Attachment 1

SAIC-90/1375

TECHNICAL EVALUATION REPORT

PILGRIM NUCLEAR POWER STATION

STATION BLACKOUT EVALUATION

TAC No. 68585

Science Applications International Corporation
An Employee-Owned Company

Final
January 14, 1991

Prepared for:

U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Contract NRC-03-87-029
Task Order No. 38

9101220278

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1.0 BACKGROUND

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).

The staff issued Regulatory Guide (RG) 1.155, "Station Blackout," to provide guidance for meeting the requirements of 10 CFR 50.63 (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). This document provides detailed guidelines and procedures on how to assess each plant's capabilities to comply with the SBO rule. The NRC staff reviewed the guidelines and analysis methodology in NUMARC 87-00 and concluded that the NUMARC document provides an acceptable guidance for addressing the 10 CFR 50.63 requirements. The application of this method results in selecting a minimum acceptable SBO duration capability from two to sixteen hours depending on the plant's characteristics and vulnerabilities to the risk from station blackout. The plant's characteristics affecting the required coping capability are: the redundancy of the onsite emergency AC power sources, the reliability of onsite emergency power sources, the frequency of loss of offsite power (LOOP), and the probable time to restore offsite power.

In order to achieve a consistent systematic response from licensees to the SBO rule and to expedite the staff review process, NUMARC developed two

generic response documents. These documents were reviewed and endorsed by the NRC staff (11) for the purposes of plant specific submittals. The documents are titled:

1. "Generic Response to Station Blackout Rule for Plants Using Alternate AC Power," and

2. "Generic Response to Station Blackout Rule for Plants Using AC Independent Station Blackout Response Power."

A plant-specific submittal, using one of the above generic formats, provides only a summary of results of the analysis of the plant's station blackout coping capability. 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 with the SBO rule requirements is verified by review and evaluation of the licensee's submittal and audit review of the supporting documents as necessary. Follow up NRC inspections assure that the licensee has implemented the necessary changes as required to meet the SBO rule.

In 1989, a joint NRC/SAIC team headed by an NRC staff member performed audit reviews of the methodology and documentation that support the licensees' submittals for several plants. These audits revealed several deficiencies which were not apparent from the review of the licensees' submittals using the agreed upon generic response format. These deficiencies raised a generic question regarding the degree of the licensees' conformance to the requirements of the SBO rule. To resolve this question, on January 4, 1990, NUMARC issued additional guidance as NUMARC 87-00 Supplemental Questions/Answers (12) addressing the NRC's concerns regarding the deficiencies. NUMARC requested that the licensees send their supplemental responses to the NRC addressing these concerns by March 30, 1990.

2.0 REVIEW PROCESS

The review of the licensee's submittal is focused on the following areas consistent with the positions of RG 1.155:

A. Minimum acceptable SBO duration (Section 3.1),

B. SBO coping capability (Section 3.2),

C. Procedures and training for SBO (Section 3.4),

D. Proposed modifications (Section 3.3), and

E. Quality assurance and technical specifications for SBO equipment (Section 3.5).

For the determination of the proposed minimum acceptable SBO duration, the following factors in the licensee's submittal 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.

For the SBO coping capability, the licensee's submittal is reviewed to assess the availability, adequacy and capability of the plant systems and components needed to achieve and maintain a safe shutdown condition and recover from an SBO of acceptable duration which is determined above. The review process follows the guidelines given in RG 1.155, Section 3.2, to assure:

a. availability of sufficient condensate inventory for decay heat removal,

b. adequacy of the class 1E battery capacity to support safe shutdown,

c. availability of adequate compressed air for air-operated valves necessary for safe shutdown,

d. adequacy of the ventilation systems in the vital and/or dominant areas that include equipment necessary for safe shutdown of the plant,

e. ability to provide appropriate containment integrity, and

f. ability of the plant to maintain adequate reactor coolant system inventory to ensure core cooling for the required coping duration.

The licensee's submittal is reviewed to verify that required procedures (i.e., revised existing and new) for coping with SBO are identified and that appropriate operator training will be provided.

The licensee's submittal for any proposed modifications to emergency AC sources, battery capacity, condensate capacity, compressed air capacity, appropriate containment integrity and primary coolant make-up capability is reviewed. Technical specifications and quality assurance set forth by the licensee to ensure high reliability of the equipment, specifically added or assigned to meet the requirements of the SBO rule, are assessed for their adequacy.

The licensee's proposed use of an alternate AC power source is reviewed to determine whether it meets the criteria and guidelines of Section 3.3.5 of RG 1.155 and Appendix B of NUMARC 87-00.

This SBO review is limited to the review of the licensee's submittals dated April 17, 1989 (10), March 28, 1990 (13), and August 31, 1990 (15), and a telephone conversation between NRC/SAIC and the licensee on December 20, 1989 and the corresponding licensee's response to a question raised during the

telephone call, and the available information in the plant Updated Final Safety Analysis Report (UFSAR) (14); it does not include a concurrent site audit review of the supporting documentation. Such an audit may be warranted as an additional confirmatory action. This determination would be made and the audit would be scheduled and performed by NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, Boston Edison Company (BECo), initially calculated (10 and 13) a minimum acceptable SBO duration of 16 hours for the Pilgrim Nuclear Power Station (PNPS) site. The licensee's revised submittal dated August 31, 1990 (15), calculated a minimum acceptable SBO duration of four hours. The licensee stated that no modifications are necessary to attain this proposed coping duration.

The plant factors used to estimate the proposed SBO duration are (15):

1. **Offsite Power Design Characteristics**

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

   a. Independence of offsite power system group "I3,"

   b. Estimated frequency of LOOPs due to extremely severe weather (ESW) of 0.0068 per year, which places the plant in ESW group "4,"

   c. Estimated frequency of LOOPs due to severe weather (SW) of 0.0063, which places the plant in SW group "2," and

   d. Expected frequency of grid-related LOOPs of less than one per 20 years.

2. **Emergency AC (EAC) Power Configuration Group**

   The EAC power configuration of the plant is "C." PNPS is equipped with two emergency diesel generators. One EAC power source is

necessary to operate safe shutdown equipment following a loss of offsite power.

3. **Target Emergency Diesel Generator (EDG) Reliability**

The licensee selected a target EDG reliability of 0.975. The selection of this target reliability is based on having a unit average EDG reliability of greater than 0.95, 0.94 and 0.90 for the last 100, 50, and 20 demands, respectively, consistent with criteria provided in NUMARC 87-00, Section 3.2.4.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of the offsite power system grouping, the estimated frequency of LOOPs due to ESW and SW conditions, the expected frequency of grid-related LOOPs, the classification of EAC, and the selection of EDG target reliability. The licensee's estimation of the frequency of LOOPs due to ESW conditions conforms with that given in Tables 3-2 of NUMARC 87-00. The licensee estimated the frequency of the LOOPs due to SW conditions using the data provided in Table 3-3 of NUMARC 87-00 for the annual expectation of snowfalls, tornadoes and storms. The licensee did not use the recommended annual expectation of storms with significant salt spray, and stated that a recent modifications in the switchyard should prevent salt-spray related offsite power loss. Based on the assumption that no salt-related offsite power loss is possible at the site, i.e. using a value of <u>zero</u> for the annual expectation of storms with significant salt spray, the licensee estimated that the site should be in SW group "2." If the licensee were to use the data provided in NUMARC 87-00 the site would be in SW group "4." We believe that the licensee has made an error in using a zero value for the annual expectation of storms with significant salt spray. The licensee does not have sufficient data to state that the salt-spray related offsite power loss will not occur at the site. Even if we were to assume that the implemented modification causes a 50% reduction in salt-spray

related offsite power loss the site would still fall in SW group "4." Therefore, the licensee should use SW group "4" for determining the offsite power characteristic of the plant, consistent with that evaluated in its previous submittal dated April 17, 1989.

The licensee correctly classified the independence of plant offsite power system as "I3." This classification is based on:

1. All offsite power sources are connected to the unit's safe shutdown buses through one switchyard, and

2. The normal source of AC power to the safe shutdown buses is from the unit main generator, and there is one automatic transfer and no manual transfer of shutdown buses to one preferred offsite power source.

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. The licensee provided (15) the following EDG reliability statistics:

	DEMANDS*		
	Last 20	Last 50	Last 100
EDG A	0	0	0
EDG B	1S, 2R	1S, 2R	2S, 2R

* R = Run failure; S = Start failure

Since the information supporting this statistics and the target EDG reliability is only available onsite for review, we can not confirm the licensee's statement. However, the information in the NSAC-108, which gives the EDG reliability data at U. S. nuclear reactors for calendar years 1983 to 1985, indicates that the EDGs at PNPS experienced an average of 39 valid start demands per calendar year with an average unit

reliability of 0.993 per diesel per year. Using this data, it appears that the target EDG reliability (0.975) selected by the licensee (15) to be appropriate.

The licensee stated (15) that he is currently formalizing the existing collection and analysis of EDG performance data by using the applicable elements of the reliability program provided in NUMARC 87-00, Appendix D. We take the licensee's statement as meaning that an EDG reliability program consistent with the guidance of RG 1.155, Section 1.2, NUMARC 87-00, Appendix D, or the resolution of generic safety issue B-56 will be implemented to maintain the targeted EDG reliability of 0.975.

With regard to the expected frequency of grid-related LOOPs at the site, the available information in NUREG/CR-3992 (3), which gives a compendium of information on the loss of offsite power at nuclear power plants in U.S., indicates that PNPS had two grid-related LOOPs prior to the calendar year 1984. Review of these events indicates that they were not symptomatic of underlying or growing grid instability, therefore, they were not considered.

Based on the above evaluations, the offsite AC power design characteristics of the PNPS site is "P3" with a minimum required SBO coping duration of eight hours. This classification is driven by the ESW and SW groupings, regardless of the plant's independence of the offsite power grouping.

3.2 Alternate AC (AAC) Power Source

Licensee's Submittal

The licensee stated that, once the modifications are complete, an AAC power source will be available at PNPS that meets the criteria specified in Appendix B to NUMARC 87-00. The proposed AAC power source at PNPS is an already installed non-class 1E station blackout diesel generator (SBO-DG) with a 2000 KW capacity shown in Figure 1 (10). The licensee

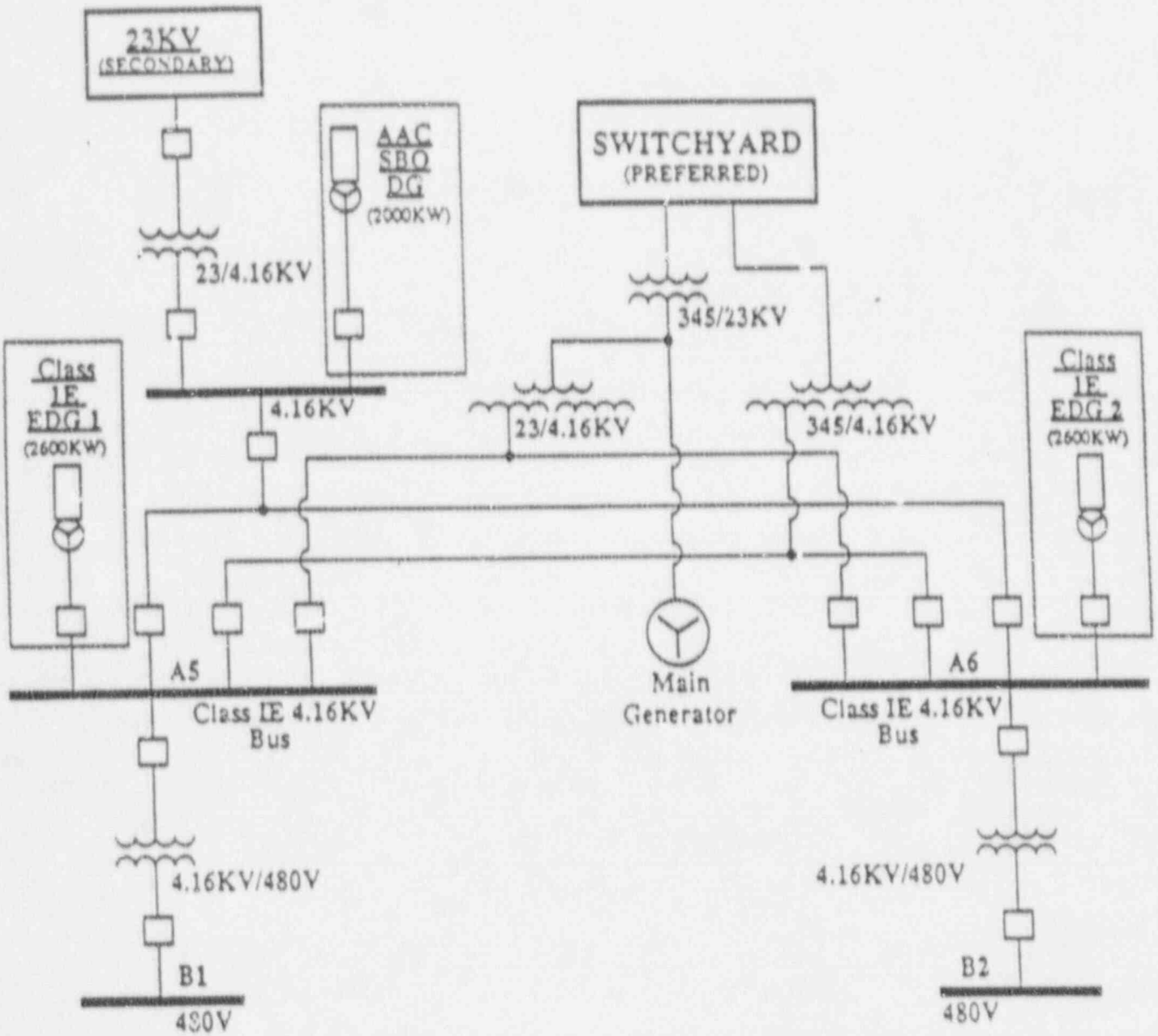

FIGURE 1
ALTERNATE AC (AAC) CONFIGURATION
NON CLASS 1E DIESEL GENERATOR

stated that the AAC power source will be available within 10 minutes of the onset of the SBO event and will have sufficient capacity and capability to operate systems necessary for coping with an SBO for the required duration to bring and maintain the plant in safe shutdown.

Review of licensee's Submittal

Based on information in the plant UFSAR, a telephone conversation on December 20, 1989, and the licensee's submittal dated August 31,1990 (15), we conclude that the AAC power source (SBO-DG) meets all the criteria stated in Appendix B of NUMARC 87-00. However, there are two items that need further explanations or actions which are discussed below:

Availability After Onset of Station Blackout, Item B.9 This item checks the adequacy of the AAC power source in terms of capacity and capability to carry the SBO loads. Our 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. This is almost equal to the SBO-DG capacity limit. However, in response to a question raised during the telephone conversion 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. These loads exceed the SBO-DG capacity. The licensee stated (10) 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 (15) 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 above, it appears that the SBO-DG will be able to carry the expected SBO loads.

Capacity and Reliability, Items B.10 to B.13 Items B.10 and B.11 are part of the SBO-DG reliability and surveillance program which need to be addressed by the licensee. Item B.12 asks the licensee to perform an initial test to demonstrate that the AAC system is capable of powering required shutdown equipment within 10 minutes of an SBO event. This test can be used to satisfy the requirement of item B.9. Finally, the licensee needs to provide a reliability program to ensure an SBO-DG reliability of at least 0.95 per demand as stated in item B.13. The licensee committed (15) to meet the guidance of B.10 through B.13 once the AAC-related modifications are completed.

3.3 Station Blackout Coping Capability

The licensee stated (13 and 15) that since the site will have an AAC power source as defined in 10 CFR 50.2, it is not required to perform a detailed coping analysis consistent with 10 CFR 50.63(c)(2). Therefore, the licensee did not provide any information on the class 1E battery capacity, the compressed air, and the containment isolation systems. In its submittal of August 31, 1990 (15), the licensee re-iterated that the rule and the NUMARC guidance exclude PNPS from the coping assessment requirement, therefore, no assessment of coping capability is provided. For the purposes of this review, it is assumed that since the AAC power source is available within 10 minutes the functions needed to cope with an SBO event are available and adequately powered for the required duration.

The plant coping capability with an SBO event for the required duration of eight hours is assessed based on responses to the questions raised during a review of the initial submittal with the following results:

1. **Condensate Inventory for Decay Heat Removal**

   Licensee's Submittal

   The licensee stated (15) that a total of 50.196, or 81,029 gallons of water are required for the decay heat removal and the reactor

coolant system (RCS) leakage for a four, or an eight hours coping duration, respectively. The RCS leakage is assumed to be 25 gpm representing the maximum allowed technical specification leakage during plant operation. The licensee claimed that, per a General Electric (GE) analysis (GEK 9651), the assumed pump seal leak rate of 18 gpm per pump can only be established if the mechanical seals were not installed. Therefore, the pump seal leak rate should not be considered.

The licensee stated that the minimum permissible condensate storage tank (CST) level during refueling per technical specification provides 200,000 gallons. The licensee added that the site has two CST's, each containing a minimum of 75,000 gallons for the operation of high pressure coolant injection (HPCI) and reactor core isolation cooling (RCIC) systems. Therefore, the available condensate at the site exceeds the quantity required to cope with a four, or an eight hour SBO event.

Review of Licensee's submittal

The licensee used the expression provided in NUMARC 87-00 with the assumption of no cooldown to estimate the condensate requirements during an SBO event. For calculating the total condensate requirement, the licensee ignored potential RCS leakage through the recirculation pump seals.

Our estimate of the condensate requirement to cope with an SBO of eight hour duration is at least 100,300 gallons. This includes: 71,020 gallons to remove decay heat, and 29,280 gallons to replenish the RCS losses due to an 18 gpm leakage per recirculation pump seal and 25 gpm maximum allowed technical specification leakage. Since each CST will have 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 eight hour SBO event.

However, we believe that the plant needs to depressurize and cool down during an eight hour SBO event. The licensee stated that the PNPS Technical Specifications 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. A review of the PNPS UFSAR and the suppression pool cooling capability using one residual heat removal (RHR) pump, (UFSAR Figure 4.8-3), indicates that the suppression pool bulk temperature will exceed 120°F within two hours of an SBO event. This estimate is based on the assumption that all the RCS leakage and the decay heat are dumped into the suppression pool. If only decay heat is dumped into the suppression pool, the pool temperature will exceed 120°F in less than three hours. Therefore, the licensee needs to 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 hours duration.

2. **Class 1E Battery Capacity**

Licensee's Submittal

Since the AAC power source will be available within 10 minutes of the onset of an SBO event, no analysis of battery capacity calculation is provided.

Review of Licensee's Submittal

A review of the LOOP loads provided by the licensee indicates that one division of battery chargers will be available within 10

minutes. Therefore, the batteries will have sufficient capacity to support the required loads during an SBO event.

3. **Compressed Air**

Licensee's Submittal

Since the AAC power source will be available within 10 minutes, no analysis of the compressed air system is provided.

Review of Licensee's Submittal

The licensee is powering one air compressor from the AAC power source within 10 minutes. Therefore, the plant has sufficient capacity of compressed air to cope with an SBO event.

4. **Effects of Loss of Ventilation**

Licensee's Submittal

The licensee stated (15) that the AAC power source provides power to heating, ventilation and air conditioning (HVAC) systems serving following dominant areas of concern to achieve and maintain safe shutdown during station blackout:

1. control room/cable spreading room,
2. HPCI room,
3. RCIC room,
4. RHR room,
5. Primary containment (Drywell), and
6. Secondary containment (Standby Gas Treatment).

Therefore, consistent with the NUMARC 87-00, Sections 7.2.1 and 7.2.4 the effects of loss of ventilation were not assessed. The licensee added that no modifications and/or procedures are

required to provide reasonable assurance for operability of ventilation equipment.

Review of Licensee's Submittal

A review of the licensee's submittal (15) indicates that other areas housing heat generation sources, or operating equipment, may need area cooling. These are the areas which house the reactor building closed loop cooling pumps, turbine building closed loop cooling pumps, vital instrumentation MG set, battery chargers, emergency switchgear, and the emergency 4160/480 transformers. The licensee needs to ensure that these areas are provided with appropriate area cooling, or provide reasonable assurance that no equipment degradation will occur during an SBO of eight hours duration.

5. **Containment Isolation**

Licensee's Submittal

since the AAC power source will be available within 10 minutes, no analysis of the containment isolation is provided.

Review of Licensee's Submittal

The AAC power source is connectible to both divisions of the safety buses. Therefore, appropriate containment integrity is obtainable.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated (10) that the AAC source powers 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 licensee's submittal indicates that only decay heat will be removed from the reactor during an SBO event, i.e. no cooldown will be attempted.

Review of Licensee's Submittal

For decay heat removal operation, the licensee uses RCIC system which uses steam and has a capacity of 400 gpm. This capacity exceeds the condensate flow rate needed to replenish the RCS losses due to pump seal leakage and the maximum allowed technical specification leakage and to remove decay heat during an SBO event. The RCIC turbine design operating pressure is between 120 to 1120 psia. Our evaluation of the torus temperature indicates that the operation of one residual heat removal pump in the torus pool cooling mode will not be sufficient to keep the average pool temperature below 120°F, therefore, reactor depressurization would be needed. This need is supported by the plant Technical Specifications 3.7.h which states that the reactor vessel depressurization shall begin before the suppression pool temperature reaches 120°F.

Although it seems that the plant has a capability to maintain adequate reactor coolant inventory using either RCIC or RHR system, the licensee needs to consider both the torus temperature and the reactor vessel pressure conditions to ensure that they are maintained according to the plant technical specifications.

NOTE:

*The 18 gpm recirculation pump seal leak rate was agreed to between NUMARC and the staff pending resolution of generic Issue (GI) 23. If the final resolution of GI-23 defines higher seal leak rates than assumed for the RCS inventory evaluation, the licensee needs to be aware of the potential

impact of this resolution on its analyses and actions addressing conformance to the SBO rule."

3.4 Proposed Procedures and Training

Licensee's Submittal

The licensee stated that the following plant procedures have been reviewed per guidelines in NUMARC 87-00, Section 4:

1. Station blackout response guidelines
2. AC power restoration, and
3. Severe weather.

The licensee listed the plant procedures which fall in each of above categories in the plant SBO submittal. The licensee indicated (10 and 15) a need for several new procedures and revision of existing procedures to incorporate the proposed modifications in order to have SBO-DG available within 10 minutes of an SBO event. The licensee stated (10) that the plant severe weather procedure does not call for shutting down the plant two hours prior to the arrival of severe weather conditions, however, it requires the plant to reduce power to 130 MWe and to start and load the EDGs eight hours before the arrival of high winds. The licensee stated that AC power restoration is part of the SBO and the SBO-DG procedures. These procedures will be modified to interface with the regional control system i.e Rhode Island Eastern Massachusetts and Vermont Energy Control (REMVEC) system.

Review of Licensee's Submittal

We neither received nor reviewed the affected SBO procedures. We view these procedures as plant specific actions concerning the required activities to cope with an SBO. It is the licensee's responsibility to revise and implement these procedures, as needed, to mitigate an SBO

event and to assure that these procedures are complete and correct, and that the associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee stated that modifications will be required to enable the operators to connect the shutdown buses to the SBO-DG (AAC power source) from the control room within 10 minutes of an SBO event in compliance with the SBO rule. The modifications will include:

1. Replacement of existing control switches with PULL-TO-LOCK (PTL) switches at panel C903 in the main control room. These switches operate the 4 kV feeder breakers to the residual heat removal and core spray pumps.

2. Replacement of existing control switches with PTL switches at Panel C3 in the control room. These switches [illegible]ate the shutdown transformer feeder breakers to shutdown buses A5 and A6.

3. Installation of logic and wire switches on panel C3 to initiate the load shedding logic on train A and B. The loads to be shed include the 4 kV control rod drive water pumps and other 480 V loads that are not required during an SBO event.

4. Installation of wiring from the replacement PTL switches to the annunciators to indicate the PTL switch positions.

5. Modification of the plant simulator to reflect the above changes.

6. Revision of the affected documents including design bases, drawings, procedures, and sections of the UFSAR.

The licensee also will modify protection relays at the Rocky Hill substation to rapidly trip (open) circuit switcher F15 should an SBO-DG fault occur when it is being tested and is generating power onto the 23 kV line. This modification is necessary to allow the SBO-DG to be load tested on a regular basis.

The licensee stated that the proposed modifications will be completed within two years after being notified of NRC acceptance in accordance with 10 CFR 50.63(c)(3). The licensee is currently planning to complete the modifications during refueling outage No. 8.

Review of Licensee's Submittal

The proposed modifications are consistent with the guidance provided in NUMARC 87-00 and RG 1.155.

3.6 Quality Assurance and Technical Specifications

The licensee's submittals do not document the conformance of the plant's SBO equipment to the guidance of RG 1.155, Appendices A and B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals, a telephone conversation on December 20, 1989, and the information available in the UFSAR for Pilgrim Nuclear Power Station (PNPS), we find that the submittal conforms with the requirements of the SBO rule and the guidance of RG 1.155 with the following exceptions:

1. **Offsite Power Design Characteristic**

   The licensee classified the plant offsite power design characteristic as "P2" with a required coping duration of four hours. This classification is based on an SW group "2, which the licensee calculated by ignoring the salt-spray related offsite power losses. We believe that the licensee does not have sufficient data to state that the salt-spray related offsite power loss will not recur at the site. Even if we were to assume that the implemented modification causes a 50% reduction in salt-spray related offsite power loss the site would still fall into an SW group "4." With this classification, the PNPS offsite power design characteristic will become "P3" with a required coping duration of eight hours.

2. **Alternate AC Power Source**

   The licensee stated that the existing configuration does not allow to load test the SBO-DG. The licensee needs to modify a protective device in one of the remote substation before the test can be performed. Therefore, no test has been performed on SBO-DG since its installment during past refueling. The licensee needs to finish the required modification(s) in order to load test the SBO-DG in its installed configuration.

3. **Condensate Inventory for Decay Heat Removal**

The licensee stated that only decay heat will be removed during an SBO event. The licensee did not consider the RCS pump seal leak rate in its calculation of required condensate inventory. Our review indicates that the reactor vessel needs to be depressurized per Technical Specifications 3.7.h, since the torus temperature can not be maintained below the 120°F with one residual heat removal (RHR) pump operating in the suppression pool cooling mode during an eight hour SBO event. The licensee needs also to re-evaluate the required condensate by considering an 18 gpm seal leak rate per RCS pump, and the coolant required for the reactor vessel depressurization activity.

4. **Effects of Loss of Ventilation**

The licensee stated that the SBO-DG will power HVAC systems serving dominant areas of concern. The licensee identified the areas where HVAC would be operating during an SBO event. It is not clear whether area cooling is provided for other areas containing heat sources such as operating pump, MG set, battery chargers, transformers, switchgear, etc.. The licensee needs to ensure that appropriate area cooling system is provided for the rooms containing heat generation source(s), or provide reasonable assurance that equipment degradation will not occur in these areas during an eight hour SBO event.

5. **Reactor Coolant Inventory**

Although the plant has the capability to maintain adequate reactor coolant inventory using RCIC system, the licensee needs to consider both torus and the reactor vessel conditions to ensure that they are maintained according to the plant technical specifications, (see item 1 above).

6. Quality Assurance and Technical Specifications

The licensee's submittals do not document the conformance of the plant's SBO equipment to the guidance of RG 1.155, Appendices A and B.

5.0 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 1986.

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. Bird, R. G., letter to the Director of Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, "Station Blackout (SBO)

Final Rule 10 CFR50.63(c)(1) Information Submittal (TAC #68585)," License No. DPR-35, Docket No. 50-293, BECo 89-057, dated April 17, 1989.

11. Thadani, A. C., letter to W. H. Rasin of NUMARC, "Approval of NUMARC Documents on Station Blackout (TAC-40577)," October 7, 1988.

12. Thadani, A. C., letter with attachment to A. Marion of NUMARC, "Publicly Noticed Meeting, December 27, 1989," dated January 3, 1990, (Confirming "NUMARC 87-00 Supplemental Questions/Answers," December 27, 1987).

13. Bird, R. G., letter to the Document Control Desk of U.S. Nuclear Regulatory Commission, "Station Blackout (SBO) Final Rule (TAC NO. 68585) Boston Edison Company response to NRC Letter to NUMARC, Dated January 3, 1990," License No. DPR-35, Docket No. 50-293, BECo 90-044, dated March 28, 1990.

14. Pilgrim Nuclear Power Station Unit 1, Updated Final Safety Analysis Report.

15. Bird, R. G., letter to the Document Control Desk of U.S. Nuclear Regulatory Commission, "Station Blackout Final Rule (TAC NO. 68585) Boston Edison Company response to NRC Letter to NUMARC, Dated January 3, 1990," License No. DPR-35, Docket No. 50-293, BECo 90-106, dated August 31, 1990.