UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO RESPONSE TO THE STATION BLACKOUT RULE (10 CFR 50.63)

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THREE MILE ISLAND NUCLEAR STATION, UNIT NO. 1

DOCKET NO. 50-289

1.0 INTRODUCTION:

On July 21, 1988, the Nuclear Regulatory Commission (NRC) amended its regulations in 10 CFR Part 50 by adding a new section, 50.63, "Loss of All Alternating Current Power," (1). The objective of this requirement is to assure that all nuclear power plants are capable of withstanding a station blackout (SBO) and maintaining adequate reactor core cooling and appropriate containment integrity for a required duration. This requirement is based on information developed under the Commission study of Unresolved Safety Issue A-44, "Station Blackout" (2-6).

To provide guidance for meeting the requirements of 10 CFR 50.63, the NRC staff issued Regulatory Guide (RG) 1.155 (7). Concurrent with the development of this Regulatory Guide, the Nuclear Utility Management and Resource Council (NUMARC) developed a document entitled, "Guidelines and Technical Basis for NUMARC Initiatives Addressing Station Blackout At Light Water Reactors," NUMARC 87-00 (8). The document provides detailed guidelines and procedures on how to assess each plant's capabilities to comply with the station blackout rule. After reviewing the NUMARC document, the NRC staff has endorsed the document as a guide for addressing the 10 CFR 50.63 requirements.

In order to achieve a consistent response to the SBO rule and to expedite the staff review process, two generic response documents were developed by NUMARC and reviewed by the NRC staff. The plant-specific submittals using the generic format provide a summary of results of the analysis of the plants' station blackout coping capability. The licensees are expected to ensure that the baseline assumptions used in NUMARC 87-00 are applicable to their plants and to verify the accuracy of the stated results. Compliance to the SBO rule is verified by review and evaluation of the licensee's submittal, audit review of the supporting documents as deemed necessary, and possible follow up NRC inspections to assure that the licensee has implemented the necessary hardware and procedure changes to comply with

the SBO rule. A normal SBO review does not 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. No audit review was performed at TMI-1.

The licensee's response to the SBO rule was provided by letter C311-89-2018 from H. D. Hukill to U. S. Nuclear Regulatory Commission, dated April 17, 1989(10). The staff has reviewed this response and prepared the following evaluation.

2.0 EVALUATION:

2.1 Station Blackout Duration

For the determination of the proposed minimum acceptable SBO duration, the following factors are reviewed: a) offsite power design characteristics, b) emergency ac power system configuration, c) determination of the emergency diesel generator (EDG) reliability consistent with NSAC-108 criteria (9), and d) determination of the accepted EDG target reliability. Once these factors are known, Table 3-8 of NUMARC 87-00 or Table 2 of RG 1.155 provides a matrix for determining the required coping duration.

The licensee calculated a minimum acceptable SBO duration of 4 hours for the Three Mile Island Nuclear Generating Station, Unit 1 (TMI-1) site. The licensee based an SBO duration on the following factors:

1. Offsite Power Design Characteristics

   The plant AC power design characteristic group is P2, based on:

   a. Independence of the plant offsite power system characteristics of I 1/2,

   b. Expected frequency of grid-related LOOPs does not exceed once per 20 years,

c. Estimated frequency of LOOPs due to extremely severe weather places the plant in ESW group 3,

d. Estimated frequency of LOOPs due to severe weather places the plant in SW group 2,

2. Emergency AC (EAC) Power Configuration Group

The EAC power configuration of the plant is "C". TMI-1 is equipped with two emergency diesel generators which are normally available to the unit safe shutdown equipment. One [illegible] supply is necessary to operate safe shutdown equipment following a LOOP.

3. Target Emergency Diesel Generator Reliability

TMI-1 has selected a target reliability of 0.975. TMI-1's nuclear unit average EDG reliability has been better than 0.95 over the last 100 starts.

After reviewing the above factors, the staff found them to be properly evaluated. The licensee's estimation of the frequency of LOOPs due to ESW and SW is consistent with the NRC provided data given in NUMARC 87-00. The licensee provided a breakdown of the EDG reliability as follows:

	EDG-1	EDG-2
Last 20 starts	1.00	1.00
Last 50 starts	0.96	0.96
Last 100 starts	0.97	0.97

The licensee expects continued high diesel reliability because the EDGs are continually prelubed and warmed and a formalized EDG preventive maintenance program has been effective in maintaining high EDG reliability.

2.2 Alternate AC Power Source

The proposed use of an alternate AC power source is reviewed to determine whether it meets the criteria and guidelines of Position 3.3.5 of RG 1.155 and Appendix B of NUMARC 87-00. If the alternate AC source (s) meet these requirements and can be demonstrated by test to be available to power the shutdown buses within 10 minutes of the onset of the station blackout, then no coping analysis is required.

The licensee proposes to use an existing emergency diesel generator (EDG) that was installed for TMI-2 as the Alternate A.C. (AAC) power source for TMI-1. Modifications will be made so that it becomes independent of TMI services, e.g., TMI-2 Nuclear Services cooling water. Electrical modifications would be made to provide connectability of this AAC source to the TMI-1 emergency buses 1C, 1D and 1E (See Figure 1). Electrical modifications will also be made so that the diesel generator (AAC source) auxiliaries (heaters, air compressors, etc.) are normally fed by TMI-1 balance of plant (BOP) electrical power. DC power, independent of that used for TMI-1 will be used to supply the AAC source and its associated breaker control. The control switches for the feeder breakers to 4kV busses 1C, 1D and 1E presently exist on the TMI-1 control console. However, modifications will be necessary to make them operational.

The AAC power source is located in the TMI-2 Diesel Generator Building which is a Seismic Category I concrete structure. Electrical cable between the AAC source and the TMI-1 buses will be run within plant structures and therefore adequately protected from weather-related events.

The normal position of the 4kV breakers are shown on Figure 1. The feeder breakers to buses 1C, 1D and 1E will be interlocked so that only one breaker can be closed at any time.

In the event of an SBO the feeder breaker to buses 1C, 1D and 1E will either trip open on undervoltage or be already open. Undervoltage will also automatically start the AAC supply.

The operator in the control room can provide power from the AAC supply to either Bus 1E or 1D by manually closing the corresponding 4kV feeder breaker. The operator can then manually load the necessary shutdown loads on the appropriate Bus 1E or 1D. Once the AAC supply is providing power to 4kV bus 1E or 1D, the operator actions are essentially identical to that under loss of offsite power with only one EDG operating.

The AAC source will be available within ten minutes from the onset of an SBO event and has sufficient capacity and capability to operate the systems necessary for coping with a station blackout for the required SBO duration (four hours) to bring and maintain the plant in safe shutdown. This will be demonstrated by an initial test.

Failure of AAC components will not adversely affect Class 1E AC power systems and the AAC source will not normally be connected to the preferred or onsite emergency AC power system.

No single active failure or weather-related event will disable both the emergency onsite AC power sources and simultaneously fail the AAC power source.

The AAC power source will be started and brought to operating conditions (loaded) at intervals not less than a quarterly frequency in accordance with plant procedures. Once every refueling period, a timed start and rated load capacity test will be performed to verify that the AAC source is capable of providing power to the safe shutdown bus within 10 minutes. Portions of the AAC power system subjected to maintenance will be tested prior to returning the AAC power system to service.

GPUN will set a target reliability goal of 0.95 per demand, as determined in accordance with NSAC-108 methodology, for the AAC system.

The applicable portions of the QA guidance contained in RG 1.155, Appendix A will be implemented for the AAC system.

After reviewing the licensee's submittal, the staff found that the submittal did not specifically address the following items of NUMARC 87-00, Appendix B.

B.8.b	The AAC should have an independent air start system
B.8.c	The AAC should have an independent fuel oil supply
B.8.f	The AAC should not depend on any of the blacked out unit's support systems powered from the preferred power supply.

A telecon with the licensee confirmed that the AAC source does meet the above criteria. Although the TMI-1 EDGs and the proposed AAC source will utilize the same main fuel oil storage tank, the AAC source has a separate day tank and a separate 25,000 gallon storage tank located in the TMI-2 building.

The telecon also disclosed that the proposed AAC diesel generator is essentially the same size and type as the TMI-1 EDGs except that the AAC EDG has a water cooled system instead of a shaft driven air cooled system. Provisions will therefore be required to provide a cooling system for the AAC EDG that is independent of offsite power or TMI-1 power sources. The licensee has not finalized the preferred method for doing this. Thus, the modification will be subject to review by the NRC.

The licensee's submittal addressed each of the other criteria of Appendix B of NUMARC 87-00 and our review of the submittal indicates that the AAC source meets all of these criteria. We therefore find that the AAC source meets the requirements of NUMARC 87-00 and RG 1.155 and is therefore acceptable provided the AAC source is cooled independent of TMI-1 power sources.

2.3 Station Blackout Coping Capability

The SBO coping capability is reviewed to assess the availability, adequacy and capability of the plant systems and components needed to achieve and maintain a safe shutdown and recover from an SBO of acceptable duration. To assure an

acceptable SBO coping capability, guidelines for a coping analysis are given in RG 1.155, Position 3.2. Using the RG 1.155 guidelines, the licensee has submitted and the NRC staff has reviewed the following information:

2.3.1 Condensate inventory for decay heat removal

The licensee's analysis has shown that 56,804 gallons of water are required for decay heat removal for the proposed SBO duration of 4 hours. The minimum permissible condensate storage tank (CST) level per technical specifications provides 150,000 gallons of water for each of two tanks. The licensee has indicated that no plant modifications or procedure changes are needed to utilize this water source.

After reviewing the supporting documentation and the technical specifications, the staff agrees with the licensee's assessment that the plant has adequate condensate inventory for the 4-hour SBO duration. In addition, the excess inventory available in the CST can be used to assist in SBO recovery.

2.3.2 Effects of loss of ventilation

The licensee states that the AAC power source will provide power to HVAC systems serving the dominant areas of concern, and therefore no further assessment on the effects of loss of ventilation was made. The licensee also states that no modifications and/or procedures are required to provide reasonable assurance for equipment operability.

Since the AAC source will be available within 10 minutes and will provide power to the HVAC systems serving the dominant areas of concern, the staff has determined that the equipment and systems necessary to cope with the SBO will not become inoperable due to excessive heat and lack of ventilation. This is contingent upon the control room, which was not identified by the licensee as a dominant area of concern, being cooled by the HVAC system(s) powered by the AAC source.

2.3.3 Reactor coolant inventory

The licensee states that the AAC source will power the necessary make-up systems to maintain adequate reactor coolant system inventory to ensure that the core is cooled for the required coping duration.

The AAC source will be available within 10 minutes to power either division emergency bus and its associated equipment. In addition, the AAC source has the capacity and capability of the normal EDGs, therefore, the staff has determined that adequate reactor coolant system inventory will be maintained.

2.3.4 Analysis of the remaining guidelines as set forth in RG 1.155

The staff has determined that in accordance with 10 CFR 50.63(c)(2) no coping analysis is required for the Class 1E battery, compressed air and containment isolation since the AAC source will be available in 10 minutes, is equivalent in capacity to the existing EDGs and can power either divisional safety train.

2.4 Proposed Procedures and Training

Pursuant to RG 1.155 and NUMARC 87-00, plant procedures and training must be revised or added to cope with an SBO and to restore normal long term core cooling once AC power is restored.

The licensee states that plant procedures have been reviewed and have been or will be modified as necessary, to meet the guidelines in NUMARC 87-00, Position 4 in the following areas:

1. AC power restoration (File #394) is sufficient as it currently exists.

2. Severe weather (EP 1202-33) is sufficient as it currently exists.

3. Procedures ATP 1210-1, ATP 1210-10 and EP 1202-2A are sufficient as they currently exist for the time prior to AAC power availability.

4. Procedure changes associated with the modifications for the AAC will be made on a schedule consistent with the completion of the modifications.

After reviewing the licensee's submittal, the staff found that the licensee did not specifically address training requirements for utilization of the AAC source. However, the licensee confirmed by telecon that such training will be implemented consistent with the completion of the modifications. Although the staff has not actually reviewed the individual procedures, the licensee has indicated that appropriate procedures exist. Therefore, the staff finds the licensee's response to be acceptable.

2.5 Proposed Modifications

To comply with the guidance of RG 1.155 and NUMARC 87-00, plant modifications will be necessary. The additions required for the AAC supply are shown in Figure 1. The AAC supply will be provided by modifying what is currently a TMI-2 EDG so that it is independent of TMI-2 support services, e.g., TMI-2 Nuclear Services cooling water. Also, modifications are necessary so that the EDG auxiliaries (heaters, air compressors, etc.) are normally fed from TMI-1. DC power, independent of that used for TMI-1 functions, will be used to supply the EDG and its associated breaker control. The cable that will be used to connect the AAC to the existing breakers on the 4kV buses 1C, 1D and 1E must be installed. Modifications are required to the existing control switches on the TMI-1 control console for control of the infeed breakers to buses 1C, 1D and 1E. These infeed breakers are interlocked so that no more than one breaker can be closed at any time.

The licensee states that the modifications and procedural changes associated with these modifications are currently scheduled for the Fall of 1991, assuming receipt of notification by the NRC of their acceptability by October 17, 1989.

After reviewing the licensee's submittal, the staff found that the submittal did not describe the DC and AC power source that would be used for the AAC, nor the method of interlocking the infeed breakers to buses 1C, 1D and 1E. This was clarified by telecon. The licensee states that the breakers will be interlocked using auxiliary contacts of the breakers. The size and exact location of the AC and DC auxiliary power supplies are still under evaluation. However, they will be located in the TMI-2 building.

With the above clarification, the staff finds the licensee's description of the proposed modifications to be generally acceptable. However, specific details of the modifications will be subject to review by the NRC, including assurance that the AAC source cooling water and other equipment needed by the AAC source following a station blackout is independent of TMI-1 power sources.

2.6 Quality Assurance and Technical Specifications

The licensee states that the applicable portions of the QA guidance contained in Regulatory Guide 1.155, Appendix A will be implemented for the AAC system. With respect to Technical Specifications, the licensee states that consistent with NRC Proposed Policy on Technical Specification Improvement, Technical Specification requirements are not applicable to the AAC power system.

The staff finds the licensee's commitment to the QA guidance of Regulatory Guide 1.155 to be acceptable.

The question of how specifications for SBO equipment will be applied is currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains as 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 Technical Specification regarding 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. However, during a telecon, the licensee stated that they believed their present EDG reliability program meets the guidelines of RG 1.155. We consider this to be an acceptable commitment for the EDG reliability program.

2.8 Scope of Staff Review

The station blackout rule (10CFR 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 did not review this supporting documentation, or the proposed hardware and procedure modifications (which are scheduled for later implementation). However, based on our review of the licensee response, we have identified the following areas for any followup inspection or assessment that may be undertaken by the NRC to further verify conformance with the SBO rule:

a. The hardware and procedural modifications associated with the AAC source.

b. Assurance that the AAC source powers the control room area HVAC systems and the control room remains fully functional, operable and manned.

c. The correctness of the EDG reliability data in accordance with RG 1.155, Position 1.1,

d. The preparation and the implementation of the plant SBO procedures in accordance with RG 1.155, Position 3.4, and NUMARC 87-00, Position 4,

e. The requirement for operator staffing and training to follow the identified actions in SBO procedures, and

f. The implementation of a quality assurance program and technical specifications for SBO equipment as guided in RG 1.155, Position 3.5.

3.0 CONCLUSIONS:

The staff has reviewed the licensee's response to the station blackout rule (10CFR 50.63) and finds that it meets the requirements of the rule and the criteria of NUMARC 87-00 and Regulatory Guide 1.155. We therefore find the licensee's response and proposed method of dealing with an SBO provide reasonable assurance that full conformance with the station blackout rule will be attained.

The licensee has committed to an expected completion of the required plant modifications and associated procedural changes and training by the end of refueling outage 9R, which is scheduled for the Fall of 1991, provided NRC acceptance of the proposed coping method is received by October 17, 1989. This condition was met by telecon notification to the licensee prior to this date that the SBO response had been reviewed by the staff and found acceptable.

4.0 REFERENCES:

1. The Office of Federal Register, "Code of Federal Regulations Title 10 Part 50.63," 10 CFR 50.63, January 1, 1989.

2. U.S. Nuclear Regulatory Commission, "Evaluation of Station Blackout Accidents at Nuclear Power Plants - Technical Findings Related To Unresolved Safety Issue A-44," NUREG-1032, Baranowsky, P.W., June 1988.

3. U.S. Nuclear Regulatory Commission, "Collection and Evaluation of Complete and Partial Losses of Offsite Power at Nuclear Power Plants," NUREG/CR-3992, February 1985.

4. U.S. Nuclear Regulatory Commission, "Reliability of Emergency AC Power System at Nuclear Power Plants," NUREG/CR-2989, July 1983.

5. U.S. Nuclear Regulatory Commission, "Emergency Diesel Generator Operating Experience, 1981-1983," NUREG/CR-4347, December 1985.

6. U.S. Nuclear Regulatory Commission, "Station Blackout Accident Analyses (Part of NRC Task Action Plan A-44)," NUREG/CR-3226, May 1983.

7. U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research, "Regulatory Guide 1.155 Station Blackout," August 1988.

8. Nuclear Management and Resources Council, Inc., "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors," NUMARC 87-00, November 1987.

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

10. Letter from H. D. Hukill to U.S. Nuclear Regulatory Commission, GPU Nuclear Corporation, Serial No. C311-89-2018, April 17, 1989.

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