87-00 section 2.3.1(3), and NUMARC 87-00 Supplemental Questions and Answers dated December 27, 1989.

After reviewing the SAIC TER and the licensee's proposed actions for crediting existing NBO unit EDGs as an AAC source, the staff has determined that the proposed AAC source for ANO-1 does not meet the requirements of 10 CFR §50.63.

Recommendation: The licensee should undertake further measures such as providing a separate AAC power source or a coping analysis which shows that the plant can cope with and recover from an SBO for the required duration independent of AC power.

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's submittals states that 56,804 gallons of condensate are required to remove decay heat from the reactor at ANO Unit 1 during a 4 hour SBO event. The minimum condensate storage tank (CST) capacity corresponding to minimum level per Technical Specifications for the unit is 107,000 gallons.

After reviewing the licensee's submittal and the SAIC TER, the staff agrees with the licensee's assessment that the plant has adequate condensate inventory for a 4 hour SBO duration. In addition, the excess inventory available in the CST is available for SBO recovery. However, there is no assurance that the condensate inventory can be used for the full 4 hour duration because the decay heat removal system would not continue to operate if the Class 1E batteries are depleted (See Section 2.3.2) after one hour since the charging source for the battery (the AAC power source) does not meet the requirements of 10 CFR §50.63.

2.3.2 Class 1E Battery Capacity

The licensee stated that a battery capacity calculation was performed to verify that the Class 1E batteries have sufficient capacity to meet the SBO loads for one hour. It is assumed that the AAC power source energizes a battery charger associated with one division within one hour.

Based upon the staff review, the licensee's proposed AAC power source does not meet the requirements of 10 CFR §50.63 and, therefore, cannot be assumed to power a battery charger within one hour. In accordance with NUMARC 87-00 Supplemental Questions/Answers, the licensee should ensure that the normal

battery backed plant monitoring and electrical system controls remain operational for successfully coping with and recovering from a SBO event. The licensee has not demonstrated that the Arkansas Unit 1 batteries have sufficient capacity to last for the full 4 hour SBO duration without charging. Also, the licensee has not provided an acceptable AAC source that meets the requirement of 10 CFR 50.63 for charging the batteries.

Recommendation: The licensee should provide for ANO-1 an acceptable AAC power source to power battery charging for at least one division or provide a battery that has sufficient capacity to power all normal battery-backed monitoring and electrical systems and controls for the required 4-hour SBO duration and recovery therefrom.

2.3.3 Compressed Air

The licensee stated that no air operated valves are relied upon to cope with an SBO for one hour. The turbine driven auxiliary feedwater (AFW) pump, and atmospheric dump valves (ADVs) are relied upon for decay heat removal during an SBO. ADVs are air operated, ADV block valves are motor operated, and the AFW flow control valves are dc motor operated valves. There is no mention of the ADVs or ADV block valves being equipped with handwheels that can be used to control the decay heat release rate manually upon loss of power.

After reviewing the licensee's proposal and the SAIC TER, the staff agrees with SAIC assessment that the licensee does not have an AAC source for ANO-1 that meets the requirements of the SBO rule (see Section 2.2.2 above) which powers the equipment for air make up capability to operate the ADV valves needed for decay heat removal.

Recommendation: The licensee should provide an acceptable AAC for ANO-1 source that meets the SBO rule and provides means for powering the equipment for air make up to operate the ADV valves or provide alternate means for achieving decay heat removal during an SBO event. Whatever method is chosen,

the licensee should simulate the proposed procedure and provide the appropriate operator training to ensure the decay heat removal can be adequately maintained.

2.3.4 Effects of Loss of Ventilation

The licensee has stated in his submittals dated April 13, 1989, and April 3, 1990, that reasonable assurance of the operability of SBO response equipment in dominant areas of concerns (DAC) including the control room, was assessed using Appendix F to NUMARC 87-00 and/or the Topical Report without taking credit for HVAC. However, the licensee, in his submittal dated July 7, 1990, has indicated that he has made the decision that the control room HVAC will be powered during an SBO event. The licensee stated that supplying ventilation in one control room results in sufficient cooling in the other control room via opening between the two control rooms. Based on the licensee's statement, since Unit 2 control room HVAC system is powered from its EDGs, the staff concludes that the Unit 1 control room will be cooled by either of the Unit 2 control room ventilation systems.

2.3.5 Containment Isolation

The licensee stated that the containment isolation valves (CIVs) which must be capable of being closed or operated under SBO conditions can be positioned (with indication) independent of the preferred and blacked out unit's Class 1E power supplies. After reviewing the SAIC TER, the staff agrees with the SAIC assessment that appropriate containment integrity is obtainable without any operator action.

2.3.6 Reactor Coolant Inventory

The licensee has stated that the ability to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is covered has been assessed for one hour, and after one hour, the proposed AAC source powers the RCS make-up systems. However the proposed AAC source does not qualify as an AAC source

based on excess capacity and, therefore, the assumption that AAC power source will power the necessary make-up systems to maintain adequate RCS inventory is invalid.

Recommendation: The licensee should provide for ANO-1 an acceptable AAC power source of sufficient capacity and capability to provide power to the make-up systems and its supporting systems to maintain adequate RCS inventory or provide an assessment that there will be adequate RCS inventory to ensure continued core cooling for the required SBO duration and recovery therefrom.

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 be implemented by the end of refueling outage number 10 (October 23, 1991).

Although the licensee has completed appropriate procedures, additional procedures may be required depending upon the licensee's proposed resolution of the AAC power source (see section 2.2.2) issue.

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 as part of the revised response to ensure an appropriate response to an SBO event. Although personnel training requirements for an SBO response were not specifically addressed by the licensee's submittal, the staff expects the licensee to implement the appropriate training to ensure an effective response to the SBO.

2.5 Proposed Modifications:

The licensee stated that modifications will be necessary to cross-tie the ANO Unit 1 and 2 safety buses in order to provide the AAC power source to the blacked-out unit. The EOP procedure would require modification to align the

breakers, load shedding and coordination of activities between each unit's operators. The AAC cross-tie modifications are planned to be completed by the end of refueling outage No. 10 depending on NRC response.

Recommendation: The licensee's proposed AAC for ANO-1 does not conform to the SBO rule requirements, and therefore the licensee should consider the addition of an independent AAC source. The licensee should provide a full description including the nature and objectives of the required modifications to meet the SBO rule and a proposed schedule for implementation.

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

The licensee did not provide any information regarding QA programs and TS for SBO equipment to the guidance of RG 1.155, Appendices A & B.

Furthermore, technical specifications for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains an open item at this time. However, the staff 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. Further, this evaluation should be documented as part of the package supporting the SBO rule response.

2.7 EDG Reliability Program

The licensee's submittals did not specifically address the EDG reliability program consistent with the guidance of RG 1.155, Section 1.2. It is the staff's position that an EDG reliability program should be developed in accordance with the guidance of RG 1.155, Section 1.2.

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, then it 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 did not perform a detailed review of the proposed procedure modifications which are scheduled for later implementation after the modifications that could result from the staff recommendations in this SER. Therefore, based on our review of the licensee SBO submittal and FSAR, we have identified the following areas for focus in any follow-up 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 SER.

3.0 SUMMARY AND CONCLUSIONS:

The staff has reviewed the licensee's response to the station blackout rule (10 CFR 50.63) and the Technical Evaluation Report prepared by the staff's consultant, Science Applications International Corporation. Based on our review, we find that ANO-1 does not conform with the SBO rule and the guidance of RG 1.155, and, therefore, recommend that the licensee reevaluate the areas of concern that have been identified in this SER. 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 SER should be addressed by the licensee, and a revised response submitted to the NRC within 60 days. The staff has not approved the use of existing EDGs as an AAC source on the basis of excess capacity made available by load shedding. The licensee is, therefore, expected to ensure that the baseline assumptions of NUMARC 87-00 are applicable to the ANO plant. Also, the licensee is expected to document all analyses and related information, and to maintain these available for NRC review.

SAIC-90/1074

TECHNICAL EVALUATION REPORT
ARKANSAS NUCLEAR ONE, UNIT 1
STATION BLACKOUT EVALUATION

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An Employee-Owned Company

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ARKANSAS NUCLEAR ONE, UNIT 1
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 nuclear power plants are capable of withstanding a station 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 on-site emergency AC power sources, the reliability of on-site emergency power sources, the frequency of loss of off-site power (LOOP), and the probable time to restore off-site 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 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 licensees' 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) off-site 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 RG 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.

This SBO evaluation is based on a review of the licensee's submittals dated April 13, 1989 (12), April 3, 1990 (14), and July 17, 1990 (13), a telephone conversation between the NRC/SAIC and the licensee on August 10, 1990, and the available information in the plant Updated Final Safety Analysis Report (UFSAR) (15). The evaluation does not include a concurrent site audit

review of the supporting documentation. Such an audit may be warranted as an additional confirmatory action. This determination would be made and the audit would be scheduled and performed by the NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Entergy Operations, Inc. (formally Arkansas Power and Light Company), calculated (12-14) a minimum acceptable station blackout duration of four-hours for the Arkansas Nuclear One (ANO), Unit 1. The licensee stated that no modifications are necessary to attain this proposed coping duration.

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

1. **Off-site Power Design Characteristics**

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

   a. Estimated frequency of LOOPs due to extremely severe weather (ESW) which places the plant in ESW Group "1,"

   b. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW Group "2," and

   c. Independence of the plant off-site power system characteristic of "I1/2," and

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

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

   The EAC power configuration group at Arkansas Nuclear One is "C." Each unit is equipped with two emergency diesel generators. One

emergency diesel generator per unit is necessary to operate safe shutdown equipment following a LOOP.

3. **Target Emergency Diesel Generator Reliability**

The licensee selected a target EDG reliability of 0.95 based on having a unit average EDG reliability for the last 100, 50, and 20 demands of greater than 0.95, 0.94, and 0.90 respectively, consistent with NUMARC 87-00.

The licensee submittals do not address a diesel generator reliability program incorporating the five elements discussed in RG 1.155. However, the licensee does recognize that the target reliability is to be maintained (14). The methodology of maintaining the target is tied to the resolution of Generic Safety Issue B-56.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of the offsite power system grouping, the estimated frequency of LOOPs due to ESW and SW conditions, the expected frequency of grid-related LOOPs, the classification of EAC, and the selection of EDG target reliability. The licensee's estimation of the frequency of LOOPs due to ESW condition conforms with that given in Table 3-2 of NUMARC 87-00.

Using Table 3-3 of NUMARC 87-00, the expected frequency of LOOPs at ANO due to SW condition is estimated to be "0.0341" or "0.0072" placing the site in an SW group "4" or "2" depending on the site having offsite power transmission lines either on one or multiple rights-of-way, respectively. The licensee's submittal stated that the plant is in SW group "2" indicating that the site has power transmission lines on multiple rights-of-way. A review of the Unit 1 UFSAR indicates that the site could be considered to have transmission lines on multiple rights-of-way.

Our review of the ANO Unit 1 UFSAR, combined with information gained from the licensee during a phone conversation on August 10, 1990, indicates that the independence of offsite power for ANO is "I1/2" based on:

1. All offsite power sources are connected to the plant through two electrically connected switchyards.

2. There are two emergency safety feature (ESF) divisions in each unit, and both divisions are normally powered from the unit auxiliary transformer (UAT).

3. The UAT for each unit is connected to the unit main generator.

4. Upon loss of the main generator, a fast automatic transfer occurs to one of two start-up transformers. Unit 1 would normally transfer to ST1 (see Figure 1) which is powered by the Auto Transformer. The Auto Transformer can take power from either the 500 kV or 161 kV buses.

5. Should the selected start-up transformer fail, load can be manually transferred to the backup start-up transformer, which is normally ST2. ST2 can support the safe shutdown loads of one unit plus the design basis accident (DBA) loads of the other unit.

With regard to the expected frequency of grid-related LOOPs at the site, we can not confirm the stated results. The available information in NUREG/CR-3992 (3), which gives a compendium of information on the loss of offsite power at nuclear power plants in U.S., indicates that ANO did not have a grid-related LOOP up to 1984. In the absence of any contradicting information, we agree with the licensee's statement that the frequency of grid-related LOOPs is expected to be less than one per 20 years.

Our review of the ANO Unit 1 UFSAR indicates that the licensee has properly classified the EAC classification as "C" based on the facts that

there are two emergency AC power supplies for each unit and one emergency AC supply is necessary to operate safe shutdown equipment for each unit.

The licensee's determination of target emergency diesel generator reliability is in accordance with RG 1.155 and NUMARC 87-00. Although the need to maintain the reliability of the EDGs is recognized by the licensee, no specific program was committed to. We take the licensee statement to maintain target reliability as a commitment to establish a reliability program consistent with resolution of the Generic Safety Issue B-56.

Based on the above, the AC power design characteristics of the ANO site is "P1" with a minimum required SBO coping duration of four hours.

3.2 Alternate AC (AAC) Power Source

Licensee's Submittal

The licensee stated that the AAC power source at ANO will be an emergency AC power source from the non-blacked out unit which meets the criteria specified in Appendix B to NUMARC 87-00 and the assumptions in Section 2.3.1 of NUMARC 87-00 (12). The proposed AAC configuration at ANO is shown in Figure 1. The licensee stated that with this configuration, including the proposed cross-tie modification, any one of the blacked out unit's emergency buses can be energized manually from either of the emergency buses of the non-blacked out unit. The AAC power source will be available within one hour of the onset of an SBO event and has sufficient capacity to operate necessary safe shutdown systems for both units. A load management scheme is being developed for the AAC power source; the scheme is to be submitted to the NRC sometime after mid-September of 1990 (14).

Arkansas Nuclear One Units One & Two

Simplified Single Line Diagram for Station Blackout

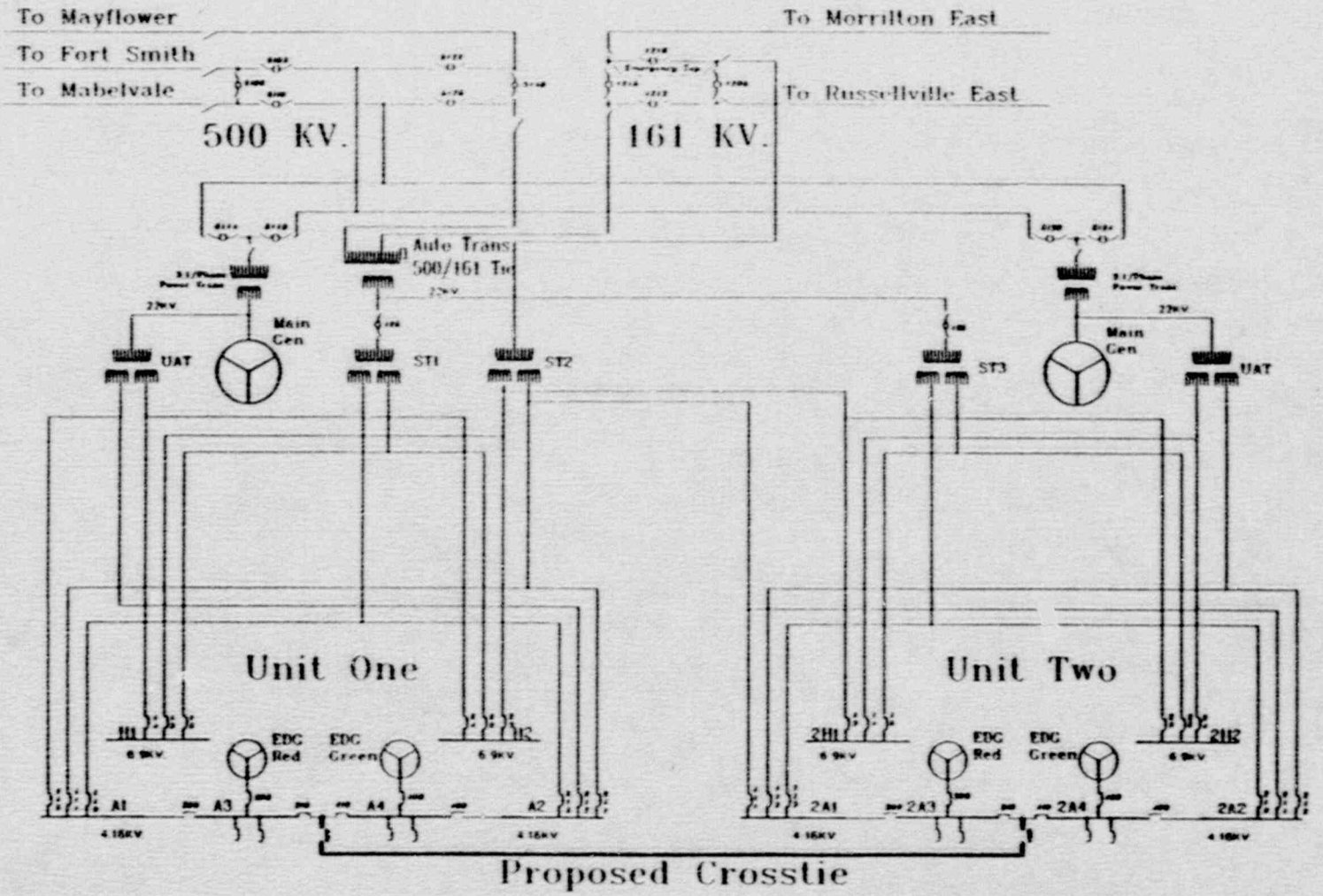

Figure 1

Review of Licensee's Submittal

The licensee's proposed AAC power source configuration (Figure 1) conforms to a variation of an acceptable configuration provided in NUMARC 87-00 Supplemental Questions/Answers under Question C.1 (10). The AAC power source, one of the site EDGs, meets all the required criteria in Appendix B of NUMARC 87-00 except for the following cases:

- Paragraph B.9 of Appendix B states, "the AAC power source shall be ... capable of maintaining voltage and frequency within limits consistent with established industry standard that will not degrade the performance of any shutdown system or component. At a multi-unit site, except for 1/2 Shared or 2/3 emergency AC power configuration, an adjacent unit's Class 1E power source may be used as an AAC power source for the blacked-out unit if it is capable of powering the required loads at both units."

- Paragraph B.12 of Appendix B states, " ... the AAC system shall be demonstrated by initial test to be capable of powering required shutdown equipment within one hour of a station blackout event."

The guidance on the use of existing EDGs as AAC power sources at multi-unit sites is documented in RG 1.155, Section 3.3.5, NUMARC 87-00, Section 2.3.1(3), NUMARC 87-00 Supplemental Questions/Answers, Questions 3.4 and B.3, and further detailed in References 16, 17, and 18. In addition, the SBO rule states that at multi-unit sites where the combination of EAC power sources *'exceeds the minimum redundancy requirements for safe shutdown (non-DBA) of all units, the remaining EAC sources may be used as AAC sources'* provided that they meet the applicable requirements.

The rule statement requires *'minimum redundancy.'* This means that in order for an EDG to qualify as an AAC source there must be an EDG available in the NBO unit in addition to the number of EDGs required to meet the minimum EDG redundancy requirement for powering a normal safe

shutdown loads following a LOOP event. Thus, the EDGs in a two-unit site with two dedicated EDGs per unit would not qualify as AAC sources. Two EDGs per unit would meet only the minimum redundancy requirement, and there is no excess EDG.

However, there are some plants at multi-unit sites which have EDGs that just meet the minimum redundancy but each EDG has sufficient capacity to power all the normal LOOP loads of the NBO unit and also has sufficient excess capacity to power the required safe shutdown loads of the SBO unit. Recognizing the existence of this type of situation, the staff has interpreted the *'literal'* excess EDG redundancy requirement of the SBO rule to allow large capacity EDGs to qualify as AAC sources, provided other applicable requirements are met.

In order to take credit for this interpretation, the NRC staff's basic position has been (16, 17, and 18) that:

1. no action should be taken that would exacerbate the already difficult situation in the NBO unit. Any actions that make operator tasks more difficult such as load switching or disablement of information readouts or alarms in the control room are also considered to be a degradation of normal safe shutdown capability for LOOP in the NBO unit. And,

2. excess capacity of the EDG being designated as an AAC source should not be the capacity made available by shedding or not powering normal safe shutdown loads in the NBO unit. Examples of such loads are: motor driven auxiliary feedwater pumps; heating, ventilation and air conditioning loads; the power supply of the plant computer; one or more sets of redundant instrumentation; etc. The shedding of such loads constitutes degradation of the normal safe shutdown capability of the NBO unit.

It is not in the interest of safety to reduce the capability to handle various eventualities in one unit for the purpose of meeting the SBO rule

in another unit. Each unit must meet the SBO rule on its own merits without reducing another unit's capability to respond to its own potential problems.

The excess capacity of the EDG in the NBO unit that qualifies it as an AAC source is, therefore, *'only that available capacity within the normal continuous rating but above the EDG load represented by the complete contingent of safety related and non-safety related loads normally expected to be available for the LOOP condition.'*

In its SBO supplemental information submittal (13) the licensee stated that load shedding is required to ensure that selected SBO equipment in the blacked out unit could be powered from one of the EDGs in the NBO unit. During a telephone conversation on August 10, 1990, the licensee was asked by the staff to explain its load management scheme and how that differs from the guidance. The licensee stated that since no conclusive determination had been made yet it could not supply the requested information at that time.

Our review of the Unit 2 UFSAR regarding the required LOOP and SBO loads indicates that the each EDG at Unit 2 does not have sufficient capacity to meet the above guidance without a load shedding scheme. If these loads were not shed, the AAC power source would not have sufficient capacity to power the selected equipment needed for safe shutdown operation of Unit 1. Therefore, the licensee's proposed AAC power source does not conform to the requirements of the SBO rule.

3.3 Station Blackout Coping Capability

The plant coping capability 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's submittal (12) stated that 56,804 gallons of condensate are required to remove decay heat from the reactor at ANO Unit 1 during a 4-hours SBO event. The minimum condensate storage tank (CST) level per technical specifications is 107,000 gallons. Sufficient condensate inventory exists for decay heat removal during a 4-hour SBO event.

Review of Licensee's Submittal

We performed a calculation of the required condensate inventory based on NUMARC 87-00. Our results confirmed the licensee's stated values and the fact that sufficient condensate inventory exists for decay heat removal during a four hour SBO event. However, there is no assurance that the decay heat removal (DHR) system at ANO Unit 1 would continue to operate after the Class 1E batteries are depleted. The batteries are expected to last two hours, (see item 2 below). The licensee needs to verify that the DHR systems will remain operational and controllable after the batteries are depleted.

2. **Class 1E Battery Capacity**

Licensee's Submittal

The licensee stated that a battery capacity calculation has been performed to verify that the class 1E batteries have sufficient capacity to meet the station blackout loads for one hour.

Review of Licensee's Submittal

The licensee states that the Class IE batteries have sufficient capacity to meet the SBO loads for one hour. The Unit 1 UFSAR (15) indicates that the class 1E batteries are sized to provide power to essential DC loads for two hours without being charged. However, the batteries are needed to supply the connected loads for four hours. Since the proposed AAC power source does not conform to the requirements of the SBO rule, it cannot be assumed that a battery charger will be available to support DC loads and the batteries will be depleted sometime after one hour into an SBO event. To conform with the guidance provided in NUMARC 87-00 Supplemental Questions/Answers, the licensee needs to ensure that the normal battery-powered plant monitoring and electrical system controls remain operational for successfully coping with and recovering from an SBO event. Therefore, the licensee needs to provide battery charging capability.

3. **Compressed Air**

Licensee's Submittal

The licensee stated that no air-operated valves are relied upon to cope with a station blackout for one hour.

Review of Licensee's Submittal

Our review of the UFSAR indicates that all safety related air-operated valves were found to go to the safe position upon a loss of air. The valves required to operate in order to cope with an SBO are those associated with the auxiliary feedwater (AFW) and atomspheric dump systems. The AFW control valves are DC powered motor operated valves. The atmospheric dump valves are air operated and their block valves are motor operated. The UFSAR indicates that the ADV block valves are supported by the emergency power system.

However, no mention is made on the capability of manual operation of either the ADVs or their block valves upon loss of power.

Since the AAC power source does not conform to the requirements of the SBO rule, neither compressed air nor electrical power are available. The licensee needs to provide an explanation of the method it intends to use to remove decay heat. If manual valve manipulation is involved, concerns related to the habitability of the area of the valves, communication with the control room, procedures to operate the decay heat removal system in this manner, and the related operator training need to be addressed. Alternatively, the license needs to provide an AAC power source to support the operation of the decay heat removal system.

4. **Effects of Loss of Ventilation**

Licensee's Submittal

The licensee stated (12) that during an SBO event no heating, ventilation and air conditioning (HVAC) systems would be available to the following dominant areas of concern:

Emergency Feedwater (EFW) pump room
Primary make-up pump rooms
Service water pump structure
Control room
Room 99 (DC Elec. Equip.)
Room 109 (DC Elec. Equip.)

In a subsequent submittal (13) the licensee stated that the control room HVAC will be powered by the AAC power source during an SBO. The licensee also stated it has performed a scoping analysis which indicates that the Unit 1 LOCA/HELB containment temperature profile envelops the SBO condition.

Reasonable assurance of the operability of station black out response equipment in DACs was assessed by the licensee using Appendix F to NUMARC 87-00 and/or the Topical Report as well as analyses previously performed.

Review of Licensee's Submittal

The information provided by the licensee and that available in the plant UFSAR is insufficient to make a judgement regarding the correctness of the licensee's stated results. The licensee only provided the final steady-state temperatures for the EFW pump room (131°F) and the control room (<120°F). No other information is provided regarding other areas evaluated. Therefore, an audit may be required to confirm compliance.

During the telephone conversation on August 10, 1990, the licensee was asked to explain the selection of dominant areas of concern. The licensee stated that the analysis is still under review and it was not ready to discuss the subject. With regard to the control room, the licensee stated that supplying ventilation to either control room results in sufficient cooling in the other control room via openings between the two control rooms. The licensee claimed that it has an analysis demonstrating that a ventilation system in either control room can cool both control rooms.

Based on the licensee's statement, and the fact that the Unit 2 control room HVAC system is powered from both Unit EDGs, we conclude that the Unit 1 control room will be cooled by one of the Unit 2 control room ventilation systems.

5. **Containment Isolation**

Licensee's Submittal

The licensee reviewed the plant list of containment isolation valves (CIVs) to verify that valves which must be capable of being closed or operated (cycled) under station blackout conditions can be positioned (with indication) independent of the preferred and blacked-out unit's class 1E power supplies. The licensee stated that no plant modifications are necessary to ensure that appropriate containment integrity is provided under SBO conditions.

Review of Licensee's Submittal

An independent review of the CIVs was performed based on Table 5-1 of the UFSAR for Unit 1. After excluding those CIVs that conform to the criteria stated in RG 1.155, Section 3.2.7, no valves requiring closure capability were found.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated (12) that the generic analyses listed in Section 2.5.2 of NUMARC 87-00, which are applicable to ANO Unit 1 were used to assess the plants ability to maintain adequate reactor coolant system inventory for one hour. The licensee concluded that the expected rate of reactor coolant inventory loss under SBO conditions does not result in core uncovering in an SBO event of one hour. Therefore, make-up systems in addition to those currently available under SBO conditions are not required.

Review of Licensee's Submittal

Based on the licensee's statement that reactor coolant inventory loss under SBO conditions does not result in core uncovering in an hour, we interpret that the reactor make-up is applied, starting at one hour. Since the AAC power source does not conform to the requirements of the SBO rule, no RCS make-up will be available. Therefore the licensee needs to have an analysis to demonstrate that the core is not uncovered during the four hour coping period, considering a 25 gpm per reactor coolant pump seal leak rate plus the maximum allowed technical specification leakage.

3.4 Proposed Procedures and Training

Licensee's Submittal

The licensee stated that the following plant procedures have been reviewed per guidelines in NUMARC 87-00, Section 4:

1. AC power restoration,
2. Severe weather, and
3. Station blackout response guidelines.

The licensee listed the plant procedures which fall in each of above areas in the plant SBO submittal. The licensee stated that procedures requiring changes in the first two areas have been reviewed and modified if deemed necessary. Procedure changes for station blackout response have been reviewed and will be modified to reflect the changes resulting from [illegible]anned modifications. All procedure changes are planned to be com[illegible]he end of refueling outage number 10 for Unit 1, estimated as [illegible], 1991, subject to the NRC's approval of the modifications.

Review of Licensee's Submittal

We neither received or reviewed the affected procedures. We consider these procedures as plant specific actions concerning the required activities to prepare for or to cope with an SBO event. We believe it is the licensee's responsibility to revise and implement these procedures, as needed, to mitigate an SBO event and to assure that these procedures are complete and correct, and that the associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee stated that modifications will be necessary to cross-tie the ANO Unit 1 and 2 safety buses in order to provide the AAC power source to the blacked-out unit. The modification will include:

1. Cabling between each unit's safety buses
2. Unit 1 switchgear modifications to accommodate the cross-tie
3. Unit 2 switchgear modifications to accommodate the cross-tie

Procedure changes for both units to address breaker alignment, load shedding, coordination of activities, and realignment of power supplies when they become available; will be needed. The AAC cross-tie modifications are planned to be completed by the end of refueling outages No. 10 at Unit 1 and No. 8 at Unit 2, subject to the NRC's approval of the modifications.

Review of Licensee's Submittal

The proposed cross-tie modification (see Figure 1) is consistent with an acceptable configuration provided in Appendix C to NUMARC 87-00, Supplemental Questions/Answer: Figure B of Sample AAC Configurations. This modification allows the licensee to power one of the emergency buses

of the blacked out unit from either of the EDGs of the non-blacked out unit.

3.6 Quality Assurance and Technical Specifications

The licensee's submittals do not document the conformance of the plant's SBO equipment to the guidance of RG 1.155, Appendices A and B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals, a telephone conversation between NRC/SAIC and the licensee, and the information available in the plant UFSARs for Arkansas Nuclear One, Units 1 and 2, we find the submittal does not conform with the requirements of the SBO rule for the following reasons:

1. Alternate AC Power Source

   The licensee's intended load shedding of the non-blacked-out (NBO) unit is not in conformance with the requirements of the SBO rule and the guidelines provided in RG 1.155, NUMARC 87-00 Supplemental Questions/Answers, and References 16, 17, and 18. The load shedding scheme will result in the degradation of LOOP safe shutdown capability of the NBO unit. This excess capacity made available by load shedding could not be credited as an AAC source for the blacked out unit (see the discussion under the AAC power source in Section 3.2). Therefore, the AAC power source does not have sufficient capacity to power the selected safe shutdown equipment in the blacked out unit.

2. Class 1E Battery Capacity

   The plant UFSAR indicates that each class 1E battery will last for two hours without being charged. However, the batteries are needed to supply the connected loads for four hours. Since the proposed AAC power source does not conform to the requirements of the SBO, it cannot be assumed that a battery charger will be available to power DC loads after the batteries are exhausted. To conform with the guidance provided in NUMARC 87-00 Supplemental Questions/Answers, the licensee needs to ensure that the normal battery-backed plant monitoring and electrical system controls remain operational for successfully coping with and recovering from an SBO event.

Therefore, the licensee needs to provide a separate AAC power source for supporting the required battery charger(s).

3. **Compressed Air**

The licensee needs to provide the method it intends to utilize to remove decay heat assuming neither compressed air or electrical power are available. If manual operation of valves is involved, the licensee needs to address related concerns which are discussed in Section 3.3.

4. **Reactor Coolant Inventory**

The licensee needs to evaluate the reactor coolant inventory with no make-up for four hours, considering a leakage of 25 gpm from each reactor coolant pump seal plus maximum allowed technical specifications leakage. No make-up capability can be assumed due to lack of sufficient AAC capacity (see item 1 above).

5. **Quality Assurance and Technical Specifications**

The licensee's submittals do not document the conformance of the plant's SBO equipment to the guidance of RG 1.155, Appendices A and B.

5.0 REFERENCES

1. The Office of Federal Register, "Code of Federal Regulations Title 10 Part 50.63," 10 CFR 50.63, January 1, 1989.

2. U.S. Nuclear Regulatory Commission, "Evaluation of Station Blackout Accidents at Nuclear Power Plants - Technical Findings Related To Unresolved Safety Issue A-44," NUREG-1032, Baranowsky, P. W., June 1988.

3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Off-site 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.

5. U.S. Nuclear Regulatory Commission, "Emergency Diesel Generator Operating Experience, 1981-1983," NUREG/CR-4347, December 1985.

6. U.S. Nuclear Regulatory Commission, "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, May 1983.

7. U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research, "Regulatory Guide 1.155 Station Blackout," August 1988.

8. Nuclear Management and Resources Council, Inc., "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00, November 1987.

9. Thadani, A. C., letter to W.H. Rasin of NUMARC, "Approval of NUMARC Documents on Station Blackout (TAC-40577)," October 7, 1988.

10. Thadani, A. C., letter with attachment to A. Marion of NUMARC, "Publicly Noticed Meeting, December 27, 1989," dated January 3, 1990 (confirming "NUMARC 87-00 Supplemental Questions/Answers," December 27, 1987).

11. Nuclear Safety Analysis Center, "The Reliability of Emergency Diesel Generators at U.S. Nuclear Power Plants," NSAC-108, Wyckoff, H., September 1986.

12. Campbell, T. G., letter to the Document Control Desk of U.S. Nuclear Regulatory Commission, "Arkansas Nuclear One, Unit 1, Docket No. 50-313, Information Submittal for Station Blackout Rule 10CFR50.63," dated April 13, 1989.

13. Fisicaro, J. J., letter N. the document control Desk of U.S. Nuclear Regulatory Commission, "Arkansas Nuclear One - Units 1 & 2, Docket Nos. 50-313 and 50-368, License Nos. DPR-51 and NPF-6, Station Blackout Issue - Supplemental Information," dated July 17, 1990.

14. Carns, N. S., letter N. the document control Desk of U.S. Nuclear Regulatory Commission, "Arkansas Nuclear One - Units 1 & 2, Docket Nos. 50-313 and 50-368, License Nos. DPR-51 and NPF-6, Station Blackout Issue - Supplemental Information," dated April 3, 1990.

15. Arkansas Nuclear One, Unit 1, Updated Final Safety Analysis Report.

16. Rosa, F., Memorandum to Docket Concerning Beaver Valley Units 1 and 2, "Meeting Summary - Meeting of February 22, 1990, on Station Blackout Issues (TAC 68510/68511)," Docket Nos. 50-334 and 50-412, dated March 6, 1990.

17. Tam, P. S., Memorandum for, "Daily Highlight-Forthcoming Meeting with NUMARC on Station Blackout (SBO) Issues (TAC 40577)," dated April 25, 1990 (providing a Draft Staff Position Regarding Use of Emergency AC Power Sources (EDGs) as Alternate AC (AAC) Power Sources, dated April 24, 1990).

18. Russell, W. T., letter to W. Rasin of NUMARC, "STATION BLACKOUT," dated June 6, 1990.