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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO STATION BLACKOUT

WISCONSIN ELECTRIC POWER COMPANY

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-266 AND 50-301

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 50.63 and requires licensees to provide a plan and schedule for conformance to the SBO rule. The SBO rule further requires that the baseline assumptions, analysis and related information be available for NRC review. Guidance for conformance to the rule is provided by (1) Regulatory Guide (RG) 1.155, "Station Blackout," (2) NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," and (3) NUMARC 87-00, "Supplemental Questions/Answers and Major Assumptions," dated December 27, 1989 (issued to the industry by Nuclear Management and Resources Council, Inc. (NUMARC) 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, 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.

Staff's review does not necessarily include a concurrent site audit review of the supporting documentation. However, a limited number of concurrent site audit reviews were performed to obtain a benchmark for licensee conformance with the documentation requirements of the SBO rule. The Point Beach Nuclear Plant was one of the plants selected by the NRC for a site audit review.

Wisconsin Electric Power Company (WEPCO) has proposed using an existing gas turbine 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 C. W. Fay, WEPCO, to the Document Control Desk of the U.S. Nuclear Regulatory Commission (NRC), dated April 17, 1989. A site audit was performed by a joint NRC/SAIC team headed by an NRC staff member on August 15-18, 1989. On September 26, 1989, WEPCO submitted a letter to the NRC that provided additional information about the status of the gas turbine generator as an alternate AC (AAC) power source for the Point Beach Nuclear Plant. In addition, the licensee provided supplemental responses with respect to the effects of loss of ventilation and gas turbine testing and reliability information by letters from C. W. Fay to the Document Control Desk, Nuclear Regulatory Commission, dated March 30 and June 29, 1990, respectively. The licensee did not specifically respond to the NUMARC 87-00 Supplemental Questions/Answers, stating that this information had been made available during the staff audit.

The licensee responses were reviewed by Science Applications International Corporation (SAIC) under contract to the NRC. The results of the review and the site audit are documented by a SAIC Technical Evaluation Report (TER), SAIC-89/1153, "Point Beach Nuclear Power Plant, Units 1 and 2, Station Blackout Evaluation," dated July 31, 1990 (Attachment No. 1).

2.0 EVALUATION:

After reviewing the licensee's SBO submittals and the SAIC TER and in consideration of the information obtained by the NRC staff during the site audit review and the supplemental information provided by the licensee, 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 8 hours based on an offsite power design characteristic group of "P2," an Emergency AC configuration group "D," and an EDG reliability target of 0.975.

After reviewing the available information from the site audit and in the licensee's submittals, RG 1.155, NUMARC 87-00 and SAIC's TER, the staff agrees with the licensee's evaluation of an 8-hour SBO coping duration.

2.2 Alternate AC (AAC) Power Source

The licensee has proposed to use an existing gas turbine as an AAC power source to operate systems necessary for the required SBO coping duration of 8 hours 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 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 two-unit site as a minimum an AAC source need only be connectable to one set of safe shutdown equipment for each unit, regardless of whether that equipment is part of a safety train or not.

2.2.2 Proposed AAC power source

The licensee proposes to make modifications to an existing gas turbine generator (GTG) and use it as an AAC source to power the safe shutdown loads of both blacked-out units. Point Beach has only two emergency diesel generators (EDG) shared between two units, and a loss of all AC power (loss of offsite power and two EDGs) therefore results in an SBO of both units. The 20 MW GTG has more than adequate capacity to power the safe shutdown loads of both units. The AAC power source would be available to power the loads within 1 hour following an SBO. The licensee stated in its letter dated June 29, 1990, that on June 15, 1990, an 8-hour SBO duration gas turbine test was successfully performed. However, the licensee did not state in its letter whether or not the AAC source was available to power the SBO loads within 1 hour after the onset of the SBO. The staff finds that the proposed AAC power source meets the guidelines of RG 1.155 and NUMARC 87-00, Appendix D, except for the required reliability of 0.95, or better. As discussed in the attached TER, past historical data pertaining to the reliability of the GTG suggests that the GTG may not be able to obtain an acceptable reliability level of 0.95 or better.

Recommendation: The licensee should demonstrate using actual test data that the GTG can obtain and maintain a reliability of 0.95 or better. This demonstration should be completed within a reasonable time period (approximately 2 years). If the demonstration does not indicate an acceptable reliability of 0.95 or better, the licensee should propose an alternative or install another AAC source to meet the guidelines of RG 1.155 and NUMARC 87-00. (By letter dated August 3, 1990 WEPCO advised NRC that two additional EDGs would be installed. That letter did not indicate how the installation would relate to planning for station blackout.)

The licensee should also complete the test to show that the AAC source (GTG) can power the SBO loads within 1 hour after the onset of the SBO.

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 the SBO for the required 8-hour coping duration.

2.3.1 Condensate inventory for decay heat removal

The licensee stated in its SBO submittal that the minimum permissible condensate storage tank inventory of 10,000 gallons per unit (the minimum technical

specification (TS) requirement) along with the initial steam generator fluid inventory is adequate to maintain steam generator decay heat removal capability for the 1 hour required to align the AAC power source. The licensee also stated that after 1 hour, service water from Lake Michigan would be available to provide water to the section of the auxiliary feedwater pumps, if required.

After reviewing the supporting documentation, technical specifications and SAIC's TER, the staff concludes, for the reasons discussed in the attached TER, that the 10,000-gallon TS requirement may not be adequate considering the other priorities that the operators may be engaged in at the end of 1 hour.

Recommendation: The licensee should revise the TS to specify a minimum condensate tank storage inventory of 13,000 gallons per unit to provide assurance that adequate water is available to cope with an SBO for the required 1-hour duration.

2.3.2 Class 1E battery capacity

Initial calculations by the licensee indicate that the Class 1E batteries have sufficient capacity to cope with an SBO for the 1 hour prior to the availability of the AAC power source. However, as noted in the attached TER, the licensee is in the process of updating the battery capacity calculations for all four batteries. Calculations or tests are also needed to assure that the battery voltages are adequate to power the needed equipment after the 1 hour discharge of the batteries.

Recommendation: The licensee should complete the battery capacity calculations in conformance with RG 1.155, Section 3.2, and include the calculations and results in the documentation package supporting the SBO analyses. The licensee should develop and implement any modifications that are required to assure adequate battery capacity to power the needed equipment for an SBO event.

2.3.3 Compressed air

The licensee stated that no air-operated valves are needed to cope with an SBO during the first hour because the decay heat removal system (auxiliary feedwater system) operation is independent of both AC and instrument air systems and because other air operated valves will fail in safe conditions. Based on the statement, the staff agrees with the licensee that the compressed air is not needed to cope with an SBO for 1 hour and, after 1 hour, the AAC power source will supply the compressed air.

2.3.4 Effects of loss of ventilation

The licensee does not expect the temperature rises in the areas of concern to adversely effect equipment operability because all ventilation systems will be restarted within 1 hour after the onset of the SBO. However, the licensee has calculated temperature rises that will occur in 1 hour for the computer, control, cable spreading, auxiliary feedwater pump and smallest vital switchgear rooms.

These calculations showed that heat-up would not become excessive during the 1-hour period prior to the availability of the AAC source for any of these rooms except for the control and computer rooms. The licensee therefore decided to remove a sufficient number of ceiling tiles in these rooms to limit the heatup to an acceptable value by permitting circulation between the air volumes below and above the "drop ceilings." These modifications have been completed.

However, as noted in the attached TER, the licensee's heat-up calculations are based on methods other than those identified in NUMARC 87-00. The information provided is not sufficient to assure the NRC staff that the methodology used has been verified as to its accuracy, or that it has been found acceptable for the purpose for which it has been used. Also, more information is needed regarding the assumptions and initial conditions used in the calculations.

In particular, the licensee needs to address the concerns expressed in the attached TER regarding the basis for selecting the number and location of the ceiling tiles that have been removed in the control and computer rooms, and the basis for assuming that cabinet doors do not need to be opened in the control room.

Recommendation: 1) The licensee should document additional information to demonstrate the acceptability of the methodology, assumptions, adjacent room effect, and initial conditions used in the heat-up calculations. 2) The licensee also should confirm that the assumed initial room temperatures for the control and computer rooms are maximum allowable values and not just typical values, and if necessary, the room heat-up calculations for these two rooms should be reanalyzed based on the higher initial temperature. 3) The licensee should document additional justification as to why it is not necessary to open cabinet doors in the computer room, and the basis used for determining the number of and location of ceiling tiles that were removed in the control and computer rooms. 4) The licensee should describe the controls that are to be used to assure that the ceiling tiles are not replaced or reconfigured in the future. The licensee should maintain the additional information and any analyses performed as a result of these recommendations in the documentation supporting the SBO submittal.

2.3.5 Containment isolation

The licensee stated that the plant list of containment isolation valves needed for containment isolation was reviewed to verify that containment isolation is attainable and maintainable during an SBO. After reviewing the available documentation and the SAIC TER, the staff finds that the licensee's analysis is in conformance with RG 1.155, Section 3.2.7. The staff therefore concludes that the appropriate containment integrity can be maintained during an SBO for the required duration.

2.3.6 Reactor coolant inventory

The licensee stated that reactor coolant system (RCS) inventory would be reduced by reactor coolant pump (RCP) seal leakage, but adequate initial RCS inventory is available for the 1 hour prior to bringing the AAC power on line.

A review of reactor coolant inventory shows that the initial RCS inventory is adequate for the 1 hour prior to the availability of the AAC power source. After the AAC power source becomes available, full RCS make-up capacity is established. The staff therefore agrees with the licensee that the reactor coolant inventory will be adequately maintained to ensure core cooling for the required coping duration.

2.4 Procedures and Training

The licensee currently has Emergency Operating Procedures (EOPs) for loss of all AC power including the use of the GTG as an alternate source of AC power. The staff concludes that the current procedures are applicable for an SBO, except that they should be reviewed after modifications currently being made to the 13.8 kV distribution system are completed, to assure that these changes are taken into account. An additional EDG is also being considered and the procedures may need to be modified to reflect this addition if it is made. The licensee has committed to a review and revision of the procedures if the new EDG is installed.

Recommendation: The EOPs should be reviewed and modified accordingly if necessary to account for any changes made to the EDG/GTG configuration or the associated 13.8 kV system, and appropriate training should be implemented to ensure an effective response to the SBO.

2.5 Proposed Modification

The licensee is currently modifying the 13.8 kV distribution system to improve its reliability and to separate the Unit 1 and Unit 2 offsite power sources. These modifications are not considered to be SBO modifications. By letter dated August 3, 1990, WEPCO stated they are purchasing two additional emergency diesel generators. If the EDGs are added to complement the existing EDGs, then they may be used to change the emergency AC configuration group from "D" to "C" and thereby reduce the required SBO coping duration for the Point Beach plant. If they are installed as independent AAC sources, they would need to be sized to have sufficient capacity for powering the SBO loads of both units; or if installed as a supplementary AAC source to the existing GTG they may be used for justifying a lower GTG reliability requirement than 0.95, depending on how the EDG is electrically connected and used in the plant.

Recommendation: Installation of additional EDG capacity. The SBO coping duration and evaluation would have to be re-evaluated subsequent to the licensee providing information on the installation.

2.6 Quality Assurance and Technical Specifications

The licensee has committed to incorporate equipment used to cope with an SBO and not covered by current QA programs into a QA program that meets the guidance of RG 1.155, Appendix A. The staff finds this to be an acceptable commitment.

The technical specifications (TSs) for the SBO equipment are currently being considered generically by the NRC in the context of the TS 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 TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

2.7 EDG Reliability Program

The licensee's submittal on SBO did not specifically address the 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 their reliability program would meet these guidelines. The staff finds this to be an acceptable commitment toward meeting the requirements of the SBO rule.

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 evaluations available for NRC review." The staff or its contractor (SAIC) did not perform a detailed review of the proposed hardware and procedural modifications which are scheduled for later implementation. Therefore, based on its review of the licensee supporting documentation and SBO audit, the staff has 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.

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,

f. AAC power source (Gas Turbine Generator and associated systems necessary for operation) meets the guidelines of RG 1.155, C.3.3.5.5, and reliability test data indicates that the AAC source can realistically obtain and maintain a reliability of 0.95 or better,

g. Heating and ventilation calculations for the areas of concern during an SBO show that the systems and equipment therein are operable under the SBO conditions,

h. Class 1E battery and DC voltage drop calculations show that the batteries are adequate for the 1 hour prior to the availability of the AAC power source,

i. Test data shows that the GTG can power the SBO loads within 1 hour of the onset of the SBO; and

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

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. Based on the staff's review, additional analyses and confirmations described in the recommendations provided in this SE need to be completed. These include obtaining test data to establish that the GTG can realistically obtain a 0.95 reliability index, establishing testing and surveillance procedures to assure the GTG reliability is maintained at an acceptable level, a test to demonstrate that the GTG can power SBO loads within 1 hour following an SBO, condensate storage tank (CST) technical specification revision, battery capacity calculations, and additional information and bases for heat-up calculations in the identified areas containing equipment and systems needed to cope with an SBO for 8 hours. The licensee should maintain these analyses and other documentation supporting the SBO submittal available for further inspection and assessment as may be undertaken by the NRC to further verify conformance with the SBO Rule. Based on its review of the submittal and site audit, the staff finds the licensee's design 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 identified in this SE will be implemented. The schedule for implementation should also be provided in accordance with 10 CFR 50.63(c)(4).

Attachment: Technical Evaluation Report
SAIC-89/1153

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Date: