ENCLOSURE

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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO STATION BLACKOUT EVALUATION

NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR POWER STATION UNIT NO. 1

DOCKET NO. 50-220

1.0 INTRODUCTION

On July 21, 1988, the Code of Federal Regulations, 10 CFR Part 50, was amended to include a new section, 10 CFR 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 a specified duration. The SBO rule also requires licensees to submit information as defined in 10 CFR 50.63 and 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 SBO rule is provided by: (1) Regulatory Guide (RG) 1.155, Station Blackout, (2) The Nuclear Management and Resources Council, Inc. (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 on 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 with 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 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.

Niagara Mohawk Power Corporation (the licensee) responses to the SBO rule were provided by letters from C. D. Terry on April 13, 1989, April 3, 1990, April 16, 1990; and January 24, 1991, to the U.S. Nuclear Regulatory Commission, Document Control Desk. Also, there was a teleconference between representatives of the licensee and the NRC staff on October 9, 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 a SAIC Technical Evaluation Report (TER) SAIC-91/6661, "NINE MILE POINT NUCLEAR POWER STATION UNIT 1 STATION BLACKOUT EVALUATION," dated May 15, 1991, (Attachment 1).

2.0 EVALUATION

After reviewing the licensee's submittals and the SAIC TER, the NRC staff concurs with the SAIC analysis and conclusions as identified in the SAIC TER. The NRC staff findings and recommendations are summarized as follows.

2.1 Station Blackout Duration

The licensee has calculated a minimum acceptable SBO duration of 4 hours based on a plant AC power design characteristic group "P2," an emergency AC (EAC) power configuration Group "C," and a target Emergency Diesel Generator (EDG) reliability of 0.975. The Group "C" EAC configuration is based on 2 EDGs not credited as AAC power supplies, with 1 EDG required to operate safe shutdown equipment following a loss of offsite power. The target EDG reliability was based on Nine Mile Point Unit 1 (NMP1) having an average EDG reliability greater than 0.90, 0.94, and 0.95 for the last 20, 50, and 100 demands, respectively. The "P2" grouping is based on an independence of offsite power classification of Group "I 1/2," a severe weather (SW) classification of Group "3," and an extremely severe weather (ESW) classification of Group "1." Upon review of the NMP1 Updated Final Safety Analysis Report (UFSAR) and the criteria stated in Table 5 of RG 1.155, it is concluded in the TER that the plant independence of offsite power system classification is Group "I3" rather than "I 1/2." During the telephone conversation on October 9, 1990, and in the submittal dated January 24, 1991, the licensee agreed that NMP1 is in the "I3" grouping. The change in classification, however, does not affect the offsite power design characteristic group "P2" or the plant's 4-hour coping duration. After reviewing the available information in the licensee's submittals, RG 1.155, NUMARC 87-00, and SAIC's TER, the staff agrees with the TER and licensee's evaluation of a 4-hour SBO coping duration.

2.2 Station Blackout Coping Capability

The licensee has proposed coping independent of an alternate AC power source for the SBO coping duration of 4 hours and recovery therefrom. 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 to recover from an SBO for a 4-hour coping duration.

2.2.1 Condensate Inventory for Decay Heat Removal

The Technical Specification minimum condensate initially available in the emergency condensate system is 111,720 gallons of water, which is sufficient to provide core cooling for the 4-hour SBO. This capacity consists of 19,860 gallons in each of the two loops of the emergency condensers plus 72,000 gallons in the gravity drain makeup tanks. The licensee stated that 58,700 gallons of water is needed for cooldown and decay heat removal using the emergency condensers during a 4-hour SBO event.

The licensee determined that, if no operator action is taken, the gravity drain makeup tanks would be empty 3.8 hours into the SBO event due to the makeup flow control valves opening upon loss of compressed air. The water remaining in the emergency condensers would be sufficient to cope with the remaining 2 hours of the event. However, the licensee is proposing to manually control the emergency condenser level within 30 minutes of the onset of the SBO event. The licensee further stated that the valves which will be used to manually control the water level in the emergency condensers were walked down by NMP1 operating personnel to assure that they are accessible during an SBO event.

After reviewing the SAIC TER, the NRC staff agrees with the licensee that NMP1 needs to manually control the makeup flow to the emergency condensers within 30 minutes in order to prevent condensate overflow and to ensure sufficient condensate availability during SBO. This review is based on a final reactor pressure of 260 psia. If a lower pressure should be needed to allow the diesel-driven fire pump to supplement the reactor vessel water inventory (see Section 2.2.6 of this safety evaluation), makeup water to the shell side of the emergency condensers may be required.

Recommendation: The licensee should perform an analysis showing that adequate condensate inventory exists if an additional depressurization is required to allow the diesel-driven fire pump to supplement the reactor vessel water inventory. This analysis should be included with the other documentation that is to be retained by the licensee in support of the SBO submittals.

2.2.2 Class 1E Battery Capacity

The licensee has installed two new larger Class-1E batteries (2320 vs. 1500 ampere-hours) to cope with the SBO loads for 4 hours. The licensee stated that the new batteries have the capacity to cope with a 4-hour SBO provided that the load shedding occurs within the first 30 minutes of the onset of the event. The licensee will shed two motor-generator (MG) sets from each battery. The licensee also provided information regarding battery loads and calculations. The calculations included a 12-part sensitivity study for each battery with load shedding beginning at 15 and 30 minutes into the SBO event, with a final terminal voltage of 105 and 106 VDC, and with 58, 59, and 60 cells available. The 30 minute load shedding scenario was reviewed, since load shedding within 15 minutes is not consistent with the guidance provided in NUMARC 87-00. After reviewing the supporting document, the NRC staff agrees with the licensee that with load shedding within 30 minutes, the station batteries appear to have sufficient capacity to cope with a 4-hour SBO event, however, the NRC staff concurs with the SAIC TER that there are three concerns pertaining to the battery capacity calculation that require further analyses by the licensee. These are:

1. Time-load assignment: The licensee has divided the loads that usually occur in the first minute into two 1-minute segments to lower the total current drawn during the first minute. But in the actual case, for example, the EDG needs to start up within 10 seconds of the detection of low voltage after a Loss of Offsite Power (LOOP). The licensee's analysis showed the governor and the field flashing circuit of the EDG occurring in the 1 to 2 minute segment.

2. Last-minute loads: The last-minute load should include the load needed to close circuit breakers to power the emergency buses. It is expected that the emergency buses will be connected to the first available source after an SBO event. However, the licensee assumed only that an EDG will be started after a SBO.

3. Turbine emergency bearing oil pump: The licensee assigned the load for the turbine emergency bearing oil pump to the 2 to 3 minute load segment. The licensee's load profile shows this load initiating at 1 minute into the event.

Recommendation: The licensee should address the above battery capacity calculation concerns, specifically, 1) the time-load assignment, 2) that the assigned load is bounding considering the circuit breaker load required for connecting the outside power source to the emergency buses at the end of the SBO, 3) determine when the turbine emergency bearing oil pump will start, and if it is within the first minute, add this load to the 0 to 1 minute segment. The licensee should either justify or reevaluate its battery calculation taking these concerns into account and include the results with the other SBO documentation to be retained by the licensee in support of the SBO submittals.

2.2.3 Compressed Air

The licensee stated that the air-operated valves relied upon to cope with an SBO for 4 hours can either be operated manually or have sufficient backup sources independent of the preferred and blacked out units Class 1E power supply. The NRC staff concurs with the SAIC TER, that if it is determined that the reactor will have to be depressurized quicker than is expected in order to inject water using the fire pump, it may be necessary to use the automatic depressurization system (ADS) valves. It is not apparent that there is a sufficient reserve supply of air for operation of all ADS valves to perform the necessary depressurization.

Recomendation: The licensee should confirm that enough compressed air is available to operate the ADS valves for performing necessary depressurization of the reactor vessel.

2.2.4 Effects of Loss of Ventilation

Following the teleconference of October 9, 1990, the licensee provided information on its heat-up calculations for the control room and drywell following the loss of the Heating, Ventilation, and Air Conditioning (HVAC) system. For the drywell analysis, the licensee performed a comparison between NMP1 and the Browns Ferry Nuclear (BFN) Plant. The licensee assumed a leak rate of 25 gpm, which is considerably less than the 115 gpm (18 gpm for each recirculation pump and 25 gpm maximum allowable technical specification leakage) leak rate recommended in NUMARC 87-00 and RG 1.155. Using the lower leak rate, the licensee concluded that drywell temperature would not exceed the design temperature.

In the control room analysis, the licensee used a time dependent computer model, assuming an initial control room temperature of 75°F, and heat load of 18kW. The final control room temperature was calculated to be 102°F. The licensee did not assume a bounding initial temperature allowed by the Technical Specifications to show the worst-case situation. However, the NRC staff concludes that if the control room initial temperature were conservatively assumed to be 90°F, the final temperature would still be less than the dominant area of concern (DAC) threshold of 120°F. The licensee has committed to open the control room and auxiliary control room instrument cabinet doors. This action should be taken within 30 minutes of the onset of a SBO.

Recommendation: The licensee should reevaluate the drywell heat up calculation using an 115 gpm leak rate instead of 25 gpm as assumed, and include the analysis with the SBO supporting documentation to be maintained by the licensee. The licensee should confirm that the instrument cabinet doors in the control room and auxiliary control room will be opened within 30 minutes of the onset of a SBO.

2.2.5 Containment Isolation

The licensee stated that the plant list of containment isolation valves (CIVs) had 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 AC power supply. The licensee also stated that the procedures will be revised to identify valves which must be manually operated to isolate containment during SBO.

After reviewing the SAIC TER and list of isolation valves from the UFSAR, Tables VI-3a and VI-3b, the NRC staff concurs with the SAIC TER that there are several valves (for example, core spray pump suction and discharge, containment spray pump suction) which do not meet the exclusion criteria outlined in RG 1.155.

Recommendation: The licensee should provide in an appropriate procedure a listing of all CIVs that cannot be excluded by the NUMARC 87-00 criteria and are either normally closed or open and fail as-is upon loss of AC power, and identify the actions necessary to ensure that the valves are fully closed, if

needed. The NRC staff's position is that the valve closure needs to be confirmed by position indication (local, mechanical, remote, process information, etc.). This information should be included with the other documentation that is to be maintained by the licensee in support of the SBO submittals.

2.2.6 Reactor Coolant Inventory

The licensee stated that the expected rates of reactor coolant inventory loss using a plant specific analysis do not result in core uncovery during a 4-hour SBO event. Therefore, there are no makeup systems necessary to maintain core cooling other than those currently available. The licensee concluded that the core will remain covered during a 4-hour SBO event based on an analysis which assumed a leakage rate of 45 gpm and the reactor depressurized to 175 psia in 1 hour.

In a scoping analysis the licensee concluded that with a 115 gpm leakage rate, the core would be uncovered within 1.9 hours. However, operator action per emergency operating procedure, would actuate the automatic depressurization system at or before the time the water level reached the top of active fuel. After the vessel is depressurized, the operator would initiate reactor vessel makeup water using the diesel-driven fire pump. The licensee noted, however, that the use of the fire pump is not presently credited in the NMP1 SBO coping analysis. After reviewing the supporting documentation and the SAIC's TER, the NRC staff recommends the following action.

Recommendation: The licensee should adhere to the NUMARC and NRC staff agreement of 18 gpm per recirculation pump seal leakage and the Technical Specifications maximum allowable leakage of 25 gpm. For NMP1, which has five recirculation pumps, the total assumed leakage rate is 115 gpm, which will uncover the core in 1.25 hours. To keep the core covered, the licensee should revise its SBO emergency operating procedure (EOP) to initiate RCS depressurization at the proper time to a pressure where the diesel-driven fire pump can be used to inject water into the vessel. The results of a plant specific analysis should be provided to back up this EOP to assure that no more than a momentary core uncovery could occur during the 4-hour SBO period using the modified EOP. The licensee should consider the fire pump as equipment necessary for SBO mitigation. The modified EOP and supporting analysis should be documented in the SBO file at NMP1.

The reactor coolant inventory evaluation was based on the guidance of NUMARC 87-00 of 18 gpm per recirculation pump seal leakage for boiling water reactors. The 18 gpm recirculation pump leakage 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 recirculation pump seal leakage rates than assumed for the RCS inventory evaluation, the licensee should be aware of the potential impact of this resolution on its analysis and actions addressing conformance to the SBO rule.

2.3 Procedures and Training

The licensee stated that the plant procedures, SBO response guidelines, AC power restoration, and severe weather procedures, have been reviewed and the changes necessary to meet the NUMARC 87-00, Section 4, guideline will be implemented.

The NRC staff did not review the procedures or proposed procedure modifications. The NRC staff expects the licensee to maintain and implement these procedures including any others that may be required 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 NRC staff expects the licensee to implement the appropriate training to ensure an effective response to an SBO.

2.4 Proposed Modifications

The licensee stated that it has installed two new Class-1E station batteries, which will meet the required 4-hour SBO loads with no operator actions assumed for the first 30 minutes. The licensee stated that no other modifications are necessary.

2.5 Quality Assurance and Technical Specifications

The licensee provided a copy of the list of equipment necessary to cope with, as well as to recover from, an SBO event. The licensee identified the equipment that is not presently under an appropriate quality assurance program but will be under a program later on.

The 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 NRC 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 NRC staff later determines that 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 will be covered by an appropriate QA program consistent with the guidance of RG 1.155. This evaluation should be documented as part of the documentation supporting the SBO rule response.

2.6 EDG Reliability Program

The licensee's submittal did not specifically address the commitment to implement an EDG reliability program to conform to the guidance of RG 1.155, Position 1.2.

Recommendation: It is the NRC staff's position that an EDG reliability program should be developed in accordance with the guidance of RG 1.155 Position 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 that is to be maintained by the licensee in support of the SBO submittals.

2.8 Scope of Staff Review

The SBO 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 evaluations available for NRC review." The NRC staff and its contractor (SAIC) did not perform a detailed review of the proposed procedural modifications which are scheduled for later implementation. However, based on our review of the licensee's supporting documentation, we have identified the following areas for focus in any follow-up inspection or assessment that may be undertaken by the NRC to verify conformance with the SBO rule. Additional items may be added as a result of the NRC staff review of the actions taken by the licensee in response to this safety evaluation.

a. procedural modifications;

b. SBO procedures in accordance with R.G. 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 CONCLUSION

The NRC staff has reviewed the licensee's responses to the SBO rule (10 CFR 50.63) and the TER prepared by the NRC staff's consultant, SAIC. Based on our review, some additional analyses and verifications as described in the recommendations provided in this safety evaluation need to be completed. These include:

a. ensuring adequate condensate inventory exists to supplement the reactor vessel water inventory;

b. verification of Class-1E battery time-load assignment, last minute load capability to assure dc power to close circuit breakers after a

SBO event, and verification of the battery's capacity to start and carry the turbine emergency bearing oil pump;

c. confirmation that enough compressed air is available to operate the ADS valves if their use is required;

d. reevaluation of the drywell heat-up calculation with a 115 gpm leakage rate and confirmation that the control room and auxiliary control room instrument cabinet doors will be opened within 30 minutes of the onset of a SBO;

e. listing, in an appropriate procedure, all CIVs that cannot be excluded by the NUMARC 87-00 criteria and are either normally closed or open and fail as-is upon loss of AC power, and identification of the actions necessary to ensure the valves are fully closed, if needed;

f. adherence to the NUMARC and NRC staff agreement regarding leakage from the RCS;

g. revision of the SBO EOP to initiate use of the diesel-driven fire pump for injecting water into the vessel;

h. ensuring that the SBO equipment is covered by a QA program consistent with RG 1.155, Appendix A; and

i. implementation of an EDG reliability program in accordance with the guidance of RG 1.155, Position 1.2.

The licensee should include these analyses and confirmation in the documentation supporting the SBO submittal, and maintain this documentation for further inspection and assessment as may be undertaken by the NRC to further verify conformance with the SBO rule.

Based on our review of the submittals, we find the licensee's responses and proposed method of dealing with an SBO to be in conformance with the SBO rule contingent upon receipt of confirmation from the licensee within 30 days that the recommendations documented in this safety evaluation will be implemented. The schedule for implementation should also be provided in accordance with 10 CFR 50.63(c)(4).

4.0 ATTACHMENT

SAIC-91/6661, Technical Evaluation Report, Nine Mile Point Nuclear Power Station Unit 1, Station Blackout Evaluation, May 15, 1991.

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