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

February 13, 1991

Docket No. 50-293

Mr. George W. Davis
Senior Vice President - Nuclear
Boston Edison Company
Pilgrim Nuclear Power Station
PFD #1 Rocky Hill Road
Plymouth, Massachusetts 02360

Dear Mr. Davis:

SUBJECT: SAFETY EVALUATION OF THE PILGRIM NUCLEAR POWER STATION RESPONSE TO THE STATION BLACKOUT RULE (TAC NO. 68585)

By letters dated April 17, 1989, March 28, 1990, and August 31, 1990, Boston Edison Company submitted information in response to the Station Blackout (SBO) rule. The licensee also provided additional information in a telphone conversation between the staff and the licensee on December 20, 1989. The responses were reviewed by an NRC contractor, Science Application International Corporation (SAIC), and the NRC/DST staff. Enclosure 1 is our Safety Evaluation (SE) of the licensee's responses and the asscciated SAIC Technical Evaluation Report (TER) SAIC-90/1375, "Pilgrim Nuclear Power Station, Station Blackout Evaluation," dated January 14, 1991 (Attachment 1 of Enclosure 1). Boston Edison Company has proposed to use an already installed non-Class 1E Diesel Generator as an alternate AC (AAC) power source and has submitted its response in the SBO generic response format.

We find the licensee's response and the proposed method of dealing with an SBO to be acceptable. However, the approval is contingent upon verification that the AAC power source (diesel generator) is load tested in its SBO configuration after modifications are complete; reevaluation of the condensate inventory by considering 18 gpm seal leak rate per RCS pump and depressurization of the reactor pressure vessel; provision of appropriate cooling for the rooms containing heat generating sources; assurance that the torus temperature and the reactor vessel conditions are maintained according to the plant Technical Specifications; verification that the SBO equipment is covered by an appropriate QA program consistent with the guidance of RG 1.155; and confirmation that an EDG reliability program has been or will be implemented for maintaining the selected reliability targets. Your response to these items should indicate that the item is complete and/or indicate the expected completion date. Documentation concerning these items should be available as part of the package supporting the SBO rule response.

In addition, the following areas may require follow-up inspection by the NRC to verify that the implementation of any modifications and the supporting documentation which the licensee may propose as a result of this evaluation are adequate to meet the Station Blackout Rule. Inspection guidance for this is being developed as follows:

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

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

The guidance provided on Technical Specifications (TS) for an SBO states that the TS should be consistent with the Interim Commission Policy Statement on Technical Specifications. The staff has taken the position that TS are required for SBO response equipment. However, the question of how specifications for the SBO equipment will be applied is currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains an open item at this time. In the interim, 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 TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

Sincerely,

Original signed by
Susan F. Shankman, Acting Director
Project Directorate I-3
Division of Reactor Project - I/II
Office of Nuclear Reactor Regulation

Enclosures:
As stated

cc: See next Page

LA:PDI-3	PDI-3/PM	PM:PDI-3	PD:PDI-3
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[PILGRIM LTR 68585]

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ENCLOSURE 1

PILGRIM NUCLEAR POWER STATION
STATION BLACKOUT SAFETY EVALUATION

1.0 INTRODUCTION:

On July 21, 1988, the Code of Federal Regulations 10CFR Part 50, was amended to include a new Section 50.63 entitled, "Loss of All Alternating Current Power," (Station Blackout). The station blackout (SBO) rule requires that each light-water-cooled nuclear power plant be able to withstand and recover from an SBO of specified duration, requires licensees to submit information as defined in 10 CFR Part 50.63, and requires licensees to provide a 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 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.

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

*Nuclear Management and Resources Council, Inc.

applicable generic response format. The licensee's original response was provided by letters from R. G. Bird (Boston Edison) to U. S. Nuclear Regulatory Commission (NRC) dated April 17, 1989, March 28, 1990, and August 31, 1990. In addition, the licensee provided a response to the questions raised during a telephone conversation between NRC/Science Applications International Corporation (SAIC) and the licensee on December 20, 1989. The licensee responses were reviewed by SAIC under contract to the NRC. The results of the review are documented by a SAIC Technical Evaluation Report (TER), SAIC-90/1375, "Pilgrim Nuclear Power Station, Station Blackout Evaluation," dated January 14, 1991 (Attachment No. 1).

2.0 EVALUATION:

After reviewing the licensee's SBO submittal and the SAIC TER, the staff concurs with the conclusions as identified in the SAIC TER (refer to 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

Originally, the licensee had calculated a minimum acceptable SBO duration of 16 hours but changed it to 4 hours based on an offsite power design characteristic group of "P2," an Emergency AC configuration group "C," and an emergency diesel generator (EDG) reliability target of 0.975. The target EDG reliability was based on Pilgrim EDGs having an average reliability greater than 0.95, 0.94, and 0.90 for the last 100, 50, and 20 demands respectively. The P2 grouping was based on an independence of offsite power classification of Group "I3," a severe weather (SW) classification of Group "2," and an extremely severe weather (ESW) classification of Group "4."

The licensee did not use the data provided in Table 3-3 of NUMARC 87-00 for the recommended annual expectation of storms with significant salt spray, and stated that recent modifications in the switchyard would reduce the salt-spray related offsite power loss. Based on this, the licensee estimated the site as

SW Group "2." The licensee did not provide sufficient data to support this assumption and, therefore, the site is assigned as SW Group "4."

NUREG/CR-3992 indicates that Pilgrim nuclear plant had two grid-related LOOPs prior to 1984. Review of these indicated that they were not symptomatic of underlying or growing grid instability, therefore, they were not considered.

The EAC classification is correctly classified as "C." The licensee's assignment of the EDG target reliability is consistent with the guidance provided in RG 1.155. In addition, the NSAC-108 indicates that the EDGs at Pilgrim experienced an average of 39 valid start demands per year with an average unit reliability of 0.993 per diesel per year. Therefore, we find the target EDG reliability of 0.975 selected by the licensee to be acceptable.

After reviewing the available information in the licensee's submittal, RG 1.155, NUMARC 87-00, and SAIC's TER, the staff finds that the offsite power design characteristic group of the Pilgrim site is "P3" with a minimum required duration of 8 hours.

2.2 Alternate AC (AAC) Power Source

The licensee has proposed to install an independent AAC power source to operate systems necessary for the required SBO coping duration and recovery therefrom.

2.2.1 General staff position on AAC power sources

The definition in 10CFR §50.2, RG 1.155 and NUMARC 87-00 define AAC power source in terms of four attributes: (1) connections to the offsite or the onsite AC power systems, (2) minimum potential for common cause failure with offsite power or the onsite emergency AC power sources, (3) timely availability, and (4) required capacity and reliability. More specifically, in regard to the fourth attribute, the SBO rule reads as follows:

> "(4) Has sufficient capacity and reliability for operation of all systems required for coping with station blackout and for

the time required to bring and maintain the plant in safe shutdown (non-design basis accident)."

In view of the variety of types, capacities, and capabilities of power sources proposed as AAC sources by various licensees, the staff has characterized proposed AAC power sources as being either optimum, fully capable, or partially capable. This characterization, which relates only to the capacity attribute cited above, was necessary in order to facilitate the staff review of licensee responses to the SBO rule. It does not invalidate or revoke any of the requirements or guidance applicable to AAC power sources.

An optimum AAC power source design is one that is capable of powering simultaneously both safety trains of normal safe shutdown systems and equipment. Such a design, following actuation of the AAC source, would provide completely redundant normal safe shutdown capability during an SBO and recovery therefrom from the main control room.

A fully capable AAC power source design is one that is capable of powering at least one complete safety train of normal safe shutdown systems and equipment. This includes decay heat removal, battery charging, HVAC (heating, ventilation, and air conditioning), emergency lighting, and the associated controls and instrumentation. Thus, although redundant capability is not available, a fully capable AAC source would enable attainment of safe shutdown during an SBO and recovery therefrom from the main control room.

A minimally capable AAC power source design is one that is not capable of powering all (or any) normal safety train related safe shutdown equipment; but it is capable of powering specific equipment that, in conjunction with extensive manual operator actions both inside and outside of the control room, is critical for attaining safe shutdown during an SBO. Appendix R diesels proposed as an AAC source are examples of minimally capable AAC sources. With this design, operability of the main control room could not be assured unless the batteries were sized to operate for the SBO duration, or battery charging capability was provided by the AAC source.

2.2.1.1 Connectability of AAC power sources

The basic criteria governing the connectability of an AAC power source are contained in 10 CFR 50.2 (the AAC source should be connectable to but normally not connected to the offsite or onsite emergency AC power systems) and 10 CFR 50.63 (SBO should not assume a concurrent single failure or design basis accident). Therefore, in a one unit site as a minimum an AAC source need only be connectable to one set of safe shutdown equipment, regardless of whether that equipment is part of a safety train or not.

2.2.2 Proposed AAC power source

The proposed AAC power source for Pilgrim is an already installed non-Class 1E independent diesel generator with a 2000 KW capacity. The licensee's submittal states that this power source will be available within 10 minutes of the onset of the SBO event, and has sufficient capacity and capability to provide power for safe shutdown of the unit.

The SBO diesel generator is rated at 2000 KW continuous and 2200 KW at the 2 hour rating. The review of Table 8.5-1 of the plant UFSAR indicates that 2000 KW of AC loads need to be supported after a LOOP event. However, in response to a question raised during the telephone conversation on December 20, 1989, the licensee provided a breakdown of the list of LOOP loads that are expected to be carried by one of the two EDGs. This list shows that the LOOP loads, including the short term loads, on EDG "A" and "B" to be 2,219.5 and 2,323.3 KW, respectively. Without the short term loads, the estimated continuous loads on EDG "A" and "B" are 2,080.9 and 2,184.7 KW, respectively. The licensee stated that the 4 KV control rod drive (CRD) pump (227 KW), and the 480 V loads that are not required during an SBO event will be shed. In addition, the licensee provided a list of loads that are expected to be carried by the SBO-DG. The sum of these loads, according to the licensee, is approximately 1,750 KW. The 1,750 KW does not include the loads associated with the turbine generator auxiliaries, CRD pump, and the motor operated valves loads. Based on the above, the proposed AAC power source will be able to carry the expected SBO loads in

accordance with paragraph B.9 of Appendix B, NUMARC 87-00, and is, therefore, acceptable. The staff assessment of the proposed AAC source indicates that it falls into the fully capable AAC power source category cited above. However, paragraph B.12 of NUMARC 87-00, Appendix B, states that the AAC system should be demonstrated by initial test to be capable of powering the necessary equipment within 10 minutes and should be capable of maintaining the voltage and frequency within the limits of established industry standards.

Recommendation: A test of the operability of the 4kV and 480V crosstie circuits under SBO conditions should be performed to ensure that the AAC source meets the guidelines 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 capability to achieve and maintain a safe shutdown and recover from an SBO for an 8-hour coping duration.

2.3.1 Condensate inventory for decay heat removal

The licensee's submittal states that 81,029 gallons of water are required to provide decay heat removal for an 8-hour SBO duration. The RCS leakage is assumed to be 25 gpm representing the maximum allowed Technical Specification leakage during plant operation. The minimum permissible condensate storage tank (CST) level during refueling per Technical Specifications provides 200,000 gallons of water. The site has two CSTs, each containing a minimum of 75,000 gallons for the operation of high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) systems.

For calculating the total condensate requirements, the licensee did not consider the potential RCS leakage through the recirculation pump seals. The licensee states that per GEK 9651, recirculation pump leakage of 18 gpm per pump can only be established if the mechanical seals are not installed. The

pump seal leak rate should not be considered since the pumps have mechanical seals. Therefore, including the RCS leakage of 18 gpm per pump seal, the condensate requirement to cope with an SBO of 8-hour duration is 100,300 gallons. Since each CST has a minimum of 75,000 gallons of condensate during plant operation, we conclude that the site has sufficient condensate to remove decay heat during an 8-hour SBO event. However, during an 8-hour SBO event, the plant may need to be depressurized and cooled down. The licensee states that the Technical Specification 3.7.h requires that during reactor isolation conditions the reactor pressure vessel be less than 200 psig, if the suppression pool bulk temperature reaches 120°F. By using one RHR pump during suppression pool cooling, the suppression pool bulk temperature will exceed 120°F within 2 hours of an SBO event. This is based on the assumption that all the RCS leakage and the decay heat are dumped into the suppression pool. Therefore, the licensee should estimate the condensate requirements for maintaining RCS inventory during depressurization and to verify that the site has sufficient condensate inventory for coping with an SBO of eight hour duration.

Recommendation: The licensee should estimate the condensate requirements for maintaining RCS inventory during depressurization, and to verify that the site has sufficient condensate inventory for coping with an SBO of 8 hours duration.

2.3.2 Class 1E battery capacity

Since the AAC power source is available within 10 minutes of the onset of an SBO event, the licensee was not required to perform any additional calculations to meet the requirement of the SBO rule. A review of the LOOP loads indicates that one division of battery chargers will be available within 10 minutes. Therefore, the station battery should have sufficient capacity to support the required loads during an SBO event.

2.3.3 Compressed air

The licensee did not address the compressed air system in his submittal on the basis that a 10 minute AAC power source will be available. As indicated in the

Attachment 1 (SAIC TER), one air compressor is powered from the proposed AAC source within 10 minutes. Therefore, the plant has sufficient capacity of compressed air to cope with an SBO event.

2.3.4 Effects of loss of ventilation

The licensee stated in their SBO submittal that the AAC power source will power the heating, ventilation, and air conditioning (HVAC) systems that serve the dominant areas of concern (DAC). As a result, the licensee did not submit a loss of ventilation assessment. The licensee's action is consistent with NUMARC 87-00 Sections 7.2.1 and 7.2.4. However, the licensee should ensure that other areas containing the reactor building closed loop cooling pumps, turbine building closed loop cooling pumps, vital instrumentation MG set, battery chargers, emergency switchgear, and the emergency 4160/480V transformers have appropriate cooling or have been analyzed to show that they are not DACs.

Recommendation: The licensee should ensure that other areas which have equipment needed for an SBO have appropriate cooling or have been analyzed to show that they are not DACs.

2.3.5 Containment isolation

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

2.3.6 Reactor coolant inventory

The licensee has stated that the AAC power source will power the necessary makeup systems to maintain adequate reactor coolant system (RCS) inventory to ensure that the core is covered for the required SBO coping duration. The licensee's submittal indicates that only decay heat will be removed from the reactor by using the RCIC system during an SBO event. The operation of one RHR pump in the torus pool cooling mode will not provide enough cooling to keep the average pool temperature below 120°F. Technical Specification 3.7.h states that reactor vessel depressurization shall begin before the pressure suppression pool temperature reaches 120°F. The plant has the capability to maintain adequate reactor coolant inventory using either RCIC or RHR system. However, the licensee should consider both the torus temperature and the reactor vessel conditions to ensure that they are maintained according to the plant Technical Specifications.

The reactor coolant inventory evaluation as discussed above was based on the guidance provided in NUMARC 87-00 of 18 gpm seal leakage per recirculation pump (RCP) for boiling water reactors. The 18 gpm value was agreed to between NUMARC and the staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines higher RCP leakage rates than assumed for this evaluation, the licensee should be aware of the potential impact of this resolution on their analyses and actions addressing conformance to the SBO rule.

Recommendation: The licensee should ensure that the torus temperature and the reactor vessel conditions are maintained according to the plant Technical Specifications.

2.4 Procedures and Training

The licensee has stated that the appropriate procedures have been reviewed per guidelines in NUMARC 87-00, Section 4. The licensee will add several new procedures and revise the existing procedures to incorporate the proposed

modifications in order to have the AAC source available within 10 minutes of an SBO event.

The proposed procedure modifications indicated above were not reviewed, but the staff expects the licensee to maintain and implement these procedures including any others to ensure an appropriate response to an SBO event. Although personnel training requirements for an SBO response were not specifically addressed by the licensee's submittal, the staff expects the licensee to implement the appropriate training to assure an effective response to the SBO.

2.5 Proposed Modifications

The licensee has proposed modifications to enable the operators to connect the shutdown buses to the AAC power source from the control room within 10 minutes of an SBO event in compliance with the SBO rule. These include replacing the existing control switches, installing the logic to shed 4kV control rod drive water pumps and other 480V loads that are not required during an SBO event, installing the annunciator circuits, and modifying the plant simulator to reflect the above changes. In addition, the licensee will modify protective relays at the Rocky Hill substation to rapidly trip circuit switcher F15 should a fault develop in the AAC power source during testing with the 23kV line.

The licensee has stated that the proposed modifications will be completed within 2 years after being notified by the staff in accordance with 10 CFR 50.63(c)(3). The licensee is currently planning to complete the modifications during refueling outage No. 8. The proposed modifications are consistent with the guidance provided in NUMARC 87-00 and RG 1.155.

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

The licensee did not provide any information regarding QA programs and TS for SBO equipment.

The technical specifications (TS) for the SBO equipment are currently being considered generically by the NRC in the context of the Technical Specification Improvement Program and remains an open item at this time. However, the staff would expect that the plant procedures will reflect the appropriate testing and surveillance requirements to ensure the operability of the necessary SBO equipment. If the staff later determines that a TS regarding the SBO equipment is warranted, the licensee will be notified of the implementation requirements.

Recommendation: The licensee should verify that the SBO equipment is covered by an appropriate QA program consistent with the guidance of RG 1.155. Further, this evaluation should be documented as part of the package supporting the SBO rule response.

2.7 EDG Reliability Program

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

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

2.8 Scope of staff review

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

which are scheduled for later implementation. Therefore, based on our review of the licensee SBO submittal and FSAR, we have identified the following areas for focus in any follow-up inspection or assessment that may be undertaken by the NRC to further verify conformance with the SBO rule:

a. Hardware and procedural modifications,

b. SBO procedures in accordance with RG 1.155, Position 3.4, and NUMARC 87-00, Section 4,

c. Operator staffing and training to follow the identified actions in the SBO procedures,

d. EDG reliability program meets as a minimum the guidelines of RG 1.155,

e. Equipment and components required to cope with an SBO are incorporated in a QA program that meets guidance of RG 1.155, Appendix A,

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

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

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

3.0 SUMMARY AND CONCLUSIONS:

The staff has reviewed the licensee's response to the SBO rule (10 CFR 50.63) and the TER prepared by the staff's consultant, SAIC. Based on our review, additional analyses and confirmations described in the recommendations provided in this SE need to be completed. These include the verification that the AAC power source (diesel generator) is load tested in its installed configuration, reevaluation of the condensate inventory by considering an 18 gpm seal leak rate per recirculation pump, provision of appropriate cooling for the rooms containing heat generation sources, confirmation that an EDG reliability program has been or will be implemented in accordance with the guidance of RG 1.155, and any additional analyses that may be needed. The licensee should maintain these verifications, confirmations, and analyses in the documentation supporting the SBO submittal available for further inspection and assessment as may be undertaken by the NRC to audit conformance with the SBO Rule. Based on our review of the submittal, we find the licensee's design and proposed method of dealing with an SBO to be in conformance with the SBO rule.

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

ENCLOSURE 2

SALP INPUT

FACILITY NAME: Pilgrim Nuclear Power Station

SUMMARY OF REVIEW:

The licensee responded to the Station Blackout Rule (10 CFR 50.63) by letters dated April 17, 1989, March 28, 1990, and August 31, 1990 and the licensee's response to a telephone conversation between the staff and the licensee on December 20, 1989.

NARRATIVE DISCUSSION OF LICENSEE PERFORMANCE
FUNCTIONAL AREA: ENGINEERING/TECHNICAL SUPPORT:

The licensee's initial and supplemental responses conformed to the guidance provided for addressing the Station Blackout Rule indicating good understanding of the technical issue. Beyond our evaluation of SBO submittals, we have no basis to evaluate the licensee understanding of technical competence, training, or management control.

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Date: November 7, 1990

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