Attachment 1

SAIC-91/1265

TECHNICAL EVALUATION REPORT

MCGUIRE NUCLEAR STATION

STATION BLACKOUT EVALUATION

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TECHNICAL EVALUATION REPORT

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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 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 (9) by the NRC staff 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 licensees' submittals using the agreed upon generic response format. These deficiencies raised a generic question regarding the degree of 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 3-3 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, ventilation systems, containment isolation 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 upon the review of the licensee's submittals dated April 17, 1989 (12), and April 5, 1990 (13), the information available in the plant Final Safety

Analysis Report (FSAR) (14), a meeting with the licensee in Charlotte, North Carolina, and the information provided by the licensee following the meeting (15).

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Duke Power Company, calculated (12 and 13) a minimum acceptable station blackout duration of fo·· hours for the McGuire Nuclear Station (MNS) site. The licensee stated (13) tha ··· equipment modifications are required to attain this coping duratio..

The plant factors used to estimate the prop··ed SBO duration are:

1. **Offsite Power Design Characteristics**

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

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

   b. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW Group "1."

   c Independence of the plant offsite power system characteristics of "I1/2,"

   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 of the plant is "C." Each unit is equipped with two dedicated emergency diesel generators (EDGs). One EDG per unit is necessary to operate safe-shutdown equipment following a loss of offsite power.

3. **Target Emergency Diesel Generator (EDG) Reliability**

The licensee has selected a target EDG reliability of 0.95. The selection of this target reliability is based on having an average EDG reliability of greater than 0.95 for the last 100 demands, consistent with NUMARC 87-00, Section 3.2.4. The licensee stated that the actual unit averages over the last 100 demands were 0.985 for Unit 1 and 0.97 for Unit 2, based on late 1988 data.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the estimated frequency of LOOPs due to ESW and SW conditions, the independence of the offsite power system grouping, the expected frequency of grid-related LOOPs, the classification of EAC, and the selection of EDG target reliability. The licensee's estimates of the ESW and SW groupings are consistent with those given in Tables 3-2 and 3-3 of NUMARC 87-00, using multiple rights-of-way.

The licensee stated that the independence of the plant offsite power system grouping is "I1/2." A review of the available information shows that:

1. Offsite power sources are connected to the plant through two electrically connected switchyards;

2. During normal operation, power is provided to the safety busses from the main generator;

3. Upon main generator trip, there is an automatic transfer to two step-up transformers (SUTs), each of which supplies power to one division;

4. Upon loss of either SUT, there is an automatic transfer to the remaining SUT which is capable of supplying power to both divisions.

Based on these and the criteria stated in Table 5 of RG 1.155, the plant independence of offsite power system group is "I2."

The licensee correctly categorized the EAC classification of MNS as "C." Each unit has two dedicated 4000-kW EDGs, one of which is necessary to safely shut down the reactor.

The licensee selected an EDG target reliability of 0.95 based upon the EDG reliability data for the last 100 demands. Although this is an acceptable criterion for the selection of an EDG target reliability, the licensee needs to have statistics for the last 20 and 50 demands in its SBO submittal supporting documentation. Based on the information in NSAC-108 (11), which gives the EDG reliability data at U.S. nuclear reactors for calendar years 1983 to 1985, the EDGs at McGuire experienced an average reliability of 0.986 per diesel per year. The licensee's selection of the EDG target reliability meets the criteria specified in RG 1.155 and NUMARC 87-00, provided that it is maintained.

With regard to maintaining the 0.95 EDG reliability target value, the licensee stated (15) that it currently has in place programs which are designed to maintain the reliability of the EAC power sources. These programs include among other things maintenance, testing, surveillance, and root-cause investigation. In addition, the licensee stated that it is closely following the progress of Generic Issue B-56 and, upon the resolution of this generic issue, the licensee will review its emergency power source reliability programs and make changes as necessary.

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 the U.S., indicates that McGuire did not have any symptomatic grid-related LOOP prior to the calendar year 1984. In the absence of any contradictory information, we agree with the licensee's statement.

Based on the above, the offsite power design characteristic of the McGuire 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 (13) that an AAC power source is provided at McGuire which meets the criteria specified in NUMARC 87-00, Appendix B. The AAC power source is the Standby Shutdown Facility (SSF) diesel generator which is the power source for the Standby Shutdown System (SSS). The SSF diesel generator is available within 10 minutes from the recognition of an SBO event. However, it cannot be started from the McGuire main control room. The licensee stated that testing has demonstrated the ability of plant operators to start the SSF diesel within 10 minutes of the recognition of the SBO event which satisfies the intent of the NUMARC guidance. The licensee added that the SSF diesel generator has sufficient capacity and capability to operate equipment necessary to maintain safe shutdown condition for the four-hour SBO event.

In addition, the SSF was originally designed to provide an alternate means of achieving and maintaining hot standby conditions following a postulated fire or sabotage event.

Loss of all normal and emergency station power (AC and DC) is assumed for the postulated fire and sabotage events. Because of this, the licensee concluded that the SSF diesel generator and the SSF are also designed to handle the SBO event. The licensee added that the NRC has previously reviewed and approved the SSF design as noted in the McGuire SER Supplement 6, dated February 1983.

Review of Licensee's Submittal

The licensee's proposed AAC power source, the 700-kW SSF diesel generator, is designed to meet the requirements of Appendix R. The SSF contains its own control room, diesel generator, AC and DC distribution systems, HVAC system, and lighting system. The SSF diesel generator powers one make-up pump per unit which is located inside containment. In order to provide water to the steam generators, the normal unit turbine-driven AFW pump is required. The controls for the pump are independent of the normal plant controls.

The SSF has been approved for Appendix R by the NRC to be capable of maintaining both units in hot standby for a period of up to 72 hours, and, with the exception of the AFW pump, is completely independent of the normal plant systems. Since the SSF diesel generator meets the criteria of NUMARC 87-00, Appendix B, we consider it to be an AAC power source.

3.3 Station Blackout Coping Capability

The licensee's position is that in the most probable scenario, it will use a combination of normal plant systems and certain SSF capability to achieve and maintain hot standby conditions from the main control room. Therefore, our evaluation of McGuire Nuclear Station consists of two parts: the plant's ability to cope with an SBO event with normal plant systems and with a combination of the normal plant systems and those available from the SSF.

The plant coping capability with an SBO event for the required duration of four hours is assessed with the following results:

1. **Condensate Inventory for Decay-Heat Removal**

Licensee's Submittal

The licensee stated that from Section 7.2.1 of NUMARC 87-00, it has determined that 75,452 gallons of water are required for decay-heat removal during the four-hour coping period.

Plant Systems

The licensee stated (13) that the turbine-driven auxiliary feedwater pumps would be aligned to the following normal sources of condensate-grade water:

1. Auxiliary feedwater condensate storage tank - 45,000 gallons (This tank is shared between units)
2. Upper Surge Tanks - 85,000 gallons
3. Condenser Hotwell - 170,000 gallons

Based on these sources being available, the licensee concluded (13) that there is sufficient water available to cope with a four-hou. SBO event.

SSF Feature

The licensee stated that, in addition to the normal condensate sources listed above, the SSF also has the ability to align to the Condenser Circulating Water System (CCWS), which has the capability to maintain hot standby conditions for approximately 72 hours. The licensee added that no plant modifications or procedure changes are necessary to use these water sources.

Review of Licensee's Submittal

Using the expression provided in NUMARC 87-00, we have estimated that the water required for removing decay heat during the four-hour SBO would be ~77,000 gallons. This estimate is based on 102% of a maximum licensed core thermal rating of 3411 MWt. During the audit review in Charlotte, NC, the licensee stated that it has no plans to cool down the primary system during an SBO event. If, however, the pump seal leakage is such that it requires cooldown (see Reactor Coolant Inventory section), then the licensee will follow Westinghouse procedure ECA 0.0. Based on the analyses from similarly-sized Westinghouse plants which plan to cool down, we estimate that ~90,000 gallons of water will be necessary to depressurize the primary system to a secondary-side pressure of 250 psig. With cooldown, the total amount of water necessary is ~170,000.

During the audit review, the licensee provided a statement which indicates that the minimum available volume of water in the condenser hotwell is 82,500 gallons. If the water drops to this level, there is a low level alarm and the operators are instructed by procedure (alarm response manual) to refill the hotwell. Similarly, there is a low level alarm when the upper surge tank volume reaches 42,500 gallons, in response to which the operators are instructed to refill the tank. The licensee also stated that the auxiliary feedwater storage tank is continuously being refilled and overflowing, and therefore should have 45,000 gallons for both units (22,500 gallons per unit). The total of these three volumes is 147,500 gallons. There are, however, no technical specifications limits on the levels of these water sources, and therefore there are no guarantees that these sources of condensate will be available during an SBO event. If, for any reason, sufficient sources of condensate-grade water are unavailable, the licensee can align the turbine-driven AFW pump to take suction from the CCWS, which can provide non-condensate-grade water for 72 hours. Therefore, McGuire has sufficient sources of water to cope with a four-hour SBO event.

2. Class-1E Battery Capacity

Licensee's Submittal

Plant System

The licensee stated (13) that a plant-specific battery-capacity calculation is not required because the design of the vital batteries allows cross-tieing the blacked-out (BO) unit's batteries to the non-blacked-out (NBO) unit battery charger.

SSF Feature

The licensee stated that the SSF is also provided with a 250/125-VDC power system which is independent from the normal plant 125-VDC and 120-VAC vital I&C power system. The SSF batteries are charged by the AAC power source and are also available to power the SSF instruments and controls necessary to achieve and maintain hot standby conditions from the SSF control room following an SBO event.

Review of Licensee's Submittal

Our review of the plant FSAR indicates that the McGuire site has four class-1E batteries labelled A, B, C, and D, which are shared between units. Batteries A and C make up one division for each unit, as do batteries B and D. There are five battery chargers for the site, one for each battery and one spare charger, each of which have the ability to be powered from either unit. Each battery charger has the capacity and connectability to power a complete division of batteries (either batteries A and C or B and D). Each EDG is able to power two of the normal battery chargers as well as the spare charger. Since one EDG will be available in the NBO unit, two of the normal battery chargers and hence one division in each unit will be powered. Therefore, MNS has sufficient battery capacity to cope with a four-hour SBO event.

The SSF has its own independent battery system which will be charged by a battery charger powered by the AAC power source.

3. **Compressed Air**

Licensee's Submittal

The licensee stated (13) that no air-operated valves are relied upon to maintain hot standby from the SSF.

Review of Licensee's Submittal

The licensee is planning on removing decay heat by using the steam generator safety valves (SVs) instead of the atmospheric dump valves (ADVs). Should cooldown become necessary pursuant to procedure ECA 0.0, the licensee can manually operate the ADVs, which are controlled from the outboard doghouse, and operators in the doghouse can communicate with the control-room operators via portable radio communications. The habitability of the outboard doghouse will be discussed in the Loss of Ventilation section of this review.

In addition to the ADVs, the AFW flow control valves are also air operated under normal conditions. However, during an SBO, these valves will need to be manually operated in order to control the steam-generator water level. These valves are located in the AFW pump room. Communications between the operators performing the manual actions and the control-room operators will be accomplished via portable radio communications. The accessibility of the valves and the habitability in the AFW pump room will be discussed in the Loss of Ventilation section.

4. Effects of Loss of Ventilation

Licensee's Submittal

Plant System

The licensee provided the results of its heat-up calculations in the dominant areas of concern (DACs) as follows:

DAC	Temperature (°F)	
	Initial	Final
Containment	120	201
Annulus	126	176
Turbine-Driven AFW Pump Room	†	143
Motor-Driven AFW Pump Room	†	127
Mechanical Penetration Rooms	†	188
Inboard Doghouses	‡	151
Switchgear Room	77.6	< 120

† Calculation performed using a steady-state heat balance between the area and the surrounding areas. Initial temperatures were assumed for the surrounding areas, not for the area for which the calculation was being performed.

‡ Neither a calculation nor an initial temperature provided by the licensee

The licensee stated (13) that plant-specific calculations and assumptions were used to determine the DAC temperatures. The licensee added that reasonable assurance of the operability of SBO response equipment in the above DACs has been addressed using NUMARC 87-00, Appendix F and/or the Topical Report. The licensee added that no modifications or procedure changes are required to provide reasonable assurance of equipment operability.

- **Control Room**

  The licensee stated (13) that the main control room is shared between the units, and is served by a shared heating, ventilation, and air conditioning (HVAC) system. The HVAC system, which will be powered from the NBO unit's available EDG, will be available approximately 45 minutes after the onset of an SBO event. The licensee stated (13) that the control-room temperature will be maintained at approximately 75°F with a possible short-duration excursion above

75°F (but not exceeding 120°F) for the period required to re-align the HVAC to the operable EDG. The licensee concluded that the control room is not a DAC.

- **Switchgear Room**

  The licensee stated (13) that the train "A" Unit 1 and 2 essential switchgear rooms will not exceed 120°F during an SBO event and, therefore are not DACs.

- **Turbine Building**

  The licensee stated (13) that the turbine building is not a DAC as there would not be a significant change in the turbine-building environment as a result of an SBO event.

- **Outboard Doghouses**

  The licensee stated (13) that the outboard doghouses are not a DAC as they are vented to the outside environment and are not provided with forced ventilation. The licensee concluded that the SBO environment would not be different from the normal operating environment.

<u>SSF Feature</u>

The licensee stated (13) that the SSF has its own ventilation system which is powered from the SSF diesel generator and, therefore, the SSF is not a DAC. Areas other than the SSF that contain SBO response equipment that is used in conjunction with the SSF are addressed above.

Review of Licensee's Submittal

The licensee provided (15) its calculations for the AFW pump room, the containment and annulus, the mechanical penetration room, and the switchgear room. These heat-up calculations used a steady-state heat balance between the area of concern and its surrounding rooms. Except for the assumed roof temperature of

95°F in the switchgear-room heat-up calculation, the assumptions seemed reasonable. No calculation was provided for the doghouse.

Based upon the information provided by the licensee following the audit review in Charlotte, we agree with the licensee's conclusions for the annulus, the mechanical penetration room, the inboard doghouse, and the turbine building. With regard to the remaining areas, we have the following comments:

Containment

The licensee provided (15) two heat-up calculations for the containment following a loss of all AC power. One of these calculations used a hand-calculated time-dependent heat-transfer method. This calculation, which did not include the postulated 111-gpm leak rate (25 gpm per reactor coolant pump and 11 gpm technical specifications) nor the ice inside containment, indicated a final temperature of 201°F, assuming an initial temperature of 120°F. The second calculation was performed using the MAAP computer code and assumed an initial leak rate of 111 gpm. This calculation resulted in a final temperature of ~170°F and a peak temperature of ~196°F with an assumed initial temperature of 120°F. Both the final temperature and the peak temperature are below the temperature for which the licensee evaluated the SBO equipment operability (201°F). Therefore, we concur with the licensee's conclusion concerning the equipment operability inside containment.

AFW Pump Room

Based upon the calculations we received, we concur with the licensee's conclusions regarding the equipment operability in the AFW pump room. However, during normal plant operations, the AFW flow control valves are air-operated and, since they do not have a back-up supply of compressed air, they will need to be manually operated under SBO conditions. The manual controls for the AFW flow control valves are located in the motor-driven AFW pump room, which has direct communication with the turbine-driven AFW pump room. We concur with the licensee's conclusions regarding the equipment operability in both the turbine-driven and motor-driven AFW pump rooms. Although the motor-driven AFW pump room will be hot under SBO conditions (127°F), the expected temperature should not preclude the manual actions necessary to operate the AFW flow control valves. During the site audit review, we saw the AFW pump room at Catawba Nuclear Station. The licensee indicated that the general arrangement of the AFW pump rooms at McGuire and Catawba are similar. During the site audit review, we noticed that access to the handwheels for the AFW flow control valves is feasible but difficult. This is due to the location of the control valve handwheels which is about seven feet above the floor and in a cramped area The licensee stated that it will use a combination of a normally locked open gate valve and a flow control valve to adjust the flow to each steam generator. In addition, ladders, which have been previously identified as required support equipment for the operation of the control valves under Appendix R, are available in the area near the valves. Communication with the control-room personnel is accomplished via portable radios. The operator actions necessary to manually control the steam-generator water level during an SBO event are consistent with those which have been addressed under Appendix R.

Outboard Doghouses

As mentioned in the Compressed Air section, operators may need to perform manual ADV actions in the outboard doghouse during an SBO event. The outboard doghouse is open to the outside air on three sides and has no forced ventilation; it relies on natural circulation to provide the necessary cooling. Under SBO conditions, the heat load in the outboard doghouse could be larger than under normal operating conditions. The additional heat load is due to the safety-valve tail pipes. However, this additional heat load should not affect the operators' ability to manually control the ADVs due to the doghouse's three open sides. Therefore, we concur with the licensee's conclusion regarding the outboard doghouse.

Control Room

The McGuire control room is shared between the two units. The control-area HVAC system provides heating and cooling for the control room, the cable room, the battery room, the motor control center room, and the switchgear room. Each room within the control area has its own ventilation system consisting of two 100%-capacity fans. The control-area heating and cooling system consists of two redundant systems, with one system capable of being powered from each unit. Each system is connectable to either of its respective unit's two emergency busses. There is a selector switch which prevents the system from being powered from both emergency busses at once. Normally, power for the system comes from one of the emergency busses. Since the NBO unit will have one EDG available, there is a 50% chance that one HVAC system will be available in a short period of time after the onset of an SBO event. Should the NBO's HVAC system be aligned to the emergency bus with the failed EDG, manual actions will be required to re-align the HVAC system to the powered bus. These manual actions would take no more than 45 minutes. We consider the ventilation fans for each of the rooms within the control area are designed such that any of the emergency busses is capable of powering one ventilation system for each room. The licensee needs to verify that this is the case. For its assessment of the control-room heat up, the licensee assumed that the room temperature at the onset of the SBO event is 75°F. Our review of the plant FSAR Section 6.4.2 indicates that the design temperature for the control room is 90°F. However, since HVAC will be available to the control room within 45 minutes of the onset of an SBO event, we agree with the licensee that the control-room temperature will not exceed 120°F during an SBO event. Nevertheless, the licensee needs to open the control room cabinet doors within 30 minutes in the absence of air conditioning, consistent with the guidance.

Switchgear Room

We received two heat-up calculations for the switchgear room from the licensee which were provided to support the use of the SSF during an SBO event. During the site audit review in Charlotte, the licensee stated that the switchgear room, as part of the control-area, will have HVAC available within 45 minutes of the onset of an SBO event. The switchgear-room temperature, therefore, is not expected to exceed 120°F during the first hour of an SBO event. Based upon the licensee's statement, we concur that the switchgear room should not be a dominant area of concern. We consider the licensee's calculations to be extraneous with respect to the postulated SBO event, although we have some concerns regarding the calculations. Since the availability of HVAC to the switchgear room has not been formally documented, the licensee needs to verify that the switchgear room will have HVAC available within 45 minutes.

5. Containment Isolation

Licensee's Submittal

Plant System

The licensee stated that the plant list of containment isolation valves (CIVs) has been reviewed to verify that valves which must be capable of being closed or that must be operated (cycled) under SBO conditions can be positioned with indication independent of the blacked-out unit's class-1E power supplies. The licensee added that no modifications or associated procedure changes were determined to be required to ensure that appropriate containment integrity can be provided under SBO conditions.

SSF Feature

Same as above.

Review of Licensee's Submittal

During the site audit review, the licensee stated that it used the plant list of CIVs and excluded valves based on the criteria given in RG 1.155. Closure confirmation for the valves which were not excluded by the criteria have been incorporated in the SBO procedures. We reviewed the plant list of CIVs and the licensee's SBO procedures. We did not find any valves in addition to those listed in the McGuire SBO procedures which do not meet the exclusion criteria listed in RG 1.155. Therefore, McGuire has the ability to ensure that containment isolation can be provided during an SBO event, should it become necessary.

6. **Reactor Coolant Inventory**

Licensee's Submittal

Plant System

The licensee performed a calculation using the MAAP computer code. The assumptions used in the calculation included an initial leak rate of ~110 gpm which decreased to ~30 gpm after four hours and did not include the make-up pump which can be powered from the SSF diesel generator. In addition, the calculation considered the automatic injection of the upper head injection accumulators, which discharge water to the primary system at ~1250 psi, which occurs about 50 minutes into the SBO event. The results of the calculation show that the core will not become uncovered during a four-hour SBO event.

SSF Feature

The licensee stated that the AAC source (the SSF diesel generator) powers the necessary make-up system to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is cooled for the four-hour coping duration. A standby make-up pump powered from the SSF diesel generator is located in the annulus of each unit to supply make-up to the RCS. The licensee stated (13) that the pump is sized to accommodate normal system leakage, reactor coolant pump (RCP) seal leakage, and additional flow for system make-up. The standby make-up pump delivers borated water from the spent fuel pool to the RCS at a rate of 26 gpm. Approximately 18 gpm is required for normal seal leakage and cooling, thus preventing the seals from degrading which would lead to the NUMARC postulated 111-gpm seal leak rate. The remaining capacity of the pump (8 gpm) is available for RCS make-up and boration.

Review of Licensee's Submittal

Reactor coolant make-up is necessary to replenish the RCS inventory losses due to the reactor coolant pump seal leakage (25 gpm per pump per NUMARC 87-00 guideline), and the technical specifications maximum allowable leakage (11 gpm). The licensee provided (15) the results of its MAAP calculations which indicate that the core will not become uncovered during a four-hour SBO event.

We performed a calculation to determine the adequacy of the reactor coolant inventory. Over four hours with a postulated constant 111-gpm leak rate, the RCS would lose 26,640 gallons of water, which is ~3600 ft^3. According to he plant FSAR, the RCS liquid volume is 11,298 ft^3 with the pressurizer 60% full (Table 5.1-1). After four hours with no cooldown, the RCS has 7500 ft^3 of water remaining, neglecting the accumulators. The plant FSAR indicates that each steam generator contains 1080 ft^3 of primary coolant and the pressurizer is contains 1080 ft^3 of water (60% of the pressurizer volume). Therefore, after four hours, the pressurizer would be empty and each of the four steam generator would have ~450 ft^3 of primary coolant remaining. If cooldown is considered, the remaining 7500 ft^3 at 550°F would shrink to 6200 ft^3 at 350°F, which is a sufficient volume to maintain natural circulation and to keep the core covered and cooled during an SBO event.

Therefore, even if the make-up pump is not considered, the core will not become uncovered during an SBO event.

NOTE:

The 25-gpm RCP 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 stated that the following procedures have been reviewed and the changes necessary to meet NUMARC 87-00 guidelines will be implemented:

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

Review of Licensee's Submittal

We did not review the licensee's procedures in detail. We consider these procedures to be plant-specific actions concerning the required activities to cope with an SBO. 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 Modification

Licensee's Submittal

The licensee stated that no modifications or associated procedure changes are required in order for McGuire to be able to cope with an SBO event for four hours.

Review of Licensee's Submittal

We did not find the need for any modifications in order for McGuire Nuclear Station to be able to cope with a 4-hour SBO event.

3.6 Quality Assurance and Technical Specifications

The licensee stated (15) that the SBO response equipment is classified into three Quality Assurance (QA) categories. The three categories are 10 CFR 50, Appendix B, which covers safety-related equipment; 10 CFR 50, Appendix R, which covers fire and security-related equipment; and RG 1.155, Appendix A, which would cover the SBO equipment not covered in other categories. The licensee added that equipment covered by Appendices B and R meet the QA requirements of RG 1.155. Duke power is in the process of establishing a program which meets the requirement of RG 1.155, Appendix A.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals and the information available in the FSAR for McGuire Nuclear Station, 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. **Loss of Ventilation**

   Control Room

   The control room will have heating and cooling available within 45 minutes once the control-area HVAC system is aligned to the powered bus in the NBO unit. The licensee needs to verify that each emergency bus has the capability to power a ventilation fan for each of the rooms within the control area. In addition, the licensee needs to open the control room cabinet doors within 30 minutes in the absence of air conditioning, consistent with the guidance.

   Switchgear Room

   Since the availability of HVAC to the switchgear room has not been formally documented, the licensee needs to verify that HVAC will be available in the switchgear room within 45 minutes of the onset of an SBO event.

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 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.

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)," dated October 7, 1988.

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

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

12. Tucker, H. B., letter to U.S. Nuclear Regulatory Commission Document Control Desk, "Requirements for Station Blackout," dated April 17, 1989.

13. Tucker, H. B., letter to U.S. Nuclear Regulatory Commission Document Control Desk, "Requirements for Station Blackout (SBO)," dated April 4, 1990.

14. McGuire Nuclear Station Final Safety Analysis Report, 1988 update.

15. Supplemental information provided by the licensee following the meeting in Charlotte, NC.