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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

STATION BLACKOUT RULE (10 CFR 50 63)

NORTHEAST NUCLEAR ENERGY COMPANY, ET AL.

MILLSTONE NUCLEAR POWER STATION, UNIT NO. 3

DOCKET NO. 50-423

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 or 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, 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* January 4, 1990).

To facilitate the NRC staff's (hereafter referred to as staff) review of licensee responses to the SBO rule, the staff endorsed two generic response formats. One response format is for use by plants proposing to use an Alternate A.C. (AAC) power source and the other format is for use by plants proposing an A.C. 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.

Northeast Nuclear Energy Company (the licensee) has proposed using an independent, dedicated air cooled 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 E. J. Mroczka (Northeast Utilities) to

*Nuclear Management and Resources Council, Inc.

...RC) dated April 17, and May ... Supp... response to the NUMARC 87-00 Supp... dated ... E. J. Mroczka to T. E. Murley dated ... were reviewed by Science Applications ... under contract to the NRC. Millstone 3 was ... NRC for a site audit review. The site audit was ... SAIC team headed by an NRC staff member on July 18-21 ... the review and site audit are documented by a SAIC Techn... Report (TER), SAIC-89/1151, Millstone Unit 3, Station Blackout ... dated July 18, 1990 (Attachment No. 1).

2.0 EVALUATION

After reviewing the licensee's SBO submittal and the SAIC TER and in consid... of the information obtained by the NRC staff during the site audit review, 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 eight hours based on an offsite power design characteristic group of "P3", an Emergency A.C. configuration group "C", and an emergency diesel generator (EDG) reliability target of 0.975. The target EDG reliability was based on Millstone Unit 3 EDGs having a reliability greater than 0.95 over the last 100 demands. The P3 grouping is based on an independence of offsite power classification of Group "I 1/2", a severe weather (SW) classification of Group "5" and an extremely severe weather (ESW) classification of Group "5".

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

2.2 Alternate A.C. (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 definition 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 A.C. power systems, (2) minimum potential for common cause failure with offsite power or the onsite emergency A.C. power sources, (3) timely availability, and (4) required capacity and reliability. More specifically, in regard to the fourth attribute, we require that the AAC have 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).

T. E. Murley (NRC) dated April 17, and May 30, 1989. In addition, the licensee provided a response to the NUMARC 87-00 Supplemental Questions/Answers by a letter from E. J. Mroczka to T. E. Murley dated March 30, 1990. The licensee responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. Millstone 3 was one of the plants selected by the NRC for a site audit review. The site audit was performed by a joint NRC/SAIC team headed by an NRC staff member on July 18-21, 1989. The results of the review and site audit are documented by a SAIC Technical Evaluation Report (TER), SAIC-89/1151, Millstone Unit 3, Station Blackout Evaluation," dated July 18, 1990 (Attachment No. 1).

2.0 EVALUATION

After reviewing the licensee's SBO submittal and the SAIC TER and in consideration of the information obtained by the NRC staff during the site audit review, 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 eight hours based on an offsite power design characteristic group of "P3", an Emergency A.C. configuration group "C", and an emergency diesel generator (EDG) reliability target of 0.975. The target EDG reliability was based on Millstone Unit 3 EDGs having a reliability greater than 0.95 over the last 100 demands. The P3 grouping is based on an independence of offsite power classification of Group "I 1/2", a severe weather (SW) classification of Group "5" and an extremely severe weather (ESW) classification of Group "5".

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

2.2 Alternate A.C. (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 definition 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 A.C. power systems, (2) minimum potential for common cause failure with offsite power or the onsite emergency A.C. power sources, (3) timely availability, and (4) required capacity and reliability. More specifically, in regard to the fourth attribute, we require that the AAC have 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 B 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 (or in multi-unit sites where an independent AAC (non-EDG) power source is proposed for only one unit) as a minimum an AAC source need only be connectable to one set of safe shutdown equipment, regardless of whether or not that equipment is part of a safety train.

2.2.2 Proposed AAC power source

The proposed AAC source for Unit 3 is an independent air-cooled diesel generator. The licensee has stated that this power source will be available within one hour from the onset of an SBO event and has sufficient capacity and capability to provide power for the unit's SBO loads. The licensee also stated that the AAC power source will meet the criteria in Appendix B of NUMARC 87-00.

Originally the licensee had proposed using Millstone Unit 1 or Millstone Unit 2 EDGs as the AAC source for Millstone 3. However, the licensees submittal of March 30, 1990, proposed the installation of an independent air-cooled diesel generator as an AAC power source for Millstone 3. The proposed diesel generator was not evaluated during the site audit review of July 18-21, 1989. The licensee did not provide any detailed design information including the capacity (kWs) of the porposed diesel generator. During the site audit review, the licensee identified the SBO loads as 663kW for Millstone 3. These loads were based on actual required loads instead of nameplate ratings of SBO equipment. It is assumed that the proposed diesel generator is capable of powering at least the identified SBO loads (663kW). Therefore, based on the limited information provided by the licensee, the staff assessment of the proposed AAC power source indicates that it would fall into the minimally capable AAC power source category. The licensee is required to verify that the diesel generator has sufficient capacity to power the SBO loads.

Furthermore, the NUMARC 87-00, Appendix B guidance states that the AAC system should be demonstrated by initial test to be capable of powering the necessary equipment within one hour and should be capable of maintaining voltage and frequency within the limits of established industry standards.

Recommendation: 1) The SBO loads (nameplate rating) and the capacity of the AAC diesel generator should be verified and included, along with other design information of related modifications, in the documentation supporting the SBO submittals; and 2) The licensee should conduct the appropriate AAC tests in accordance with the guidance of NUMARC 87-00, Appendix B, item B.12.

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 capacity to achieve and maintain a safe shutdown and recover from an SBO for an eight-hour coping duration.

2.3.1 Condenstate inventory for decay heat removal

The licensee's submittal states that a total of 166,000 gallons of water are required for decay heat removal and reactor cooldown for the proposed SBO duration of eight hours. The minimum permissible level for the demineralized water storage tank per Technical Specifications provides a useable volume of 334,000 gallons of water which exceeds the required quantity for coping with an eight-hour SBO. The staff, therefore, concludes that there is sufficient condenstate water to cope with an SBO of eight hours.

2.3.2 Class 1E battery capacity

The licensee has determined that there is sufficient battery capacity for one hour at which time the AAC source and station battery "A" will provide the necessary power.

The staff agrees with the licensee's assessment contingent on confirmation of the following:

1) Since the calculations used actual current (ammeter readings) instead of nameplate ratings, any change to present plant DC loading will require a reevaluation of battery capacity (refer to SAIC TER).

2) The actual ammeter readings are acceptable provided that they are the maximum values taken over a period of testing and not from a one-time test.

3) The normal battery-backed plant monitoring and electrical system controls in the control room for at least one safety train remain operational during an SBO. These are considered to be essential for successful coping with and recovery from an SBO.

Recommendation: The documentation supporting the SBO submittals that is to be maintained by the licensee should include confirmation of the items identified above.

2.3.3 Compressed air

The licensee stated that no air-operated valves other than the atmospheric depressurization valves (ADVs), which will be manually operated, are relied upon to cope with an SBO for an eight-hour duration. The short-term decay heat removal is accomplished via auxiliary feedwater (AFW) turbine driven feed pump (TDFP) and the steam generator safety valves. Long-term decay heat release is accomplished via AFW-TDFP and the manual operation of ADVs. The staff finds that the proposed method of decay heat removal requires coordination of at least two to three operators.

Recommendation: The licensee should develop procedures and simulate the appropriate actions and provide the operator training to assure that decay heat removal can be maintained.

2.3.4 Effects of loss of ventilation

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

The staff agrees with the licensee's stated results except in the following areas: 1) heat up of main steam valve room due to containment wall temperature rise, and 2) the control room. The main steam valve area has a wall which is the containment building which was not considered in the licensee's assessment of heatup of this room. Therefore, the analysis performed by the licensee for

this room may not represent actual conditions. The licensee plans to install acoustic ceiling in the Millstone 3 control room. Since this installation invalidates the open ceiling assumption in the analysis, the licensee's calculations do not represent the new conditions. The staff concurs with SAIC's assessment of the deficiencies as identified in Attachment 1 for the above mentioned areas.

Recommendation: The licensee should reevaluate the effects of loss of ventilation for the areas identified above and correct the deficiencies. If the licensee's reevaluation shows that additional procedure changes or hardware modifications are necessary to ensure equipment operability in the above mentioned areas, then the licensee should implement the required procedure changes or modifications. In addition, the cabinet doors in the control room should be opened within 30 minutes from the onset of SBO to provide adequate air mixing to maintain cabinet temperatures in equilibrium with the control room temperature and plant procedures should be revised accordingly.

2.3.5 Containment isolation

The licensee has reviewed the plant list of containment isolation valves to verify which valves must be capable of being closed or cycled during an SBO event independent of the preferred and blacked out unit's Class 1E power supplies. Based on this review, the licensee stated that no plant modifications or associated procedure changes are necessary to ensure that appropriate containment integrity will be maintained.

The staff finds the licensee's assessment to be consistent with the guidance of RG 1.155 and NUMARC 87-00.

2.3.6 Reactor coolant inventory

The licensee has performed an analysis and has stated that there is sufficient RCS inventory during the first hour of SBO duration and, thereafter, the AAC power source is on line to ensure RCS make-up and core cooling for the full eight-hour SBO duration.

The staff agrees with the licensee's assessment that adequate RCS inventory will be maintained and finds it acceptable (refer to Attachment 1 for details).

2.4 Procedures and Training

The licensee has stated that the appropriate procedures have been reviewed and modified. Furthermore, the licensee has stated that the changes will meet the guidelines of NUMARC 87-00 and will be implemented one year after the issuance of this Safety Evaluation.

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 installation of an independent AAC diesel generator comprises a major hardware modification (see Section 2.2.2). Also, other modifications may be required as a result of reevaluation of the effects of loss of ventilation for the main steam valve room and the control room (see Section 2.3.4).

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

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

The licensee has stated that all SBO euipment are either currently covered by QA program or will be covered by a QA program in accordance with the guidance of RG 1.155. The staff finds the proposed licensee actions in this area to be acceptable.

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 expects plant procedures to 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.

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 RG 1.155, Position 1.2. However, during the site audit review, the licensee stated that the EDG reliability program for Millstone 3 is consistent with the guidance of RG 1.155, Section 1.2 and that if needed, the program will be adjusted in accordance with regulatory guidance. The staff finds this commitment to be acceptable.

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 perperform a detailed review of the proposed procedure modifications which are scheduled for later implementation after the modifications that could result from the staff recommendations. However, based on our review of the licensee supporting documentation and SBO audit, 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 Safety Evaluation.

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). The staff and SAIC also jointly conducted a site audit review of some of the supporting documentation for the SBO response. However, based on our review, additional analyses and confirmations described in the recommendations provided in this safety evaluation need to be completed. These include the verification of the SBO loads and the AAC diesel generator capacity and the loss of ventilation calculations for the identified areas containing equipment and systems needed to cope with an SBO for eight hours. The licensee should maintain these 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 required hardware and associated procedure modifications should be provided to the NRC within 30 days of receipt of this Safety Evaluation, in accordance with 10 CFR 50.63(c)(4).

Principal Contributor: N. K. Trehan

Dated: August 20, 1990

Attachment:
Technical Evaluation Report