Attachment 1
SAIC-91/1801

TECHNICAL EVALUATION REPORT

SEABROOK STATION UNIT 1

STATION BLACKOUT EVALUATION

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Post Office Box 1303, 1710 Goodridge Drive, McLean, Virginia 22102, (703) 821-4300

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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 (9) by the NRC staff 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 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 (10) 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 (11), 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, ventilation systems, containment isolation valves, 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.

This SBO evaluation is based upon the review of the licensee's submittals dated April 17, 1989 (12), March 30, 1990 (13), and September 6, 1991 (15), and the information available in the Seabrook Updated Final Safety Analysis Report (UFSAR) (14). An audit may be warranted as an additional confirmatory action. This determination would be made and the audit would be scheduled and performed by the NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, New Hampshire Yankee (NHY), calculated (12 and 13) a minimum acceptable station blackout duration of four hours for the Seabrook Station Unit 1 site. The licensee stated (12) that no equipment modifications are required to attain the proposed coping duration.

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

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 "I1/2,"

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

   c. Estimated frequency of LOOPs due to extremely severe weather (ESW) which places the plant in ESW Group "3," and

   d. Estimated frequency of LOOPs due to severe weather (SW) which places the plant in SW Group "3."

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

The EAC power configuration of the plant is "C." Seabrook is equipped with two emergency diesel generators. One EAC power supply is necessary to operate safe-shutdown equipment following a loss of offsite power.

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

The licensee has selected a target EDG reliability of 0.975. The selection of this target reliability is based on having an average EDG reliability greater than 0.90, 0.94, and 0.95 for the last 20, 50, and 100 demands, respectively, consistent with 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 expected frequency of grid-related LOOPs, the estimated frequency of LOOPs due to ESW and SW conditions, the classification of EAC, and the selection of EDG target reliability. The licensee stated that the independence of the plant offsite power system grouping is "I1/2." A review of the Seabrook UFSAR shows that:

1. There is one switchyard for the site;

2. During normal operation, power is provided to the safety busses from the main generator through the unit auxiliary transformers (UATs);

3. Upon main generator trip, the generator breaker automatically opens and offsite power is provided through the UATs;

4. Upon loss of the UATs, power can be provided to the safety busses through the reserve auxiliary transformers (RATs).

Based on these and the criteria stated in Table 5 of RG 1.155, the plant independence of offsite power system group is "I2."

With regard to the expected frequency of grid-related LOOPs at the site, we can not confirm the stated results. 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 the U.S., only covers these incidents through the calendar year 1984. Seabrook did not enter commercial operation until 1990. In the absence of any contradictory information, we agree with the licensee's statement.

The licensee stated that it used regional data to obtain an ESW grouping of "3." The licensee provided (15) information on the regional weather data which was used to determine that the site is in ESW grouping "3." The weather data provided by the licensee is not consistent with the weather data given in the plant UFSAR, Table 2.3-6, which gives the expected return frequency for selected fastest-mile wind speeds. The UFSAR data, if extrapolated, indicates that the site is in ESW Group "4," which is consistent with the data given in Table 3-2 of NUMARC 87-00. Since both the UFSAR and NUMARC data are consistent, we consider the Seabrook site to be in ESW Group "4."

With regard to the SW grouping, the licensee stated (15) that the Seabrook site has three transmission lines on two rights-of-way. With all three transmission lines (Scobie Pond, Newington, and Tewksbury) in operation, it is assumed that the minimum number of lines required for operation per technical specifications (Section 3.8.1.1) is two out of three lines. This could possibly be represented by the Scobie Pond and Tewksbury lines. These two lines share a right-of-way for five miles, and, therefore, it is possible for the plant to be operational with one right-of-way. Based upon this, the licensee assumed a single right-of-way for its SW-grouping calculation. With a single right-of-way, the site is in SW Group "3," whereas with multiple rights-of-way, the site is SW Group "2." With an ESW Group of "4," an SW Group of "3," and an independence of offsite power system grouping of "I2," the offsite power design characteristic is either "P3" (NUMARC Table 3-5a) requiring an eight-hour coping duration, or "P3*" (NUMARC Table 3-5b) requiring a coping duration of four hours provided that pre-hurricane shutdown procedures are implemented. However, with ESW and SW groupings of "4" and "2," respectively, and an independence of offsite power system grouping of "I2," the offsite power design characteristic is "P2," requiring a four-hour coping duration.

The licensee correctly categorized the EAC classification of Seabrook as "C." Each unit has two dedicated 7000-kW EDGs, one of which is necessary to safely shut down the reactor.

The licensee selected the EDG target reliability of 0.975 based upon the EDG reliability data for the last 20, 50, and 100 demands. The information in NSAC-108 (11) gives the EDG reliability data at U.S. nuclear reactors for calendar years 1983 to 1985. Since Seabrook Station Unit 1 was not in commercial operation during this period, we do not have any information on the EDG reliability at Seabrook. However, the licensee can choose any EDG target reliability consistent with the minimum required SBO coping duration, provided that it is maintained. The licensee has provided this commitment in its submittal dated March 30, 1990 (13). The licensee stated (13) that the selected EDG reliability of 0.975 will be maintained by implementation of a diesel generator reliability program meeting the guidelines of RG 1.155.

In order for Seabrook to have a required coping duration of four hours, the licensee must either implement pre-hurricane shutdown procedures or it must ensure that at least one line on each right-of-way is available during plant operations. If neither of these two conditions are met, then the licensee must resubmit its SBO coping analysis for an eight-hour duration. Our analysis is based upon the licensee's meeting one of the two conditions and thus remaining a four-hour coping plant.

3.2 Station Blackout Coping Capability

The plant coping capability with an SBO event for the required duration of four hours is assessed with on the following results:

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

Licensee's Submittal

The licensee initially stated (12) that 107,745 gallons of water are required for decay-heat removal during the four-hour coping period. The licensee modified (15) this value to 131,137 gallons, which includes the condensate necessary for cooldown and steam generator level shrinkage. The individual elements are as follows:

Element	Water Needed (gal)
Decay-Heat Removal	76,955
Water Required to Remove Sensible Heat	30,790
Steam Generator Level Shrinkage	23,392
Total	131,137

The minimum permissible condensate storage tank (CST) level per technical specifications corresponds to 212,000 gallons of water. The licensee concluded (15) that adequate supplies of condensate are available to cope with a four-hour SBO event.

Review of Licensee's Submittal

Using the expression provided in NUMARC 87-00, we have estimated that the water required for removing decay heat during the four-hour SBO would be ~77,000 gallons. This estimate is based on 102% of the licensed core thermal rating of 3411 MWt. Based on the information from similarly sized plants, we estimate that ~55,000 gallons of water are required for cooldown and ~38,000 gallons are needed for steam-generator level shrinkage. Based on our estimate, 170,000 gallons of water are required to remove decay heat and to cooldown to a steam-generator pressure of 250 psig. Since the licensee stated that the minimum CST level corresponds to 212,000 gallons of water, we concur with the licensee's conclusion that there is an adequate condensate supply available to cope with a four-hour SBO event.

2. **Class-1E Battery Capacity**

Licensee's Submittal

The licensee stated (12) that a battery-capacity calculation verifies that the class-1E batteries have sufficient capacity to meet SBO loads for four hours assuming loads not needed to cope with an SBO are removed from the DC busses. The licensee added that these loads are identified in plant procedure ECA 0.0 (Loss of all AC Power).

In response to questions regarding the difference between the two-hour battery capacity indicated in the UFSAR (Table 8.3-5) and the four-hour capacity indicated in the licensee's submittal (12), the licensee stated (15) that the differences reflect the use of actual versus rated load for some loads and load shedding. The licensee added that in its battery-capacity calculation, it followed IEEE Std-485, including a temperature correction factor to account for the batteries operating at the minimum temperature anticipated during an SBO event and an aging factor to ensure that the batteries will have sufficient capacity at the end of their design life. The licensee added that it did not include a specific design margin since this margin is included only in the initial battery sizing calculations to allow for future load growth. The load current used for the individual pieces of equipment was taken from the sizing calculation for the UFSAR load profiles which were based upon review of the devices in each circuit.

The licensee stated (15) that Seabrook has four safety-related batteries and four DC busses with two batteries/busses per train. The normal configuration is to have each battery feed its respective bus (one battery/one bus). However, per technical specifications, it is permissible to operate for up to 30 days with the crosstie closed between the two busses within a train, i.e., one battery feeding two busses (one battery/two busses). The battery sizing calculation covers both the one battery/one bus and the one battery/two busses configurations, even though there is a low probability of an SBO occurring at the same time as being in the one battery/two busses configuration.

Review of Licensee's Submittal

We did not receive the licensee's battery-capacity calculation. The licensee provided (15) the load profile used to verify that the batteries have sufficient capacity to support the needed loads for four hours. The licensee stated that the load profiles represent the effects of load shedding and the use of actual loads instead of rated loads. Comparing the 15-120 minute UFSAR load profile (Table 8.3-5) with the 40-240 minute segment of the loads provided by the licensee, we found that the combination of the load shedding and the use of the actual equipment loads resulted in battery loads which are 173.4 ampere (A) lower for the division A battery (a combination of busses A and C) and 117.5 A lower for the division B battery (a combination of busses B and D) than the loads listed in Table 8.3-5. Based upon the information available in the plant UFSAR and that provided by the licensee, we have the following concerns:

1. In the load profile provided by the licensee (15), the loads for the one battery/two busses arrangement is not a direct sum of the loads for the two one battery/one bus arrangements; for the 40-240 minute segment, the combined load profile of busses 11B and 11D (a total of 286.51 A) is not the sum of the loads on busses 11B (286.01 A) and 11D (31.9 A). In addition, the load during the 40-240 minute period on the combination of busses 11A and 11C (276.57 A) is less than the load on bus 11A alone (303.07 A); bus 11C should add an additional 55.1 A to the combined load, which would bring the total load to 358.17 A. The licensee needs to provide justification for the discrepancy between the loads in the one battery/two busses arrangement and sum of the two one battery/one bus arrangements.

2. If we use the corrected battery loads (i.e., the sum of the two individual bus loads) in conjunction with the battery performance characteristics for NCX-2250 (the Seabrook batteries), we find that the 30-day technical specification for plant operation with the two batteries crosstied will be in jeopardy (i.e., cannot be justified).

3. Contrary to the guidance of IEEE Std-485, the licensee used a zero design margin (i.e., a factor of 1.0) in its calculation. The IEEE Std recommended design margin is 1.10-1.15. This is necessary to provide a capacity margin to allow for unforeseen additions to the DC system and less-than-optimum operating conditions of the battery due to improper maintenance, recent discharge, or ambient temperature lower than anticipated.

4. The licensee used a temperature factor which corresponds to the minimum expected battery-room temperature. The licensee needs to verify that the

minimum temperature used is that of the electrolyte and ensure that under no circumstances will the electrolyte temperature drop below the assumed temperature.

5. From the load profiles provided (15) by the licensee, it appears that the load shedding will occur within the first 15 and 40 minutes of the SBO event. The guidance provided in NUMARC 87-00 identifies that loads can be shed commencing 30 minutes into the SBO event unless the loads are automatically shed. According to the plant UFSAR, the plant computer (600 A) is automatically shed from bus 11C at 15 minutes into the SBO event. From the licensee's load profile, the computer is the only load shed from the batteries within the first 30 minutes. Therefore, the timing of the load shedding is consistent with the guidance provided in NUMARC 87-00. However, we did not receive any information on the loads which will be shed. The licensee needs to list the loads that will be shed and state why this load shedding will not adversely affect the ability to safely shut the plant down or maintain the plant in a safe shutdown condition.

6. The licensee used actual equipment loads instead of the rated loads for some equipment. This approach is reasonable if the assumed loads are the maximum values taken from several tests. In addition, for the constant-power loads (i.e., uninterruptable power supplies) which are voltage-dependent, the licensee needs to consider the effect of a lower battery terminal voltage (i.e., 105 V) and the change in efficiency due to the reduced load in the actual current requirement for these loads. The licensee cannot use a one-time test to justify the use of the actual loads in its calculation.

3. **Compressed Air**

Licensee's Submittal

The licensee stated that air-operated valves relied upon to cope with a station blackout for four hours can either be operated manually or have sufficient back-up sources independent of the preferred and class-1E AC power supply. The licensee also stated that valves requiring manual operation or valves that require back-up sources for operation are identified in plant procedure ECA 0.0 (Loss of all AC Power).

Review of Licensee's Submittal

Upon review of the decay-heat-removal systems (turbine-driven AFW system and atmospheric heat release system) we found that the steam generator atmospheric steam dump valves (ASDVs) would require compressed air for their operation. Should cooldown following ECA 0.0 be required, the ASDVs will need to be operated. According to the plant UFSAR (Section 9.3.1.6.1), these valves are equipped with back-up nitrogen supplies which are capable of providing 10 complete operation cycles per valve. Therefore Seabrook has sufficient compressed air to cope with a four-hour SBO event.

4. **Effects of Loss of Ventilation**

Licensee's Submittal

The licensee stated that the calculated steady-state ambient-air temperature for the steam-driven emergency feed water (EFW) pump room during an SBO-induced loss of ventilation would be 128°F. The licensee also stated that the control-room temperature will not exceed 120°F, and is therefore not a dominant area of concern (DAC).

The licensee stated (12) that reasonable assurance of the operability of SBO response equipment in the EFW pump room has been assessed using Appendix F to NUMARC 87-00. The licensee added that no modification or procedure change is required to provide reasonable assurance for equipment operability.

In response to questions concerning its heat-up calculations, the licensee provided (15) a summary of its calculations. For the most part, the licensee used the NUMARC methodology. For some areas, the licensee stated (15) that it modified the method to account for external thermal influences. In the control room and the electrical tunnels, the licensee used existing plant-specific steady-state calculations to evaluate the area. The following table is a compilation of the information given by the licensee:

Area	Temperature Initial	(°F) Final	EQ	Methodology
EFW Pump House	104	128	165	NUMARC
Switchgear Room A	104	114	130	NUMARC
Switchgear Room B	104	112	130	NUMARC
Containment:				
- Annular Compartment	120	184	255	MAAP 3.0B
- Upper Compartment	120	188	N/A	MAAP 3.0B
- Lower Compartment	120	204	280	MAAP 3.0B
- Cavity	120	227	300	MAAP 3.0B
MS/FW Pipe Chase (East & West)	130	206	225	steady-state heat balance
MS/FW Pipe Chase Electrical Room	118.5	132	130	modified NUMARC
MS/FW Pipe Chase Stairwell (West)	130	133	139	NUMARC
Mechanical Penetration Area (MPA-1)	116	141	250	modified NUMARC
Mechanical Penetration Area (MPA-2)	111	142	250	modified NUMARC
Mechanical Penetration Area (MPA-3)	118	135	250	modified NUMARC
Mechanical Penetration Area (MPA-4)	115	136	250	modified NUMARC
Mechanical Penetration Area (MPA-5)	105	123	250	modified NUMARC
Electrical Tunnels A & B	†	111.3	130	steady-state heat balance
Control Room	75	<120	130	steady-state heat balance

N/A Not applicable. No SBO equipment is located in the upper compartment of the containment.
† No initial temperature provided.

In addition to the areas listed above, the licensee provided a statement concerning the battery room. The licensee assumed that the final temperature in the battery rooms was the same as the temperature of the surrounding space (the switchgear rooms) since the battery rooms have no significant heat loads.

The licensee stated that the heat loads used for the containment areas (annular compartment, upper containment, lower containment, and cavity) are based on plant shutdown from full power. The major contributor to the containment heat up are the reactor coolant system, the main steam system, and the assumed primary system leakage into the containment (366.5 gpm).

The licensee stated (15) that the temperature in the MS/F-- Pipe Chase Electrical Room pertains to the main steam isolation valve (MSIV) cabinets. MSIV closure will be performed in accordance with either Step 2 or Step 10 of SBO procedure ECA 0.0. In either case, MSIV closure will occur prior to the start of load shedding, which has been determined to begin within 30 minutes of the onset of an SBO event. The licensee added that it would be reasonable to conclude that the MSIV closure would necessarily occur within the first 30 minutes following the reactor trip. Once established, main steam isolation would be maintained for the duration of the SBO event. The four-hour temperature in the area is 132°F and the environmental qualification (EQ) temperature is 130°F. It is expected that the temperature at 30 minutes into the event would be less than 130°F. The licensee concluded that it is therefore reasonable to expect the MSIV cabinets to be capable of performing the intended function during an SBO event.

Review of Licensee's Submittal

In response to questions, the licensee was asked to provide a summary of its heat-up calculations. For each of the areas listed in the above table, the licensee provided the assumed initial temperature (except for the electrical tunnels), the room surface area, the assumed heat load, the method used to determine the room temperature, final calculated temperature, and the EQ temperature. The licensee's modified NUMARC method consisted of taking the weighted average of the wall temperatures as the ini. room temperature. The change in temperature (ΔT) was calculated using the NUMARC method.

Based on the information provided, we concur with the licensee's conclusion for the EFW pump house, the pipe chases, and the mechanical penetration areas. With regard to the remaining rooms, we have the following comments:

Control Room and Switchgear Room

From the information provided (15) by the licensee, the heat loads assumed for the control room and switchgear rooms appear to be low. Most of the loads in these areas are due to equipment and instrumentation powered by the batteries. Since the battery loads, for the most part, are resistive loads, we estimated that all of the energy provided by the battery is lost as heat either in the control room or the switchgear rooms. The total heat load used by the licensee for the control room and switchgear rooms A and B is ~33 kW. The total DC loads are estimated to be ~62 kW, based upon the battery loads provided (15) by the licensee and an average battery voltage of 110 VDC. Since the heat loads directly affect the calculated temperature, the licensee needs to verify that its heat loads accurately reflect the loads expected during an SBO event. In addition, the licensee assumed an initial temperature of 75°F, which is non-conservative. If the licensee wishes to use a 75°F initial temperature, then it must place an administrative control which ensures that the control-room temperature will not exceed the assumed temperature under any circumstances.

Containment

In its heat-up calculation for the containment, the licensee assumed a leak rate of 366.5 gpm. This leak rate would result in the entire primary system inventory leaking to containment in four hours. The licensee's leak rate is considerably higher than the leak rate of 110 gpm (25 gpm per RCP and an estimated technical specifications leak rate of 10 gpm) postulated by NUMARC. Based upon the licensee's assumed leak rate, we concur with its conclusions for the cavity and the annular, upper, and lower compartments.

MS/FW Pipe Chase Electrical Room

The licensee's calculated final temperature (132°F) exceeds the EQ temperature for this area (130°F). The licensee stated that the temperature pertains to the MSIV cabinets. The NUMARC methodology is for calculating the bulk room air temperature, and the temperature inside the cabinets would be ~15°F higher. The licensee needs to verify that the MSIVs will close before the temperature inside the MSIV cabinets exceeds the operability temperature. If the operability temperature for the MSIVs is exceeded prior to the closure of the valves, then the licensee needs to assess the consequences of the failure of the MSIVs to perform their function and to find a remedy for the situation.

Electrical Tunnels A&B

Using the NUMARC methodology and the licensee's values for the room areas and heat loads, we calculated that the temperature increase for electrical tunnels A and B would be 4°F and 6°F, respectively. If an initial temperature of 104°F were assumed for these areas, the final temperature for both areas would be at least 20°F below their EQ temperatures of 130°F. Therefore we concur with the licensee's conclusion for these areas.

5. Containment Isolation

Licensee's Submittal

The licensee stated (12) that the list of Seabrook containment isolation valves (CIVs) has been reviewed to verify that valves which must be capable of being closed or that must be operated (cycled) under SBO conditions can be positioned with indication independent of the class-1E power supplies. The licensee added that no modifications or associated procedure changes were determined to be required to ensure that appropriate containment integrity can be provided under SBO conditions at Seabrook.

In response to questions, the licensee provided a list of the CIVs which could not be excluded using the five criteria given in RG 1.155. The licensee used UFSAR Table 6.2-83 as the source for initial identification of CIVs. The licensee noted (15) that this table contains several valves which are not considered essential for maintaining containment integrity during design-basis-accident conditions. The scope of valves considered essential for maintaining containment integrity is encompassed by:

1. Valves that automatically close on Phase A or B containment isolation signal and,

2. Valves that are included in the containment integrity monthly and cold shutdown surveillance procedure (OX 1456.76), which lists valves that are not automatically closed on either a Phase A or Phase B isolation signal but are considered essential for maintaining containment integrity.

The licensee stated that specific consideration was given to the containment sump isolation valves. These valves would be in the closed position at all times except during surveillance testing or in the event of an accident, such as LOCA, a main steam line break, or a feedwater line break inside containment. In the event of such an accident, the containment sump valves would be opened to allow sump recirculation when containment isolation would be most likely initiated. The licensee added that, according to the American National Standard for Containment Isolation, these valves are technically not CIVs. Based upon the above, the licensee stated that it does not consider the containment sump valves as CIVs.

The licensee concluded that no valves that have been identified as CIVs of concern for station blackout are required to be operable during an SBO event. Once the valves are closed or verified closed, they will remain in that position for the duration of the event.

Review of Licensee's Submittal

The licensee provided (15) a list of the CIVs which cannot be excluded by the five criteria given in RG 1.155. The licensee provided justification for the exclusion of these valves. Upon review of the list of containment isolation valves (UFSAR Table 6.2-83), we concur with the licensee's conclusion with the exception of the containment sump valves. The licensee stated that these valves would be closed under all circumstances with the exception of surveillance testing and accident conditions. In order to be able to exclude this valve, the licensee needs to verify that the containment sump valves are closed before entering Mode 3, remain closed during normal plant operations, and the surveillance testing of these valves is performed during cold shutdown or during a refueling outage.

6. Reactor Coolant Inventory

Licensee's Submittal

The licensee stated (12) that the ability to maintain adequate RCS inventory to ensure that the core is adequately cooled for four hours has been assessed. The licensee used the generic analyses listed in Section 2.5.2 of NUMARC 87-00 and stated that these analyses are applicable to the specific design of Seabrook Station Unit 1. The expected rates of reactor coolant inventory loss under SBO conditions do not result in core uncovery in a four-hour SBO event. The licensee concluded that make-up systems under SBO conditions are not required to maintain core cooling under natural circulation (including reflux boiling).

Review of Licensee's Submittal

The licensee's use of a generic analysis without specific justifications for its applicability to the plant is not acceptable. We performed an independent evaluation of the RCS inventory using the available information in the plant UFSAR. Using a postulated leak rate of 110 gpm (25 gpm per pump per NUMARC 87-00 guideline and an estimated technical specifications maximum allowable leakage of 10 gpm), the total leakage from the RCS during the 4-hour SBO event is 26,400 gallons or ~3500 ft^3. Upon review of the UFSAR (Table 5.1-1), we found that the total RCS volume to be 11,524 ft^3, leaving an RCS volume of ~8000 ft^3 without any cooldown. If the primary system is cooled down following ECA 0.0, the RCS volume will be ~5000 ft^3 at the end of the SBO event, which is sufficient to keep the core covered. Therefore we concur with the licensee that sufficient RCS inventory exists to keep the core covered, and natural circulation, through reflux boiling, will keep the core cooled.

NOTE:

The 25-gpm RCP seal leak rate was agreed to between NUMARC and the NRC staff pending resolution of Generic Issue (GI) 23. If the final resolution of GI-23 defines higher RCP 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.

3.3 Proposed Procedure and Training

Licensee's Submittal

The licensee stated that the following procedures have been reviewed and modified to meet NUMARC 87-00 guidelines:

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

Review of Licensee's Submittal

We neither received nor reviewed the affected procedures. We consider these procedures to be 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.

3.4 Proposed Modification

Licensee's Submittal

The licensee stated that no modifications are required to are required to attain a 4-hour coping duration.

Review of Licensee's Submittal

We did not find the need for any modifications in order for Seabrook to be able to cope with an SBO event for four hours. However, our review has identified several concerns which may require modifications for their resolution.

3.5 Quality Assurance and Technical Specifications

The licensee did not provide any information on how the plant complies with the requirement of RG 1.155, Appendices A and B.

4.0 CONCLUSIONS

Based on our review of the licensee's submittals and the information available in the UFSAR for Seabrook Station Unit 1, 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/Coping Duration**

   The licensee used regional weather data to determine an ESW grouping of "3" and, based upon a single right-of-way, an SW grouping of "3." The licensee's estimate of the site ESW grouping is inconsistent with that obtained from both the NUMARC weather data and the data provided in the plant UFSAR; both the NUMARC and the UFSAR data place the site in ESW group "4." With an ESW grouping of "4" and an SW grouping of "3," the offsite power design characteristic is "P3*." In order to be a four-hour coping plant, the licensee needs to do one of two things (also see Section 3.1):

   1. The licensee needs to implement pre-hurricane shutdown procedures.

   2. For the plant to be classified as "P2," the licensee needs to ensure that both transmission line rights-of-way will have an offsite power supply available to the plant.

2. **Class-1E Battery Capacity**

   Based upon the information available in the plant UFSAR and that provided by the licensee, we have the following concerns:

   1. In the load profile provided by the licensee (15), the loads for the one battery/two busses arrangement is not a direct sum of the loads for the two one

battery/one bus arrangements. The licensee needs to provide justification for the discrepancy between the loads in the one battery/two busses arrangement and sum of the two one battery/one bus arrangements.

2. If we use the corrected battery loads (i.e., the sum of the two individual bus loads) in conjunction with the battery performance characteristics for NCX-2250 (the Seabrook batteries), we find that the 30-day technical specification for plant operation with the two batteries crosstied will be in jeopardy (i.e., cannot be justified).

3. Contrary to the guidance of IEEE Std-485 which recommends a design margin of 1.10-1.15, the licensee used a design factor of 1.0 in its calculation.

4. The licensee used a temperature factor which corresponds to the minimum expected battery-room temperature. The licensee needs to verify that the minimum temperature used is that of the electrolyte and ensure that under no circumstances will the electrolyte temperature drop below the assumed temperature.

5. We did not receive any information on the loads which will be shed. The licensee needs to list the loads that will be shed and state why this load shedding will not adversely affect the ability to safely shut the plant down or maintain the plant in a safe shutdown condition.

6. The licensee used actual equipment loads instead of the rated loads for some equipment. This approach is reasonable if the assumed loads are the maximum values taken from several tests. In addition, for the constant-power loads (i.e., uninterruptable power supplies) which are voltage-dependent, the licensee needs to consider the effect of a lower battery terminal voltage (i.e., 105 V) and the change in efficiency due to the reduced load in the actual current requirement

for these loads. The licensee cannot use a one-time test to justify the use of actual loads in its calculation.

3. **Loss of Ventilation**

Control Room and Switchgear Room

From the information provided (15) by the licensee, the heat loads assumed for the control room and switchgear rooms appear to be low. Most of the loads in these areas are due to equipment and instrumentation powered by the batteries. Since the battery loads mostly power resistive loads, for conservatism, we estimated that all of the energy provided by the battery is lost as heat either in the control room or the switchgear rooms. The total heat load used for the control room and switchgear rooms A and B is ~33 kW whereas the total DC loads are estimated to be ~62 kW. The licensee needs to verify that its heat loads accurately reflect the loads expected during an SBO event. In addition, the licensee assumed an initial temperature of 75°F, which is non-conservative. However, if the licensee wishes to use a 75°F initial temperature, then it must place an administrative control which ensures that the control-room temperature will not exceed the assumed temperature under any circumstances.

MS/FW Pipe Chase Electrical Room

The licensee's calculated final temperature (132°F) exceeds the EQ temperature for this area (130°F). The licensee stated that the temperature pertains to the MSIV cabinets. The licensee needs to verify that the MSIVs will close before the temperature inside the MSIV cabinets exceeds the operability temperature. If the operability temperature for the MSIVs is exceeded prior to the closure of the valves, then the licensee needs to assess the consequences of the failure of the MSIVs to perform their function and to find a remedy for the situation.

4. Containment Isolation

The licensee needs to verify that the containment sump valves are closed before entering Mode 3, remain closed during normal plant operations, and the surveillance testing of these valves is performed during cold shutdown or during a refueling outage.

5. Proposed Modifications

We did not find the need for any modifications in order for Seabrook to be able to cope with an SBO event for four hours. However, our review has identified several concerns which may require modifications for their resolution.

6. Quality Assurance and Technical Specifications

The licensee's submittal does not document the conformance of the plant's SBO equipment with 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 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. Thadani, A.C., Letter to W. H. Rasin of NUMARC, "Approval of NUMARC Documents on Station Blackout (TAC-40577)," dated October 7, 1988.

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

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

12. Thomas, G.S., letter to U. S. Nuclear Regulatory Commission Document Control Desk, "Information Submittal Required by 10 CFR 50.63," dated April 17, 1989.

13. Feigenbaum, T.C., letter to U. S. Regulatory Commission Document Control Desk, "Supplemental Information Submittal on Station Blackout Rule," dated March 30, 1990.

14. Seabrook Station Updated Final Safety Analysis Report, Revision 0, dated May 26, 1991.

15. Feigenbaum T.C., letter to U. S. Nuclear Regulatory Commission Document Control Desk, "Response to Request for Information on Station Blackout Rule," dated September 6, 1991.