TECHNICAL EVALUATION REPORT

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT 2

STATION BLACKOUT EVALUATION

Science Applications International Corporation

An Employee-Owned Company

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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 (9) 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 licensee 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 (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 Regulatory Guide 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 evaluation is based on a review of the licensee's submittals dated March 3, 1989 (12) and March 30, 1990 (13), a telephone conversation between NRC/SAIC and the licensee on August 8, 1990, a follow-up letter from the licensee dated August 30, 1990 (14) and the information available in the

plant Updated Final Safety Analysis Report (UFSAR) (15); 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 the NRC staff at some later date.

3.0 EVALUATION

3.1 Proposed Station Blackout Duration

Licensee's Submittal

The licensee, the Carolina Power & Light Company (CP&L), calculated (12 and 13) a minimum acceptable SBO duration of eight hours for the H. B. Robinson Steam Electric Plant, Unit 2 (Robinson 2). 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 as follows:

1. **Offsite Power Design Characteristics**

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

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

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

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

e. Expected frequency of grid-related LOOPs of less than once per 20 years, and

f. Implementation of plant-specific pre-hurricane procedures consistent with the guidance provided in NUMARC 87-00.

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

The EAC power configuration of the plant is "C." Robinson 2 is equipped with two emergency diesel generators which are normally available to the unit safe shutdown equipment. One emergency AC power supply is sufficient 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 0.95 based on having a nuclear unit average EDG reliability of greater than 0.95 for the last 100 demands consistent with NUMARC 87-00.

Review of Licensee's Submittal

Factors which affect the estimation of the SBO coping duration are: the independence of offsite power system grouping, the estimated frequency of LOOPs caused by grid-related failures, the estimated frequency of LOOPs caused by severe weather (SW) and extremely severe weather (ESW) conditions, the classification of EAC, and the selection of EDG target reliability.

The licensee's estimation of LOOP frequency caused by SW conditions is consistent with the guidance provided in NUMARC 87-00, Table 3-3, assuming that the plant receives off-site power from multiple rights-of-way. We accept the licensee's consideration of multiple rights-of-way for the Robinson site, but we cannot verify this configuration from information available in the UFSAR. During the telephone conversation of August 8, 1990, the licensee stated that the ESW-caused LOOP frequency is based on the hurricane frequency of 2E-3/yr as reported in the UFSAR (15), Section 2.3.1-2. This differs from the frequency of 3.6E-3 reported in NUMARC 87-00, Table 3.2. In order to review alternative approaches to estimating ESW-caused LOOP frequency, we need an explanation of why the alternative (UFSAR) data is more accurate than

the NUMARC 87-00 data. In the absence of any justification, we conclude that Robinson 2 is in ESW group "4" instead of group "3" as the licensee stated in its submittal. This conclusion was communicated to the licensee during the telephone conversation on August 8, 1990. The ESW classification, however, does not affect the determination of the off-site power design characteristic ("P") group.

Robinson 2 has two electrically connected switchyards operating at 230 kV and 115 kV. The 230 kV switchyard is used for outgoing (generated) power and the 115 kV switchyard is used to supply the unit's start-up transformer (SUT). As shown in Figure 1, the unit auxiliary transformer (UAT) takes power directly from the main generator's output. Safety bus E1 is normally powered from the UAT via 4160 VAC bus 1 and 4160 VAC bus 2, and safety bus E2 is normally powered from the SUT via 4160 VAC bus 3. Upon failure of the main generator, the power to 4160 VAC bus 2, and subsequently safety bus E1, is manually transferred to the SUT. The SUT is the only readily available source of offsite power, thus there is no transfer to an alternate source of offsite power. Therefore, the plant independence of offsite power system group is "I3." In the initial submittal (12), the licensee took credit for removing the main generator disconnect and backfeeding power from the grid, and claimed to be in the independence of offsite power system group "I1/2." However, since the removal of this disconnect takes about four hours to complete, the licensee revised (13) the independence of offsite power group to "I3" by not considering the disconnect link in accordance with the guidance of NUMARC 87-00 Supplemental Questions/Answers. We agree with the licensee's revised assessment (13) of the plant independence of offsite power system grouping.

Establishment of the proper Emergency AC (EAC) Configuration Group is based on the number of available EAC sources and the number of EAC sources required to operate safe shutdown equipment following a LOOP. Robinson has two dedicated EAC sources, one is required after a LOOP. We agree with the licensees assessment which places the plant in EAC Group "C."

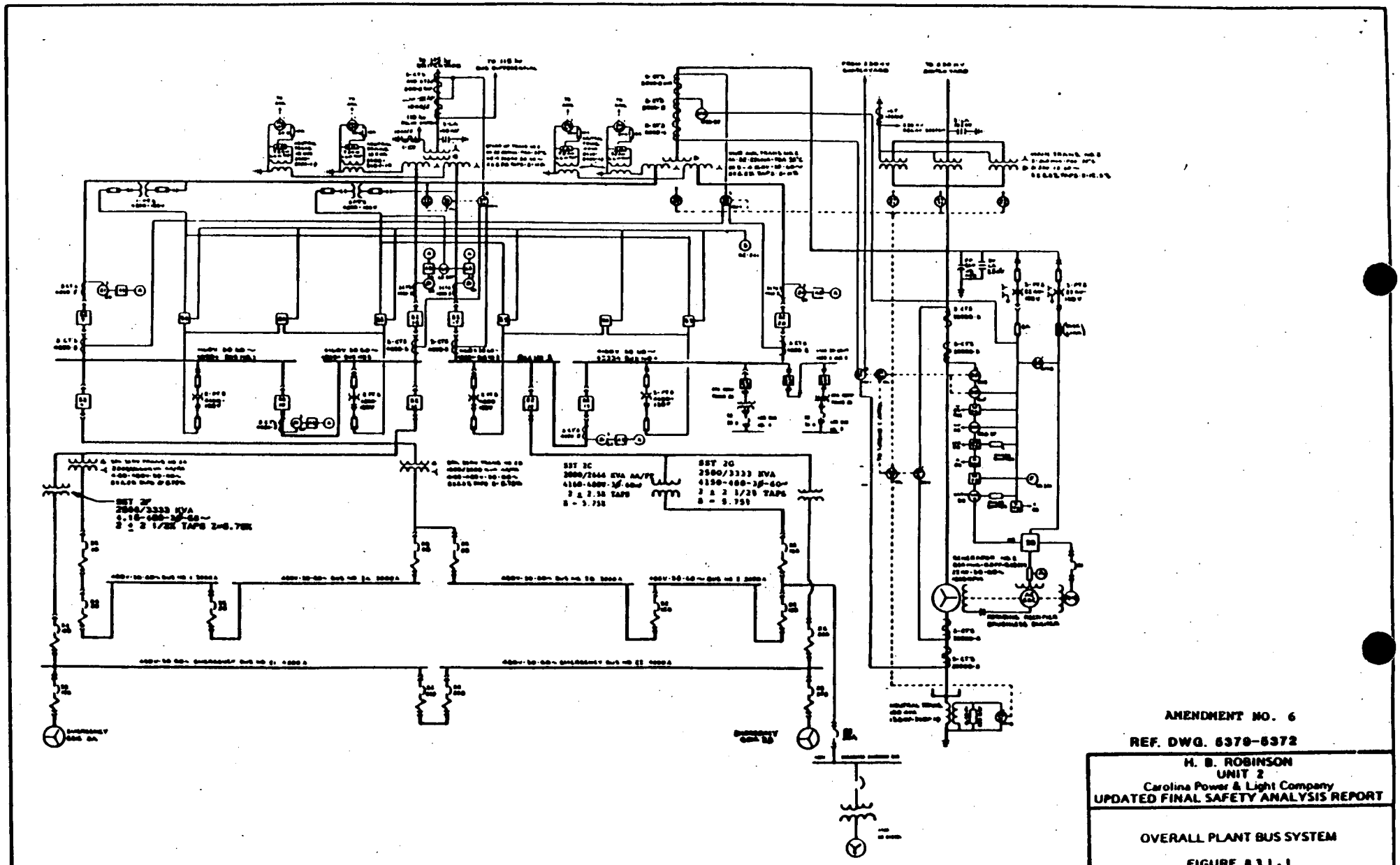

FIGURE 1. H. B. ROBINSON AC POWER SYSTEM

The final characteristic needed to establish the required coping duration is the target EDG reliability. The licensee stated (12) that the assignment of the EDG target reliability of 0.95 is based on having an average EDG reliability of greater than 0.95 for the last 100 demands. Although this is an acceptable criterion for choosing an EDG target reliability, the guidance in RG 1.155 requires that the EDG reliability statistics for the last 20 and 50 demands also be calculated. Without this information it is difficult to judge how well the EDGs have performed in the past and if there should be any concern. We are unable to verify the demonstrated start and load-run reliability of the plant EDGs. This information is only available onsite as part of the submittals supporting documents. The available information in the NSAC-108, which give EDG reliability data at U. S. nuclear reactors for calendar years 1983 to 1985, indicates that the EDGs at Robinson 2 experience an average of 51 valid start demands per diesel per calendar year and have reliability levels of higher than 0.95. Using this data, it appears that the EDG target reliability (0.95) selected by the licensee (12) is appropriate. Nevertheless, the licensee needs to have an analysis showing the EDG reliability statistics for the last 20, 50, and 100 demands in its SBO submittal supporting documents.

During the telephone conversation held on August 8, 1990, in response to the requirement for an EDG reliability program, the licensee stated, that a reliability program consistent with the guidance provided in RG 1.155 and NUMARC 87-00 will be developed. This was not documented in the licensee's submittals; however, the licensee has committed to maintain the targeted EDG reliability of 0.95 consistent with the resolution of Generic Issue B-56 (13).

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., covers only the events prior to the calendar year 1984. No grid-related LOOPS for Robinson were reported. During the telephone conversation on August 8,

1990, the licensee stated that Robinson 2 has not had any grid-related LOOPs in the last 20 years. In the absence of any contradicting information, we agree with the licensee's statement.

Based on the above, the AC power design characteristics of the Robinson site is "P2" with a minimum required SBO coping duration of eight hours.

3.2 Alternate AC (AAC) Power Source

Licensee's Submittal

The AAC power source is a dedicated shutdown diesel generator (DSDG) that was installed in order to meet 10 CFR 50 Appendix R fire protection requirements. The licensee stated that the AAC power source is available within one hour of the onset of an SBO event, and that it has sufficient capacity and capability to operate systems necessary for coping with an SBO with a duration of eight hours. Additionally, the licensee stated that modifications are needed for the proposed AAC source to meet the requirements of NUMARC 87-00 Appendix B, (see Section 3.5). Figure 2 (12) shows the arrangement of the dedicated shutdown bus and the connected loads.

Review of Licensee's Submittal

The dedicated shutdown system is not connected to the plant's safe shutdown buses; it supplies alternate power to selected equipment necessary to maintain the plant in a hot shutdown condition. Since the AAC power source is both electrically and physically separate from the class 1E electrical systems (as required to meet the 10 CFR 50 Appendix R criteria) it meets criteria B.1, B.2, and B.4 through B.7 of NUMARC 87-00, Appendix B. Following the modifications described in Section 3.5, the AAC source should be able to meet criteria B.3.

The DSDG has a dedicated air-start system, fuel supply and storage system and a 24 hour battery. The engine is cooled by a radiator which

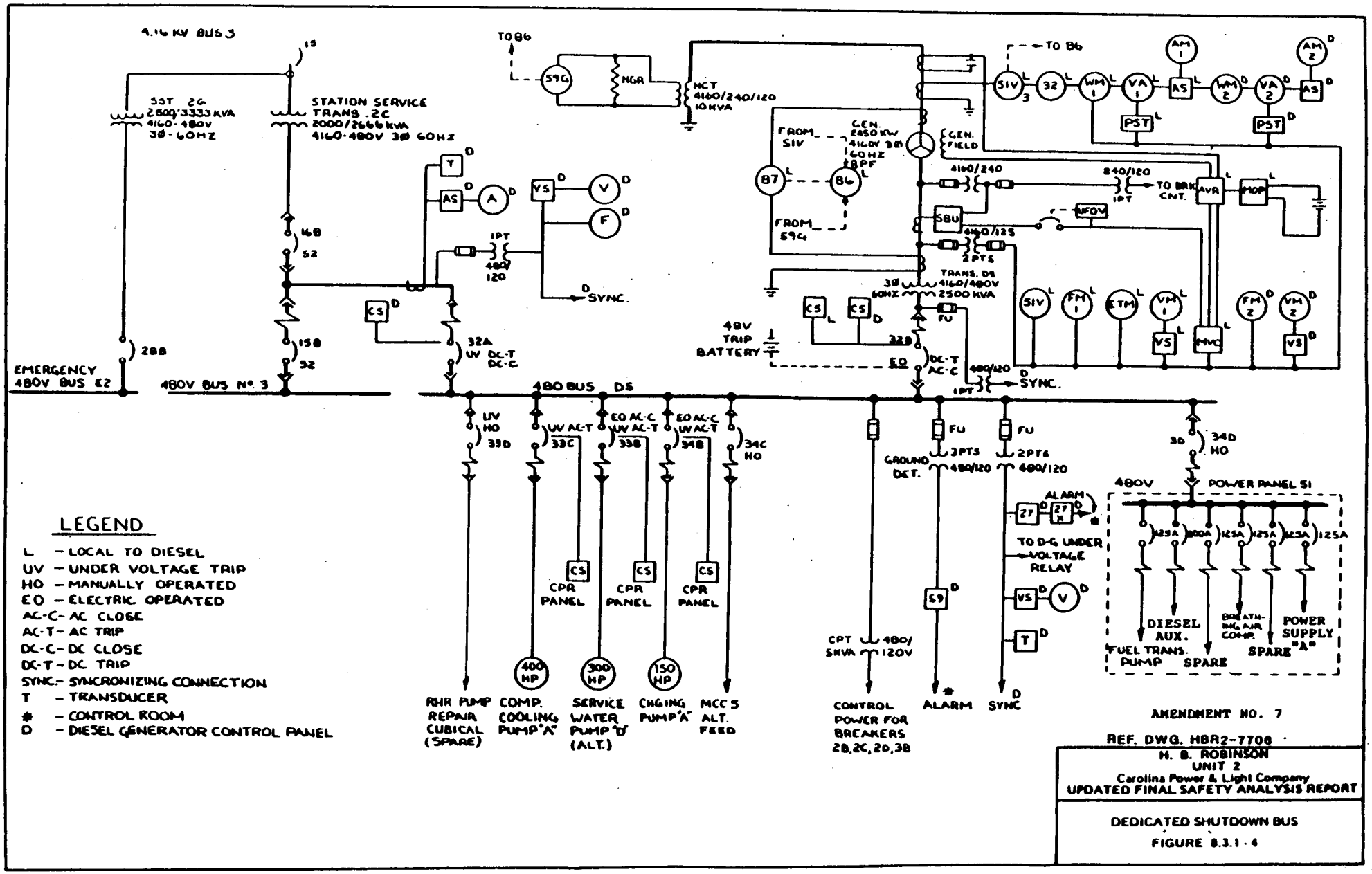

FIGURE 2. H. B. ROBINSON ALTERNATE AC POWER SYSTEM

needs no support from any plant systems. Therefore, the DSDG diesel meets criteria B.8 of NUMARC 87-00, Appendix B.

In response to questions asked during the telephone conversation of August 8, 1990, the licensee provided (14) a list of loads that are expected to be powered from the DSDG. The loads, which include: a charging pump, a service water pump, a component cooling water (CCW) pump, assorted DSDG auxiliary loads and MCC-5 (which powers lighting and many safety-related valves) require a total of 1,308 kVA, which is considerably less than the DSDG system capacity. The capacity of the DSDG is 2,450 kW, but the system is limited by the capacity of transformer DS, which is 2,500 kVA, see Figure 2. Therefore, we agree that the DSDG has adequate capacity to power all necessary loads and meets criteria B.9 of NUMARC 87-00.

The licensee stated that the DSDG is tested weekly in accordance with Operating Surveillance Test 9.10. Additionally, the licensee stated that DSDG reliability is tracked and reported to INPO in accordance with INPO Criteria and that its reliability level exceeds 95%. We agree that the AAC source meets the NUMARC 87-00, Appendix B criteria for AAC system capacity and reliability (B.10-B.13) with the exception of the performance of an initial test to confirm that the DSDG is available within one hour following the onset of an SBO event.

3.3 Station Blackout Coping Capability

The plant coping capability with a station blackout for the required duration of eight hours is assessed based on the following results:

1. **Condensate inventory for decay heat removal**

   Licensee's submittal

   The licensee stated (13) that the Robinson 2 Technical Specifications requires a minimum condensate storage level of

35,000 gallons and that 28,600 gallons are required for decay heat removal and reactor coolant system cooldown during the first hour. After the first hour, the AAC source can power a service water pump to provide an additional seven hours of cooling water to the steam generators through the steam driven auxiliary feedwater pump via a service water system cross-connection. The licensee stated that no modifications or procedural changes are necessary to use these water sources.

Review of Licensee's Submittal

Robinson 2 has a turbine-driven AFW pump that should be available to supply the steam generators with up to 600 gpm of condensate water. During the telephone conversation of August 8, 1990, it became apparent that the licensee did not include the effects of steam generator cooldown in calculating the condensate requirements (13). The licensee re-calculated (14) the condensate requirements for the first hour to be 33,500 gallons.

Our independent calculations of the required condensate inventory indicate that 18,228 gallons of water are needed to remove decay heat (based on a 102% power level of 2,346 MWt), 6,292 gallons of water are required to cooldown the reactor coolant fluid and associated metal temperature by 100°F (based on the RCS internal energy given in Table 6.2.1-1 of the UFSAR), and 4,900 gallons of condensate are required to compensate for the steam generator level shrinkage (based on the licensee's estimate). Therefore a total of 34,630 gallons of condensate would be needed for the first hour of an SBO event. Hence, we agree with the licensee's conclusion that the minimum condensate storage tank level allowed by technical specifications is adequate.

2. **Class 1E Battery Capacity**

Licensee's Submittal

The licensee stated (13) that the class 1E batteries have been evaluated in accordance with NUMARC 87-00 and have sufficient capacity to meet station blackout loads for one hour.

Review of Licensee's Submittal

The batteries should be able to provide the normal plant monitoring and control for the entire SBO duration. The licensee's battery calculations were neither received nor reviewed. During the telephone conversation of August 8, 1990, the licensee stated that the batteries would be charged by the AAC power source (via MCC-5) within one hour of the onset of an SBO event. According to the NRC review of the licensee's battery calculations (16), battery A will last for one hour during station blackout conditions, but battery B is not sufficiently sized for a one hour duty cycle without AC power if the appropriate design margin and aging factor are considered. Although one train of instrumentation and control power is generally adequate to meet SBO guidance, we are concerned because switchyard control power, as well a control power to quite a few buses, is supplied from battery B. The licensee needs to verify that the unavailability of battery B will not hamper the ability to cope and recover from an SBO event.

The capability to charge the A battery from MCC-5 after it was energized from the DSDG could not be verified from the information available in the UFSAR, but is accepted subject to future NRC audit. Therefore, based on the assumption that the required battery chargers will be powered from the AAC power source through MCC-5, we agree with the licensee that the existing battery capacity meets the guidance provided in NUMARC 87-00.

3. **Compressed Air**

Licensee's Submittal

The licensee stated that the air operated valves needed to cope with an SBO are the steam generator power operated relief valves (PORVs). The licensee stated (12) that a procedure (DSP-010) and equipment for using back-up nitrogen are available. Additionally, the licensee stated that one instrument air compressor can be started after the AAC source is on line.

Review of Licensee's Submittal

The plant breathing air compressor is powered from the DSDG and could be powered during an SBO event. Although not included in the DSDG load list (14), there is enough excess capacity to operate this air compressor. It is not clear from the Robinson 2 UFSAR compressed air system description (no drawing is provided) whether or not the breathing air compressor can provide compressed air to the instrument air header. Additionally, the UFSAR provides no information on the hook-up of the back-up nitrogen supply to operate the PORVs. Therefore, the licensee needs to describe the approach to providing adequate compressed air/gas in accordance with the NUMARC 87-00 guidance. The description should include the level of effort required, the time required and the flow paths used.

4. **Effects of Loss of Ventilation**

Licensee's Submittal

In its original submittal (12), the licensee stated that the steam driven AFW pump area is not a dominant area of concern (DAC)

because it is an open area, and that the control room is not a DAC because it will not exceed 120°F during a four hour SBO event. No other DACs were identified by the licensee.

In its March 30, 1990 submittal (13), upon realizing that Robinson 2 needs to cope with a minimum required duration of eight hours, the licensee identified two DACs: the Battery Room and the Cable Spreading Room. The licensee evaluated the equipment operability in these rooms with steady-state ambient air temperatures of 145°F and 121°F, respectively, and concluded that there is reasonable assurance of equipment operability.

In response to questions raised during the August 8, 1990 telephone conference, the licensee submitted (14) the following room temperatures:

Room	Old T_f	New T_f
CCW pump room	149°F	151.1°F
Charging pump room	137°F	137.7°F
Battery room	145°F	147.1°F
Cable spread room	121.5°F	122.2°F
Control room - no door open	126.9°F	128.3°F
Control room - one door open	119.3°F	120.7°F
Control room - two doors open	-	114.6°F

The licensee stated (14) that two control room doors will have to be opened for the room temperature to be less than 120°F.

The licensee stated (14) that inverter "A" (safety train A power) is located in the electrical equipment area, which is not a DAC because it is a large open area with no heat sources other than the inverters and the lighting.

With regard to the containment temperature increase during an SBO event, the licensee stated (14) that Figure 32 of Westinghouse ECA-0.0 is applicable to Robinson 2. This figure shows that the containment temperature rise in an SBO event is bounded by the 35°F degree temperature rise. This temperature rise was evaluated based on a variable pump seal leak rate assuming a seal leak rate of 300 gpm per pump at the onset of an SBO. The seal leak rate was considered to be a function of the primary system pressure. Assuming an initial temperature of 120°F, the licensee stated that this would result in an increase to 155°F which is well below the calculated 219°F EQ one day envelope temperature.

The licensee also provided (14) a list of assumptions and values, and a description of the methodology used in the control room heat-up calculations. These calculations were based on a methodology developed by the NUMARC-sponsored Nuclear Utility Group on SBO (NUGSBO) entitled: "Calculation Station Blackout Room Temperatures for Events Lasting Longer than Four Hours," October 17, 1988.

Review of Licensee's Submittal

The licensee's calculations of Old T_f refer to the steady state room air temperatures resulting from the use of the equations E-18 and E-27 of NUMARC 87-00. These equations are recommended for use in four hour coping heat-up calculations. The calculations of New T_f refer to the same results obtained from using NUGSBO (modified NUMARC 87-00) equations.

We reviewed the NUGSBO methodology (which was provided as an enclosure to Reference 14) and determined that it cannot properly determine the room air temperature for time periods longer than four hours. This method incorrectly lumps the entire concrete wall mass into a single homogeneous heat sink with a linear temperature distribution. This approach will only be appropriate

when the wall reaches its final steady state temperature, which can take several days depending on the wall thickness. Such a representation of a concrete wall is not realistic because the inner wall surface will heat up much more rapidly than the outer wall layers. Since the outside wall temperature will increase with time causing the wall's heat transfer capability to reduce and the room temperature to increase, the use of this method is non-conservative. A more detailed one or two dimensional transient heat conduction model may be needed to calculate a more accurate room temperature response.

In its calculations of control room heat-up the licensee used (14) an initial control room air temperature of 75°F, which is non-conservative. The licensee needs to use an initial control room temperature equal to the maximum design or technical specification-allowed temperature of the control room. Additionally, the licensee needs to commit to adding a procedural step to open cabinet doors in the control room within 30 minutes of an SBO in accordance with the guidance of NUMARC 87-00 Supplemental Questions/Answers.

The licensee needs to ensure that the assumptions in ECA 0.0 analysis are consistent with the conditions at Robinson 2 during an SBO event. Pending this verification of assumptions, we agree with the licensee's conclusion of reasonable assurance of equipment operability inside containment.

5. **Containment Isolation**

Licensee's Submittal

The licensee stated that it has reviewed the plant list of containment isolation valves to verify that valves which must be capable of being closed or that must be operated under SBO conditions can be positioned (with indication) independent of the

preferred and blacked-out unit's class 1E power supplies. The licensee identified two isolation valves (SI-860B and 861B) on RHR Pump B suction line whose positions need to be verified. These valves are normally closed, located in an area under security control, and if both valves were left open it would cause the reactor water storage tank (RWST) to drain to containment. Therefore, the licensee stated that it is assumed that these valves would be in the closed position at the onset of an SBO.

Review of Licensee's Submittal

The plants UFSAR does not contain adequate information to review the licensee's containment isolation analysis. We accept that the licensee has systematically reviewed the containment penetrations, identified the proper containment isolation valves and incorporated them into the appropriate procedures subject to future NRC audits. In regard to the above mentioned suction valves on RHR Pump B, the license needs to provide a means to detect the misposition of at least one of these valves during power operation to maintain appropriate containment integrity during an SBO event.

6. **Reactor Coolant Inventory**

Licensee's Submittal

The licensee stated that the ability to maintain reactor coolant system inventory for eight hours to ensure that the core is cooled has been assessed. The licensee concluded that make-up systems in addition to those currently available under SBO conditions are not required to maintain core cooling under natural circulation.

Review of Licensee's Submittal

Reactor coolant makeup is necessary to replenish the RCS inventory losses due to the assumed RCP seal leakage (25 gpm per pump per NUMARC 87-00) and the technical specification maximum allowable leakage (estimated to be 25 gpm). The available charging pump is a positive displacement pump with a design flow rate capacity of 77 gpm. Reactor coolant inventory is a concern because the assumed leak rate (100 gpm) is greater than the charging pump capacity, and, additionally, there will be some cooldown and related shrinkage of the reactor coolant water volume. During the telephone conversation on August 8, 1990, the licensee stated that the reactor coolant inventory was assessed to be adequate, using Westinghouse ECA-0.0 and appropriate SBO assumptions. We agree with the licensee's conclusion that the core will not be uncovered during an eight hour SBO event.

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.

3.4 Proposed Procedures and Training

Licensee's Submittal

The licensee stated (12) that the following plant procedures have been reviewed per guidelines in NUMARC 87-00, Section 4:

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

The licensee listed the plant procedures which fall into each of the above categories in the plant SBO submittal. The licensee stated (12) that the procedure changes will be completed within two years of the notification provided by the NRC in accordance with 10 CFR 50.63 (c)(3).

Review of Licensee's Submittal

We neither received nor reviewed the affected procedures or training. These procedures are plant specific actions concerning the required activities to cope with a 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 in their contents, and that the associated training needs are carried out accordingly.

3.5 Proposed Modifications

Licensee's Submittal

The licensee committed (12) to provide additional supports to the DSDG system conduits and electrical ducts, and to a battery storage cabinet that are external to existing buildings. According to the licensee, these supports currently do not conform to the allowable stress levels due to wind loads given in the Uniform Building Code. The licensee also stated that some minor structural modifications will also be required to the 4160 V switchgear room. The licensee stated that these modifications will be completed within two years of the notification provided by the NRC in accordance with 10 CFR 50.63(c)(3).

Review of Licensee's Submittal

The licensee stated that this design change will be implemented in accordance with the applicable design and licensing requirements to comply with the guidance of RG 1.155 and NUMARC 87-00. If properly implemented, this design change will improve the reliability of the AAC (DSDG) power system. The licensee needs to document the details of the proposed modifications and include this in the SBO submittal supporting documentation.

3.6 Quality Assurance And Technical Specifications

The licensee did not provide any information on how the plant complies with the requirements of RG 1.155, Appendices A and B. During the telephone conversation on August 8, 1990, the licensee stated that all the SBO equipment is covered by NRC-approved QA programs (10 CFR 50 Appendix B or Appendix R). Future NRC audits should verify that the SBO equipment is covered by appropriate QA and technical specification programs consistent with 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 between NRC/SAIC and the licensee, and the information available in the UFSAR for the H. B. Robinson Steam Electric Plant, we find the submittal conforms with the requirements of the SBO rule and the guidance of RG 1.155 with the following exceptions:

1. Extremely Severe Weather (ESW) Group

The licensee stated that the ESW-caused LOOP frequency is based on the hurricane frequency reported in the UFSAR (15), Section 2.3.1-2 of about 2E-3/yr. This differs from the frequency of 3.6E-3 reported in NUMARC 87-00, Table 3.2. In order to review alternative approaches to estimating ESW-caused LOOP frequency, the licensee needs to provide an explanation of why the alternative (UFSAR) data is more representative than the NUMARC 87-00 data. Therefore, in the absence of any information, we conclude that Robinson is in ESW group "4" rather than group "3." This determination, however, does not affect the classification of the plant off-site power design characteristic ("P") group or the required coping duration.

2. Alternate AC (AAC) Power Source

The licensee needs to perform an initial test to confirm that the AAC power source (the DSDG) is available to power the required safe shutdown loads within one hour following the onset of an SBO event.

3. Class 1E Battery Capacity

According to the NRC review of the licensee's battery calculations (16), battery A will last for one hour during station blackout conditions, but battery B does not have adequate capacity to

operate for the one hour without AC power. Although one train of instrumentation and plant control power is generally adequate to meet SBO guidance, we are concerned because switchyard control power, as well a control power to other breakers, is supplied from battery B. The licensee needs to verify that the unavailability of battery B will not hamper the ability to align the electrical systems for DSDG operations.

4. Compressed Air

The licensee stated (12) that an instrument air compressor would be available one hour after the onset of an SBO. It is not clear from the UFSAR compressed air system description that a compressor will be available to provide compressed air to the instrument air header. Therefore, the licensee needs to describe its approach (including air compressor power source, power requirement and air path to SBO equipment) to providing adequate compressed air in accordance with the NUMARC 87-00 guidance.

5. Effects of Loss of Ventilation

We reviewed the methodology used by the licensee to evaluate the bulk air temperature in various rooms (which was provided as an enclosure to Reference 14) and determined that it cannot properly determine the room air temperature. This method incorrectly lumps the entire concrete wall mass into a single homogeneous heat sink with a linear temperature distribution. Additionally, the licensee used a non-conservative initial temperature when it calculated the control room temperature rise during an SBO. Therefore, the licensee needs to re-evaluate the effects of loss of ventilation.

6. Containment Isolation

The licensee identified two inaccessible containment isolation valves (SI-860B and 861B) that cannot be verified to be in the closed position. The licensee needs to provide position indication for at least one of these valves.

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," dated 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. McDuffie, M. A., Letter to the Document Control Desk of the U. S. Nuclear Regulatory Commission, "H. B. Robinson Steam Electric Plant, Unit No. 2, Docket No. 50-261/License No. DPR-23, Response to Station Blackout Rule (TAC 68595)," Serial: NLS-89-045, March 3, 1989.

13. Cutter, A.B., Letter to the Document Control Desk of the U. S. Nuclear Regulatory Commission, "H. B. Robinson Steam Electric Plant, Unit No. 2, Docket No. 50-261/License No. DPR-23, Response to Station Blackout Rule (TAC 68595)," Serial: NLS-90-71, March 30, 1990.

14. Floyd, S. D., Memorandum to Mr. A. S. Gill of the U. S. Nuclear Regulatory Commission, "Additional Information for Station Blackout Review of H. B. Robinson Steam Electric Plant Unit No. 2 (HBR2)," August 30, 1990.

15. H. B. Robinson Steam Electric Plant Unit 2, Updated Final Safety Analysis Report.

16. Rosa, F., Memorandum to E. G. Adensam, Project Director, Project Directorate II-1, Division of Reactor Projects, U. S. Nuclear Regulatory Commission, "H. B. Robinson Unit 2 - Evaluation of Reduction of Station Battery Duty Cycle from Eight Hours to One Hour", Docket No. 50-261, August 29, 1988.