UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO STATION BLACKOUT

TOLEDO EDISON COMPANY

CENTERIOR SERVICE COMPANY

AND

THE CLEVELAND ELECTRIC ILLUMINATING COMPANY

DAVIS-BESSE NUCLEAR POWER STATION, UNIT NO. 1

DOCKET NO. 50-346

1. INTRODUCTION

On July 21, 1988, the Code of Federal Regulations 10 CFR Part 50 was amended to include a new Section 50.63, entitled, "Loss of All Alternating Current Power," (Station Blackout). The station blackout (SBO) rule requires that each light-water-cooled nuclear power plant be able to withstand and recover from an SBO of specified duration, requires licensees to submit information as defined in 10 CFR Part 50.63 and requires licensees to provide a plant and schedule for conformance to the SBO rule. The SBO rule further requires that the baseline assumptions, analyses and related information be available for NRC review. Guidance for conformance to the 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 (Nuclear Management and Resources Council, Inc.) January 4, 1990.

To facilitate the NRC staff's review of licensee responses to the SBO rule, the staff endorsed two generic response formats. One response format is for use by plants proposing to use an Alternate AC (AAC) power source and the other format is for use by plants proposing an AC independent response. The generic response formats provide the staff with a summary of the results from the licensee's analysis of the plant's SBO coping capability. The licensees are expected to verify the accuracy of the results and maintain documentation that supports the stated results. Compliance to the SBO rule is verified by a review of the licensee's submittal, and audit review of the supporting documentation as deemed necessary, and possible follow-up NRC inspections to ensure that the licensee has implemented the appropriate hardware and/or procedure modifications that will be required to comply with the SBO rule.

The Davis-Besse Station has proposed using an independent non-Class 1E diesel generator as an AAC power source and has submitted its response in the

applicable generic response format. The licensee's original response was provided by a letter from D. C. Shelton (Toledo Edison) to the U. S. Nuclear Regulatory Commission (NRC) dated April 17, 1989. In addition, the licensee provided a response to the NUMARC 87-00 Supplemental Questions/Answers by a letter from D. C. Shelton to NRC dated April 2, 1990. The licensee's responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. The results of the review are documented by an SAIC Technical Evaluation Report (TER), SAIC-90/1056, "Davis Besse Nuclear Power Station, Station Blackout Evaluation," dated August 17, 1990 (Attachment to the staff's SE).

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 the attachment to these SE 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 emergency diesel generator (EDG) reliability target of .95. The target EDG reliability was based on Davis-Besse EDGs having a reliability greater than 0.95 for the last 100 demands. The P1 grouping is based on an independence of offsite power classification of Group "1 1/2," a severe weather (SW) classification of Group "2," and an extremely severe weather (ESW) classification of Group "2."

After reviewing the available information in the licensee's submittal, RG 1.155, NUMARC 87-00 and SAIC's TER, the staff agrees with the licensee's evaluation of a 4-hour SBO coping duration.

2.2 Alternate AC (AAC) Power Source

The licensee has proposed to install an independent 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 definitions in 10 CFR 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 Connectability of AAC power sources

The basic criteria governing the connectability of an AAC power source are contained in 10 CFR 50.2 (the AAC source should be connectable to but normally not connected to the offsite or onsite emergency AC power systems) and 10 CFR 50.63 (SBO should not assume a concurrent single failure or design basis accident). 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.

2.2.2 Proposed AAC power source

The proposed AAC power source for Davis-Besse is an independent (non-safety) diesel generator. The licensee's submittal states that this power source will be available within 10 minutes of the onset of the SBO event, and has sufficient capacity and capability to provide power for safe shutdown of the unit for a 4-hour duration. However, the licensee did not provide any detailed information

regarding the capacity (kWs) of the proposed AAC source (diesel generator) or the safe shutdown loads for an SBO event. Therefore, it is assumed that the proposed AAC power source has sufficient capacity for supplying the full compliment of safe shutdown loads, including heating, ventilating and air conditioning (HVAC), of at least one safety division; that is, the AAC source has sufficient capacity and capability to power the loss of offsite power (LOOP) loads for one safety division. Under this assumption, the proposed AAC source would be in the fully capable category cited in Section 2.2.1.

It can be concluded that the safe shutdown loads for an SBO condition will be bounded by the safe shutdown loads for a LOOP condition, and no coping analysis is required. If the proposed AAC power source is of less capacity than the existing EDGs and cannot power all of the assumed SBO loads (battery charging, HVAC, reactor coolant system makeup, compressed air and others), then the licensee is required to perform a coping analysis which shows that the plant can cope with and recover from an SBO for the required duration. The proposed configuration shows that the proposed AAC source can only be connected to one division.

Recommendation: The capacity (kWs) of the proposed AAC power source (diesel generator) should have approximately the same capacity (kWs) as one of the existing EDGs. If the proposed AAC power source has less capacity, then the licensee should perform a coping analysis which shows that the plant can cope with and recover from SBO for the required duration. Such an analysis should be included in the documentation supporting the SBO submittals that is to be maintained by the licensee.

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 submittal states that 62,000 gallons of water are required to provide decay heat removal for a 4-hour SBO duration. The minimum permissible condensate storage tank level per Technical Specifications provides 250,000 gallons of water which exceeds the required capacity for coping with a 4-hour SBO event. The staff, therefore, concludes that there is sufficient condensate water to cope with an SBO of 4 hours.

2.3.2 Class 1E battery capacity

Since the AAC power source is available within 10 minutes of the onset of an SBO event, the licensee was not required to perform any additional calculations to meet the requirement of the SBO rule. The station batteries have a 1-hour capacity of 750 ampere hours and a 1-minute rating of 1600 amperes which appears to be sufficient to satisfy the SBO load requirements for the first 10 minutes. It is assumed that the proposed AAC power source will power the

battery chargers after 10 minutes, therefore, the station battery should have sufficient capacity to meet the SBO load requirements for the 4-hour required duration.

Recommendation: The licensee should ensure that the battery charger associated with the battery supplying SBO loads is powered from the AAC power source during the SBO.

2.3.3 Compressed air

The licensee did not address the compressed air system in his submittal on the basis that a 10-minute AAC power source will be available. As indicated in the attached SAIC TER, an emergency instrument air compressor is powered from an essential bus and, therefore, it is expected that it could be powered from the proposed AAC source during an SBO event. Since the present configuration of the proposed AAC source is only connected to one division, the licensee is required to ensure that this compressor can be powered from the proposed AAC source or show that compressed air is not required during an SBO event.

Recommendation: The licensee should ensure that the emergency instrument air compressor is powered from the proposed AAC power source or show that compressed air is not required during an SBO event.

2.3.4 Effects of loss of ventilation

The licensee stated in its SBO submittal that the AAC power source will power the heating, ventilation and air conditioning (HVAC) systems that serve the dominant areas of concern (DAC). As a result, the licensee did not submit a loss of ventilation assessment. The licensee's action is consistent with the guidance provided in RG 1.155 and NUMARC 87-00 and is, therefore, acceptable. However, the licensee should ensure that other areas which have equipment needed for an SBO have appropriate cooling or have been analyzed to show that they are not DACs.

2.3.5 Containment isolation

The licensee did not address the containment isolation since the AAC power source is available within 10 minutes of the onset of an SBO event. The licensee was not required to address containment isolation if the AAC source is available within 10 minutes. The licensee's action is consistent with the guidance of NUMARC 87-00, Section 7.1.2. Since power is available to only one division of safe shutdown equipment, it is assumed that the AAC source provides power to the appropriate isolation valves to assure containment integrity during an SBO.

2.3.6 Reactor coolant inventory

The licensee has stated that the AAC power source will power the necessary make-up systems to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is covered for the required SBO coping duration. The make-up

system has two centrifugal pumps; each having a design flow capacity of 150 gpm. One pump is capable of providing the assumed 125 gpm RCS leakage without loss of inventory during the SBO.

Based on the licensee's submittal and after reviewing the SAIC TER, the staff agrees with the licensee's assessment that adequate RCS inventory will be maintained to ensure core cooling for the full 4-hour SBO duration.

2.4 Procedures and Training

The licensee has stated that the appropriate procedures have been reviewed per guidelines in NUMARC 87-00, Section 4, and will be revised, if necessary, by the seventh refueling outage.

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

2.5 Proposed Modifications

The installation of an independent AAC source (diesel generator) comprises a major hardware modification (see section 2.2.2). Although the licensee has stated in his submittal that the proposed AAC source has adequate capacity to power all systems required to cope with an SBO, no details have been provided on the capacity (kWs) of the proposed AAC source or the required SBO loads. Therefore, the staff assumes that the proposed AAC source is of sufficient capacity (approximately the same capacity as the existing EDGs) to operate all systems necessary for coping with an SBO. For this case, no coping analyses are required. If the proposed source is not of sufficient capacity, additional modifications may be required as a result of reevaluation of the proposed AAC source, or additional coping analyses will be required to show that the plant can cope with and recover from an SBO.

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

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

The licensee did not provide any information regarding QA programs and TS for SBO equipment. However, the licensee has stated that all SBO equipment is covered by the normal QA program and TS.

The technical specifications (TS) for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains an open item at this time. However, the

staff would expect that the plant procedures will reflect the appropriate testing and surveillance requirements to ensure the operability of the necessary SBO equipment. If the staff later determines that a TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

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 submittal on SBO did not specifically address a commitment to implement an EDG reliability program to conform to the guidance of R.G. 1.155, Position 1.2 and NUMARC 87-00, Appendix D.

Recommendation: The licensee should implement an EDG reliability program which meets the guidance of RG 1.155, Section 1.2. If an EDG reliability program currently exists, the program should be evaluated and adjusted in accordance with RG 1.155. Confirmation that such a program is in place or will be implemented should be included in the documentation supporting the SBO submittals that is to be maintained by the licensee.

2.8 Scope of staff review

The station blackout rule (10 CFR 50.63) requires licensees to submit a response containing specifically defined information. It also requires utilities to have baseline assumptions, analyses and related information used in their coping evaluation available to NRC. The staff and its contractor (SAIC) did not perform a detailed review of the proposed equipment or procedure modifications which are scheduled for later implementation. 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 guidance of RG 1.155, Appendix A;

f. AAC power source (non-safety diesel generator) will be inspected, maintained and tested to demonstrate that it has a reliability of 0.95 or better in accordance with the guidance of RG 1.155, C.3.3.5.5; and

g. Actions taken pertaining to the specific recommendations noted above in this SE.

Additional areas may be identified following staff review of the licensee's revised response to the SBO rule.

3.0 SUMMARY AND CONCLUSIONS

The staff has reviewed the licensee's response to the station blackout (SBO) rule (10 CFR 50.63) and the Technical Evaluation Report (TER) prepared by the staff's consultant, Science Applications International Corporation (SAIC). However, based on our review, additional analyses and confirmations described in the recommendations provided in this SE need to be completed. These include the verification of the AAC power source (diesel generator) capacity to power the SBO loads, confirmation that the battery charger and the emergency instrument air compressor are powered from the AAC source, confirmation that an EDG reliability program has been or will be implemented in accordance with the guidance of RG 1.155, and any additional analyses that may be needed if, e.g., AAC source capacity is not sufficient for powering the functions cited. The licensee should maintain these verifications, confirmations and analyses in the documentation supporting the SBO submittal available for further inspection and assessment as may be undertaken by the NRC to audit conformance with the SBO Rule. Based on our review of the submittal and site audit, we find the licensee's design and proposed method of dealing with an SBO to be in conformance with the SBO rule.

Additionally, the schedule for implementation of any hardware and associated procedure modifications resulting from the recommendations documented in this SE should be provided to the NRC within 30 days of receipt of this SE, in accordance with 10 CFR 50.63(c)(4).

Attachment: Technical Evaluation
Report - SAIC-90/1056

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